



Further details on performing in-situ permeability tests are provided in *SKM Work Instruction WI-CS-7 Aquifer Testing*.

Copies of the calculation sheets used to estimate in-situ permeability values from the insitu permeability tests are provided in **Appendix F**.

6.2.6 Soil Gas Surveys

Volatile compound concentrations in the soil-gas phase in soils were assessed using permanent soil gas monitoring bores at five locations (MW30 to MW34) at the Former Gasworks site, targeting those areas that have been identified by previous investigations as exhibiting elevated concentrations of BTEX, PAH and/or TPH compounds in soils. Procedures for testing soil-gas phase concentrations were consistent with Australian Standard AS4482.2-1999 "*Guide to the sampling and investigation of potentially contaminated soil, Part 2: Volatile substances*".

Permanent soil gas monitoring bores were installed to a maximum depth of 1.5 m below ground level.

Absorbent tubes were connected to air sampling pumps to collect soil gas vapour samples from each of the 5 locations. The air samplers operated for between 50 and 110 minutes at a flow rate of between 600 and 2000 ml/ min. The absorbent tube data provided quantitative information on the constituents and concentrations of the soil gases.

The sampling apparatus was cleaned between measurements using the following procedures:

- Brushing of contaminated soil from the sampling probe; and
- Flushing the system with clean air to ensure that all sample gases have been removed.

Further details on performing soil gas tests are provided in *SKM Work Instruction WI-CS-12 Field Measurements and QA procedure ET-4.2 Attachment 5 "Standard Sampling Instructions for Soil Gas Sampling (Below ground surface)*.

6.2.7 Soil Sampling

Boreholes were drilled using a 4-wheel drive rubber tyred rig at the same 5 locations where the soil gas probes were installed. A solid stem auger was used. An engineering log was produced for each borehole location in accordance with Australian Standard AS1726-1993 *Geotechnical Site investigations*. Copies of the SKM Engineering Logs are provided in **Appendix A** together with copies of the borehole logs produced by the previous investigations.



A soil sample from each of the five boreholes was collected for laboratory analysis and tested for TPH, BTEX and speciated TPH. The soil samples were collected as “undisturbed” samples using a split-tube push sampler. Sampling locations are shown on **Figure 5**.

Additional soil samples were also collected from the three deep boreholes to the south of the Site where groundwater wells were constructed¹. A soil sample from each of these three boreholes was collected for laboratory analysis and tested for the full suite of potential contaminants of concern.

Further details on drilling and soil sampling are provided in *SKM Work Instruction WI-CS-4 Investigation Methods* and *WI-CS-5 Soil Sampling*.

6.2.8 Decontamination

All field equipment was decontaminated in accordance with the summary procedures specified in the SAP. Further details on decontamination procedures are provided in *SKM Work Instruction WI-CS-11 Decontamination*.

6.2.9 Survey Control

SKM utilised an Ausimage package to prepare a Site plan showing the main features and sampling point locations. Images are orthographically corrected and dimensions of building and Site boundaries are available from embedded information.

All sample locations are marked on the final plans and are logged using GPS coordinates and mapped on the geo-references aerial photographs.

Further details on survey methods are provided in *SKM Work Instruction WI-CS-10 Survey Methods*.

6.2.10 Buried Service Location

RailCorp supplied the information in regards to underground services. SKM conducted a detailed search of third party services to ensure that any underground infrastructure was protected during field works. A qualified service locator was then engaged to clear each drilling location.

¹ Site Auditor request as given in 3/08/04 meeting minutes



6.3 Field Tests

6.3.1 Photoionisation Screening

A photoionisation detector (PID) was used to detect and quantify organic vapours in soil samples. The PID used for this investigation was a Rae Systems Minirae 2000 PID.

The PID was used to obtain head-space concentrations of volatile gases emitted from bagged soil samples. The tests were conducted during the soil-sampling program, with the PID sampling results summarised on the borelogs in **Appendix A**. PID results were used to provide a qualitative assessment of volatile gas levels in soils and to help determine which samples would be analysed at the laboratory.

The PID was calibrated daily, with the calibration records included as **Appendix F**.

6.3.2 Soil Gas Survey

Permanent soil gas monitoring wells were installed by SKM at five location in the centre of the former gasworks site (MW30, MW32, MW31, MW33 and MW34). Soil gas samples were then collected from each well.

The sampling was undertaken in general accordance with the OSHA sampling procedures for benzene, as benzene was the primary compound of concern due to the elevated concentrations found in the soil and groundwater samples and its carcinogenic characteristics.

An SKC 226-01 sorbent tube was used to collect samples. The collection pumps were calibrated before and after sample collected to confirm the consistent flow rate of 600ml/min for benzene and 2L/min for PAHs. Each sample was run for approximately 50mins for benzene and 110mins for PAHs. A summary of the sampling undertaken from the soil gas probes is provided in **Table 7**.



■ Table 7 Soil Gas Sampling Field Data

	BTEX	PAHs
MW30		
Sample Flow rate	600ml/min	2000ml/min
Sampling Time	50	110
MW31		
Sample Flow rate	600ml/min	2000ml/min
Sampling Time	50	108
MW32		
Sample Flow rate	600ml/min	2000ml/min
Sampling Time	50	110
MW33		
Sample Flow rate	600ml/min	2000ml/min
Sampling Time	53	111
MW34		
Sample Flow rate	600ml/min	2000ml/min
Sampling Time	50	111

6.3.3 Physico-chemical Water Quality Testing

A TPS Water Quality Meter measured the physico-chemical water quality in the groundwater monitoring wells during the Stage I February 2004 sampling event. This field instrument measures dissolved oxygen (DO), total dissolved solids (TDS), pH, redox, temperature and pH. This unit was calibrated prior to use on Site by EnviroEquip.

A Horiba water quality meter was used during the sampling to measure dissolved oxygen, pH, conductivity, temperature and salinity and was calibrated on Site prior to use.

All wells were purged prior to sampling on each occasion.

6.4 Laboratory Test Program

The main and check laboratories used for this investigation were ALS and Amdel, who are NATA registered chemical laboratories for the specified tests, with the exception of analysis for speciated TPH, which was undertaken by Amdel, using method E1224, which is not covered by their NATA accreditation.



All tests were undertaken in accordance with the NEPM (1999) and ANZECC (2000) water quality guidelines.

Soil, soil-gas and groundwater samples were tested for the potential contaminants of concern as listed in **Section 6.1.1**. Groundwater samples were tested for compounds that provide data on possible degradation processes occurring at the Site. These additional compounds include BOD, COD, TOC, total nitrogen and ammonia.

A summary of the laboratory-testing program is provided below in **Table 8**.

■ **Table 8 Laboratory Analysis Summary**

	Soil	Soil Gas	Groundwater	Rinsate	Duplicates			Total
				GW	Soil	Soil Gas	GW	
Heavy Metals			30	2			4	26
PAH			30	2			2	26
TPH	7	5	30	2		1	4	32
BTEX	10	5	30	2		1	4	32
Phenols			30	2			2	26
SVOC/VOC		5				1		6
Hardness			30	2			4	26
Speciated TPH			30	2			1	33

Note:

(1) Duplicates analysis was undertaken at a combined rate of 10%.

QA/QC samples were collected and analysed in accordance with the rates specified in Section 8 of Australian Standard AS4482.1-1997. These rates are:

- Blind field duplicates were tested at the main laboratory: 1 in 20 samples (5%)
- Split samples were tested at the check laboratory: 1 in 20 samples (5%)
- Rinsate blanks: 1 sample per sampling day
- Laboratory-prepared volatile trip spiked samples: 1 sample per sampling event

The locations of the boreholes and wells where the samples were collected are specified in earlier sections of this report.

6.5 Laboratory Test Methods

The chemical laboratories used for the samples collected in this investigation were:

- Soil and water samples – Amdel
- Initial ambient air screening - ALS



■ Passive air samples – ALS

All the laboratories are NATA approved, with copies of the laboratory test certificates provided in **Appendix E**. A summary of the laboratory test methods used for the range of analytes tested is provided in **Table 9**.

■ **Table 9 Summary of Laboratory Test Methods**

Analyte	Amdel Method Soils	Amdel Method Water	Air Test Methods
Heavy Metals	E5910	E4870/ E48501	
Total Recoverable Hydrocarbons (TPH)	E1230 & E1221	E0230/ E0221	
Benzene, Toluene, Ethyl benzene, Xylene (BTEX)	E1010	E0010	
Polycyclic Aromatic Hydrocarbons (PAH)	E1110	E0110	
PH	E3600	E2600	
Phenols/Creosols	E1140	E0140	
Semi Volatile Organic Compounds (SVOCs)	E1180	E0180	
Volatile Organic Compounds (VOCs)	E1290	E0290	
Sulphate	E3720	–	
Total and Free Cyanide	E3450/E2460	E2450/	
Initial ambient air screening for VOCs			EP091 (ALS)
Passive air samples for VOCs			US EPA 1988 TO-17 (Leeder Consulting)

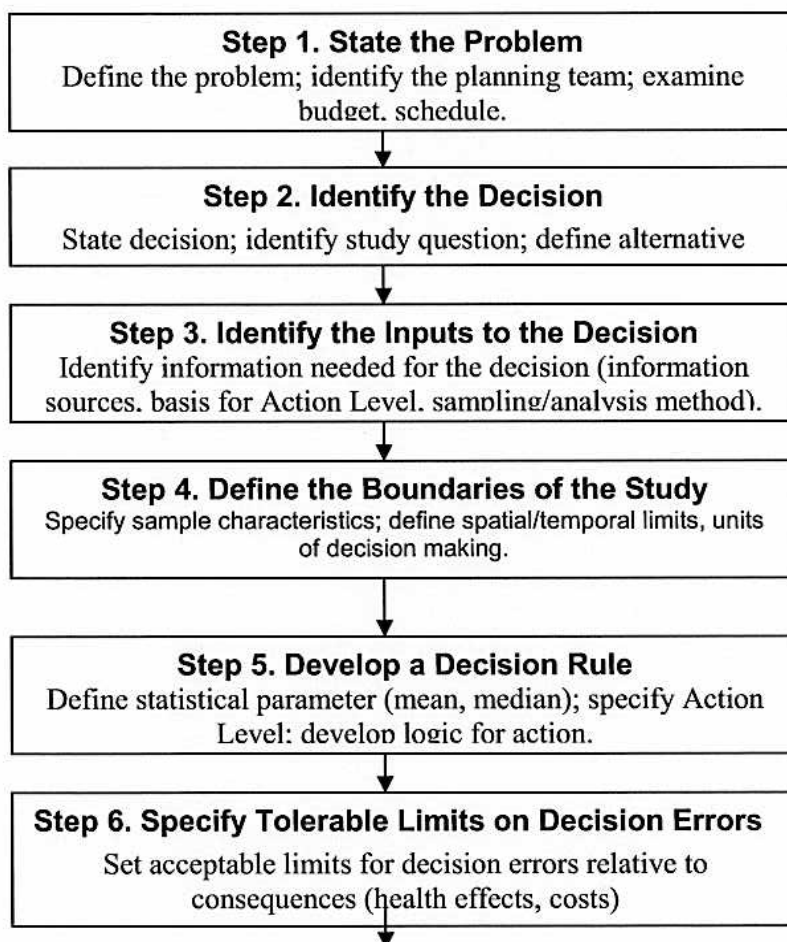


7 Quality Assurance and Quality Control

7.1 Data Quality Objectives

The investigations for the Macdonaldtown Triangle health and ecological risk assessment have been designed using a Data Quality Objective (DQO) process developed by the USEPA (August 2000) *"Guidance for the Data Quality Objective Process"* and the NEPM (1999) *"Guideline on Data Collection, Sample Design and Reporting"*². The Data Quality Objective (DQO) process is a seven step planning approach to develop sampling designs for data collection activities that support decision making. This process uses systematic planning and statistical hypothesis testing to differentiate between two or more clearly defined alternatives. A summary of the seven steps is presented in **Figure 14**.

■ Figure 14 The DQO Process



² NEPC. 1999. *"Guideline on Data Collection, Sample Design and Reporting"*. Schedule B (2), National Environment Protection (Assessment of Site Contamination) Measure

Step 7. Optimise the Design for Obtaining Data

Select resource-effective sampling and analysis plan that meets the performance criteria.

Step 1 (state the problem) is to determine whether ground contamination at and from the former gasworks site is causing unacceptable risks to human health and the environment in terms of its continued use for railway purposes.

Step 2 (the decisions) represent the principal issues that need to be assessed, which arise from the problem stated in Step 1. The issues are considered to be:

- Are contaminant concentrations at the Site and in areas surrounding the Site significantly above background levels?
- Does the concentration of contaminants exceed DEC-endorsed investigation criteria?
- Does a contaminant pose a human health or ecological risk to the receptors of concern?
- Are contaminants causing an aesthetic impact to the environment?
- Does the contamination affect the suitability of Site for current and proposed use?

Step 3 (inputs to the decisions) represent the main parameters that need to be measured by the investigation. These parameters are considered to be:

- The surface condition of the Site in terms of physical evidence of contamination;
- The presence of surface and underground structures and the potential to influence the migration of contaminants;
- Aesthetic impacts at the ground surface and at depth from contamination (ie. odour, stained materials, separate phase products in the groundwater);
- The types and distribution of contamination at the Site and surrounding areas;
- The depth of the contamination below the ground surface;
- The level of soil gas below the surface;
- The rate of flow of groundwater from the Site and the location of potential receptors;
- The ambient air quality at the Site and at properties surrounding the Site;
- The toxicity of the contaminants of concern and their persistence;
- The identification of potential receptors and the location of sensitive environments;
- The assessment of exposure period for the potential receptors of concern; and
- DEC-endorsed environmental criteria.