

REPORTING OF SITE ASSESSMENTS



Contaminated Sites Management Series

Reporting on Site Assessments

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Department of **Environmental Protection**
Government of **Western Australia**

PREFACE

The *Reporting on Site Assessments* guideline, formerly the *Draft Contaminated Site Assessment – A General Guideline for Reporting* (DEP, 2000) has been prepared by the Department of Environmental Protection (DEP) to assist environmental practitioners, local government authorities, industry and other interested parties in reporting on the investigation, remediation and validation of contaminated land and groundwater in Western Australia.

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ACKNOWLEDGEMENTS

The DEP acknowledges the Water and Rivers Commission (WRC), the Health Department of Western Australia (HDWA) and CSIRO Land and Water for their assistance in the preparation of this guideline.

LIMITATIONS

This guideline defines the stages of contaminated site investigation and provides a standard for practitioners reporting on site assessments, including investigations, remediation and validation. This guideline encourages consistent and accurate reporting by informing practitioners, industry and landowners of the information required by the DEP to enable efficient assessment of contaminated land and groundwater in Western Australia. It does not provide detailed guidance on contaminated site assessment and management. Competent professionals should be engaged to provide specific advice in relation to the assessment of contaminated sites.

This guideline should be used in conjunction with the texts referenced herein, and any other appropriate references.

This guideline does not document occupational health and safety procedures or requirements. WorkSafe Western Australia should therefore be consulted regarding such requirements.

DISCLAIMER

This guideline has been prepared by the DEP in good faith, exercising all due care and attention. No representation or warranty, expressed or implied, is made as to the relevance, accuracy, completeness or fitness for purposes of this document in respect of any particular user's circumstances. Users of this document should satisfy themselves concerning its application to their situation, and where necessary seek expert advice.

CONTAMINATED SITES MANAGEMENT SERIES

This guideline forms part of a management series developed by the DEP to provide guidance on the assessment and management of contaminated sites in Western Australia.

The Contaminated Sites Management Series will contain the following guidelines:

- Assessment Levels for Soil, Sediment and Water;
- Certificate of Contamination Audit Scheme;
- Contaminated Site Auditor Accreditation Scheme;
- Development of Sampling and Analysis Programs;
- Disclosure Statements;
- Guidance for Planners;
- Community Consultation;
- Reporting on Site Assessments;
- Potentially Contaminating Activities, Industries, and Landuses;
- Reporting of Known or Suspected Contaminated Sites; and
- Site Classification Scheme.

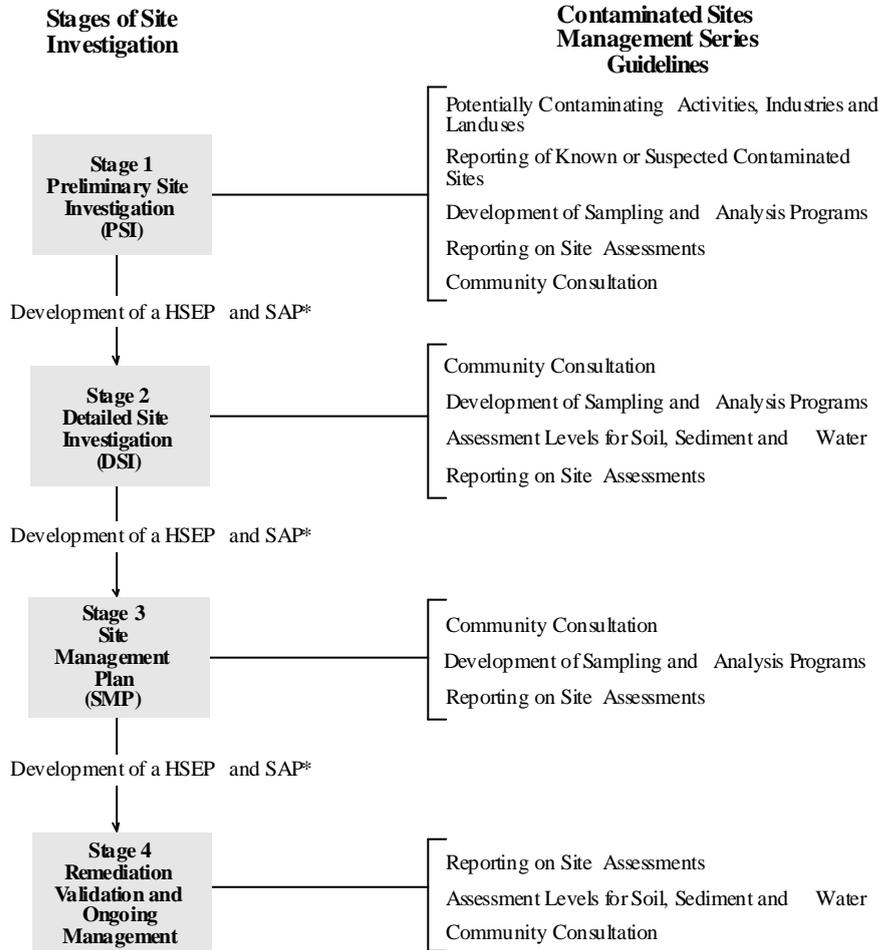
Reference to these guidelines should ensure that the minimum requirements of the DEP are satisfied.

Copies of these guidelines are available from the DEP's library located at Westralia Square, Level 8, 141 St George's Terrace, Perth, or from the DEP's website at www.environ.wa.gov.au

STAGED APPROACH TO SITE INVESTIGATIONS

The Contaminated Sites Management Series of guidelines has been developed by the DEP to encourage a consistent approach to contaminated site assessment and management. One of the main focuses of the series is the **staged approach to site investigation**.

The purpose of this flow-chart is to highlight to the reader the appropriate reference guideline(s) during each of the stages of site investigation.



*Where samples are to be collected a Health, Safety and Environment Plan (HSEP), and Sampling and Analysis Program (SAP) should be prepared.

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1. INTRODUCTION

The objectives of this guideline are:

- **to ensure that reports prepared by land owners, industry and consultants on the investigation, remediation and validation of contaminated land and groundwater contain adequate and accurate information to enable efficient assessment by regulators, accredited auditors and other interested parties;**
- **to ensure consistent reporting that enables the appropriate classification of contaminated land and groundwater; and**
- **to maintain an accurate record of known or suspected contaminated sites, including the Public Database of Confirmed Contaminated Sites, and thereby facilitate the collection and exchange of information.**

This guideline endeavours to set a standard for consistent and accurate reporting. This guideline also informs consultants, industry and landowners of the information required by the Department of Environmental Protection (DEP) to enable efficient assessment of contaminated sites in Western Australia. Contaminated sites reporting is the basis for the transfer of information to relevant stakeholders and therefore a consistent approach to reporting is essential.

It is currently difficult to estimate the exact number of contaminated sites in Western Australia, predominantly due to deficiencies in the identification and documentation of contaminated sites, and the limitations associated with the exchange of information. This guideline, together with the other DEP guidelines referenced, aims to assist in the development of a consistent methodology for contaminated site assessment, and the effective transfer of information.

This guideline should be used when reporting to the DEP on contaminated site assessments, including preliminary and detailed site investigations, site management plans, site remediation and validation, and ongoing management programs. If you are a site owner or occupier, government authority, industry or other affected party wanting to report a known or suspected contaminated site to the DEP pursuant to the *Contaminated Sites Bill 2000 (CS Bill)*, please refer to the guideline entitled *Reporting of Known or Suspected Contaminated Sites* (DEP, 2001) to ensure compliance with the *CS Bill*.

1.1 ASSESSMENT AND MANAGEMENT OF CONTAMINATED LAND AND GROUNDWATER IN WESTERN AUSTRALIA

The DEP's role is to develop a management strategy for contaminated land and groundwater as documented in the public position paper entitled *Assessment and management of contaminated land and groundwater in Western Australia* (DEP, 1997). This strategy highlighted the importance of the identification, reporting and classification of contaminated sites and the availability of this information for land transfer, site development and public awareness purposes. The *Contaminated Sites Bill 2000 (CS Bill)*, which has been prepared based on the principles in the public position paper, provides for the identification, reporting and classification of sites based on the assessment of various stages of investigation, and the establishment of a record of known or suspected contaminated sites, including a Public Database of Confirmed Contaminated Sites.

To identify contaminated sites, and manage the transfer of information on sites such that land values are not adversely affected but that all relevant parties are aware of contamination issues, the DEP has developed a Site Classification Scheme for contaminated sites within Western Australia. The site classification scheme contains the following six categories based upon the information available on a

site, the extent of contamination at a site and the risk posed by that contamination to the environment and/or human health:

- *Report not substantiated;*
- *Possibly contaminated - investigation required;*
- *Not contaminated - unrestricted use;*
- *Contaminated - restricted use;*
- *Contaminated - remediation required; and*
- *Decontaminated.*

Further information on site classification is available in the *Site Classification Scheme* (DEP, 2001) guideline.

Information submitted to the DEP, in the form of preliminary and detailed site investigations, site management plans, site remediation and validation, and ongoing management programs, represents the basis for site classification decision-making.

The exchange of information on contaminated land and groundwater is essential for ensuring acceptable current and future land uses and determining future liability. The classification of sites and the establishment of a record of known or suspected contaminated sites, including the Public Database of Confirmed Contaminated Sites, will facilitate the transfer of information between the DEP, the general public, relevant planning authorities, prospective purchasers and developers by providing them with an authoritative source of site-specific information.

1.2 OBJECTIVES OF THE GUIDELINE

The assessment and subsequent classification of contaminated sites depends on the quality of information provided in reports. Therefore, it is critical to adopt a consistent style of high quality, practical and reasonable reporting that will ensure an efficient and accurate assessment of the site.

There are a number of guidelines on reporting available. However, the purpose of this document is to encourage a reporting format consistent with the information requirements of the DEP in managing contaminated sites in Western Australia.

This guideline is based on the DEP's strategy outlined in the 1997 public position paper, for which legislative endorsement is being sought in the form of the *CS Bill*, the *National Environment Protection (Assessment of Contaminated Sites) Measure* ("the NEPM") (NEPC, 1999) and relevant Australian Standards.

Reporting on contaminated sites represents the basis for information exchanges between key stakeholders, therefore high quality accurate reporting is paramount. To emphasize this importance, the DEP may return reports, without assessing the information, where data reporting is not considered consistent, in either content or format, with this guideline.

1.3 HEALTH AND SAFETY

The scope of this guideline does not cover the health and safety aspects of contaminated sites, however some factors have been included here to prompt the consideration of health and safety when planning activities on contaminated sites.

The *Occupational Safety and Health Act 1984* places a clear obligation on persons to ensure the safety and health of anyone they engage to do work (such as drillers, earthmoving contractors, consultants). It is therefore recommended that Health, Safety and Environment Plans (HSEP) be produced and the contents adequately communicated to all site personnel prior to their exposure to the site. Guidance on the contents of HSEPs can be obtained from Schedule B(9) of the NEPM: *Protection of Health and the Environment During the Assessment of Site Contamination* (NEPC, 1999).

Copies of HSEP should be forwarded to WorkSafe WA along with notification of any site works prior to the commencement of the site works. WorkSafe WA should be contacted for further information on notification of site works and HSEP requirements. WorkSafe WA's website address is www.safetyline.wa.gov.au

Any risks to the public should also be identified and measures should be implemented to minimise these.

2. STAGES OF INVESTIGATION AND REPORTING

Stage 1 - Preliminary Site Investigation is an investigation consisting of a desktop study, a detailed site inspection and where appropriate, limited sampling. The preliminary site investigation should be of such scope as to indicate whether contamination is present, or likely to be present, and to determine whether a detailed site investigation should be conducted.

Stage 2 - Detailed Site Investigation confirms potential or actual contamination, identified during the preliminary site investigation, through a comprehensive sampling program. This investigation should accurately delineate the vertical and lateral extent of contamination, both on-site and off-site, to enable an assessment of risk to the environment and/or human health to be made. The decision-making processes involved in determining remedial and/or management strategies are dependent on the data obtained during this stage of investigation. Detailed site investigations may be completed in a number of stages depending on the complexity of the site.

Stage 3 - Site Management Plan documents the type and extent of remediation required to ensure that the site is suitable for its current or intended future use, and to protect the surrounding environment and land uses. The management plan details the remediation techniques proposed to achieve the remediation objectives and generally sets levels against which the clean-up can be assessed through the site validation process.

Stage 4 - Remediation, Validation and Ongoing Management is the process of demonstrating that a contaminated site has been successfully remediated and that the objectives of the site management plan have been achieved. Site validation requires sampling to demonstrate that the remaining soil/sediment, the backfill material, the in-situ remediated material and/or any groundwater affected by the site contamination no longer poses a risk to human health or the environment.

The objectives of site investigations are to:

1. determine the absence/presence of contamination ;
2. determine whether site contamination poses an actual or potential risk to human health and/or the environment; and
3. determine whether remediation is required.

The process of site investigation and assessment of contaminated land and groundwater generally involves four main stages:

- Stage 1 - Preliminary Site Investigation.
- Stage 2 - Detailed Site Investigation.
- Stage 3 - Preparation of a Site Management Plan.
- Stage 4 – Remediation, Validation and Ongoing Management.

Adequate data collection is fundamental for the assessment of human health and environmental risks associated with contaminated sites. The following provides a summary of the information required for reporting on each of the stages of investigation. Comprehensive checklists detailing the DEP's information requirements for each of the four stages discussed above are provided in Appendix A to Appendix D.

To ensure accurate and consistent reporting, the checklists provided in Appendix A to Appendix D of this guideline should be referenced when reporting on any site investigations.

Reports can be submitted to the DEP for assessment in stages or on completion of the entire investigation. **The DEP recommends, however, that a staged approach to the submission of contaminated sites reports be taken, consistent with the staged approach to site investigation as outlined above.** Submitting reports in a staged manner enables the DEP to provide guidance and advice in the early stages of the investigation which often reduces delays during the final assessment and clearance of sites. Difficulties associated with the quality of information, sampling parameters and distribution, adopted assessment levels and environmentally sensitive issues can be resolved in the early stages of the investigation. Submission of reports on completion of each of the stages of investigation also enables site investigation and management objectives to be developed in consultation with the DEP prior to the commencement of the next stage of investigation.

The following sections provide a description of what is expected to be completed/reported as part of any site investigation. These lists are not exhaustive due to each contaminated site presenting different issues in relation to its location, physical characteristics, contaminants and risks. Therefore, there may be additional site-specific factors which need to be addressed and included.

The DEP recommends a staged approach to the investigation of contaminated or potentially contaminated sites and the subsequent submission of site assessment reports.

It is expected that when conducting site investigations:

- **practitioners would engage contractors (e.g. drillers, earth moving contractors, surveyors) who have had suitable training associated with operating on contaminated sites, and ensure that all persons on site are familiar with the relevant health and safety aspects of the site;**
- **drilling contractors holding an appropriate National Class 2 Water Well Drillers Licence will be engaged where groundwater wells are to be installed; and**
- **all intrusive investigations will be supervised by a competent environmental professional.**

2.1 STAGE ONE - PRELIMINARY SITE INVESTIGATION

A Preliminary Site Investigation (PSI) is an initial evaluation of the contamination status of a site, which generally comprises:

- a desktop study;
- a detailed site inspection; and
- interviews with site representatives (management, owners, former employees etc).

The objective of a PSI is to determine whether there have been any potentially contaminating land uses at the site, probable contaminants and the possible locations of any contamination. The findings of a PSI form the basis of all further site investigations, and therefore it is imperative that as much information on the site as possible is obtained and assessed in this phase of investigation. A PSI found to be deficient will result in a lack of confidence in any subsequent investigations completed at a site.

Examples of when a PSI may be undertaken, and by whom, are as follows:

- a site owner or developer, to satisfy conditions set by a local or state government authority during the planning process;
- a site owner, to identify the potential for contamination prior to the sale, lease or a change in the landuse of the site;

- prospective purchasers/developers, to satisfy themselves that the site is free of contamination prior to purchase/development;
- a site owner, when preparing a Disclosure Statement, pursuant to the *CS Bill* (refer to *Disclosure Statements* (DEP, 2000)); and
- an environment practitioner, engaged by the site owner, occupier, local or state government authority or other relevant party, to undertake a preliminary investigation of the site.

2.1.1 Preliminary Site Investigation Reporting

The PSI report documents the desktop study/background information and should include, but not be limited to:

- site identification details, including street address, lot number, certificate of title, local government authority, zoning, co-ordinates of the site boundaries (northings/eastings);
- proposed landuse(s) for the site;
- surrounding current and historical landuses and zoning (e.g light industrial, mixed commercial, residential, primary schools);
- environmental value of the site and surrounding environment (land, surface waters, groundwater, air), including the location, use and installation data of all registered groundwater bores within a 500m radius of the site;
- site conditions, including topography, geology, hydrogeology and drainage conditions, site layout, location of infrastructure, location and description of any imported fill;
- site history details based on the collection of historical information such as aerial photographs, site plans, certificate of title details, land use plans;
- all past and present potentially contaminating activities;
- site inspection observations, to validate anecdotal evidence and historical information, and to identify any additional evidence of potential contamination;
- interviews with current and past site users and adjacent land users;
- potential contaminant sources, including point and diffuse sources;
- potential contaminants associated with past and present industries, activities or land uses (a list of potentially contaminating activities is provided in the *Potentially Contaminating Activities, Industries, and Landuses* (DEP, 2001) guideline);
- current and former chemical storage areas, such as above and below ground storage tanks, drum storage pads/sheds;
- potential areas of concern e.g. disturbed or affected vegetation, visual indications of spills/soil contamination, obvious odours, corrosion of infrastructure;
- building materials used on site e.g. friable asbestos, lead-based paints, building materials that may have been treated with chemicals such as wood, building materials which may have been subject to contamination such as fill material, transformers etc;
- waste and effluent management such as on-site or off-site disposal practices, on-site lagoons, ponds, septic systems, grease traps, interceptors, waste drum storage areas, wastewater discharges including stormwater discharge locations;
- contaminant characteristics such as solubility, weight, mobility, migration characteristics, persistence in the environment;
- any known spills or leaks, and the results of previous environmental investigations;
- potential exposure pathways and routes such as service trenches, open ground, stormwater drainage, leach drains, tunnels and shafts, and naturally occurring caverns, holes or fractures;
- potential off-site receptors (e.g sensitive environments such as wetlands);
- any community members who may provide input into, or require information from, the investigation (e.g. adjacent land owners, affected land owners, community action groups) and should therefore be included in the community consultation process (refer to the DEP's *Community Consultation* (2001) guideline for details); and
- details of undertaken or proposed community consultation.

In addition to the above, the following information should be included in Preliminary Site Investigation reports for **sites containing, or formerly containing underground storage tanks (USTs)** and associated infrastructure:

- the location (historical, and present) of USTs and associated infrastructure (e.g any pipework/fuel lines, bowsers, interceptor traps, fill points);
- the age of USTs and associated infrastructure;
- the construction and installation details of the USTs and associated infrastructure;
- the contents of the USTs (historical, and present);
- stocktaking data and records of leaks or spillages and any maintenance undertaken; and
- any integrity testing of tanks and associated pipework to detect leaks.

A PSI should provide a preliminary statement on the site contamination and make recommendations for further investigations, on-site and off-site, including the most appropriate sampling methods depending upon site access, site characteristics, and contaminant characteristics.

The list of information required by the DEP to be contained within a PSI report is detailed in Appendix A of this guideline.

Prior to undertaking a site inspection, a Health, Safety and Environment Plan (HSEP) should be prepared to address site conditions, expected contaminants and contaminated media that workers at the site and the general public may be exposed to. In consideration of certain liability issues and/or legal requirements, site workers may need to undergo specific training prior to any site work and/or participate in a medical monitoring program. Schedule B(9) of the NEPM: *Protection of Health and the Environment During the Assessment of Site Contamination* (NEPC, 1999) provides guidance on the development of HSEPs. As discussed in Section 1.3, WorkSafe WA should be contacted for further guidance.

Where the site history suggests the likelihood of contamination, generally determined through the desktop study and site inspections, soil and/or groundwater sampling may be required to ascertain whether contamination exists. Preliminary sampling may be undertaken as part of the PSI or a Detailed Site Investigation may be warranted in which a comprehensive sampling program is undertaken. It should be noted that without sampling and subsequent analysis from a given site it may not be possible to determine whether a site is contaminated or not.

A sampling and analysis program should be developed prior to the collection of any samples on a site. The program should be based upon the findings of the desktop study and detailed site inspection. Refer to the *Development of Sampling and Analysis Programs* (DEP, 2001) for guidance.

Composite sampling may be acceptable during the PSI stage, however, where contamination is identified, any subsequent stages of investigation will require individual samples to be analysed. A discussion on composite sampling is provided in the *Development of Sampling and Analysis Programs* (DEP, 2001) and the *Assessment Levels for Soil, Sediment and Water* (DEP, 2001) guidelines.

Where the findings of the PSI indicate contamination, or are insufficient to confirm either way, further investigations will be required to confirm and delineate the extent of contamination. This next stage of investigation is the Detailed Site Investigation.

Sites which have infrastructure (e.g. USTs, fuel lines, buildings) *in-situ* at the time the PSI was undertaken require detailed investigation following infrastructure removal.

2.1.2 Assessment of Groundwater

Groundwater is a valuable resource in Western Australia and should therefore be addressed for all sites during each of the stages of investigation, including the Preliminary Site Investigation.

Due to the often shallow and vulnerable nature of groundwater resources in Western Australia, the potential for impact to groundwater should be addressed for all sites during the PSI stage. A hydrogeological assessment is often a critical component of a staged site investigation.

Appraisal of groundwater issues will rely on the professional judgement of practitioners, who should obtain specialist groundwater advice. Intrusive groundwater investigations should only be undertaken by appropriately qualified and experienced groundwater professionals.

An initial hydrogeological assessment, based on readily available information, should be incorporated into the PSI to determine whether a risk to groundwater quality exists. Where a risk is identified, a more comprehensive assessment should be undertaken as part of the Detailed Site Investigation. However, if there is no contamination or the contamination does not pose a risk to human health or the environment then it may not be necessary to undertake further investigative work, although an ongoing monitoring program may be warranted.

A desktop hydrogeological assessment should be undertaken before the development of a groundwater sampling program. The information to be considered when compiling a desktop assessment is outlined in Appendix A, Section A-6 of this guideline.

Further information on the assessment of groundwater is provided in Schedule B(6) of the NEPM: *Guideline on Risk Based Assessment of Groundwater Contamination* (NEPC, 1999). In addition, the *Development of Sampling and Analysis Programs* (DEP, 2001) provides guidance on developing groundwater sampling programs. Information on the levels used for assessing groundwater quality is available in the *Assessment Levels for Soil, Sediment and Water* (DEP, 2001) guideline.

Enquiries regarding groundwater can be made to the Water and Rivers Commission (WRC). The WRC maintains a database of groundwater wells throughout the State. However, it should be noted that this information is often limited in coverage and the integrity of the data is unable to be guaranteed.

The WRC has produced the Perth Groundwater Atlas (available via the internet), which provides some indication of the depth and flow direction of local groundwater in the Perth area. It is recommended that this publication be used as a guide only, as information is heavily based on regional groundwater bore data and is not appropriate, or intended, to be used for site-specific contamination investigations. Site-specific groundwater information should be obtained for each investigation.

2.1.3 Potential Information Sources

Potential sources of information which may be useful when compiling a PSI report are provided as follows:

- Department of Land Administration (DOLA) - Certificates of Title and aerial photographs;
- Water and Rivers Commission (WRC) – Bore water enquiries (bore details) and beneficial use of groundwater;
- Geological Survey Maps 1:50,000 Environmental Geology Series (site geology);
- One Call Dial Before You Dig Service (Telstra Service Difficulties and Faults – 1100: for the establishment of the location of underground services prior to the undertaking of any subsurface investigations);
- DEP's records of known or suspected contaminated sites, including the Public Database of Confirmed Contaminated Sites (once available);
- Department of Mineral and Petroleum Resources (DMPR) Explosives and Dangerous Goods Division – Location of USTs and integrity testing details; and
- Local government for zoning details, service infrastructure and planning approvals, and complaints.

2.2 STAGE TWO – DETAILED SITE INVESTIGATION

A detailed Site Investigation (DSI) involves the collection of comprehensive data on contamination identified during the Preliminary Site Investigation.

The objective of a DSI is to establish the nature of contamination, the lateral and vertical distribution of contaminants, determine contaminant concentrations, identify contaminant sources and give consideration to potential human health and environmental impacts. Detailed sampling is required at this stage of investigation to determine the in-situ contamination status of the site. The *Development of Sampling and Analysis Programs* (DEP, 2001) guideline provides further information on undertaking site investigations.

2.2.1 Detailed Site Investigation Reporting

The DSI report should:

- identify/confirm sources of contamination;
- provide comprehensive information on the nature, extent and concentrations of contamination;
- assess contaminant dispersal in air, surface water, groundwater, sediments, soil, and dust;
- identify the potential for landfill gas or similar (where applicable);
- detail the appropriate investigation levels to be used in the assessment of the site;
- assess the sensitivity of receiving environments (where applicable);
- identify any off-site impacts on soil, sediments, groundwater, surface water, air and biota (where applicable);
- identify the potential effects of contaminants on public health, the environment and building structures;
- provide a comprehensive geological and hydrogeological assessment;
- consider the adequacy and completeness of all information available to be used in making decisions on remediation, or management of contamination; and
- document all community consultation undertaken.

The list of information required by the DEP to be contained within a DSI report is provided in Appendix B of this guideline.

2.2.2 Sampling and Analysis Plan

Prior to completing a DSI, a site-specific sampling and analysis plan is required to determine:

- the objectives of the investigation;
- data quality objectives;
- appropriate sampling methods;
- sampling locations (e.g. type, depth, number);
- sample preservation and handling requirements; and
- quality assurance/quality control (QA/QC).

The sampling and analysis plan should be developed based upon the findings of the preliminary site investigations, and should take into account site conditions and potential contaminants. Further information on developing a sampling and analysis plan is provided in the *Development of Sampling and Analysis Programs* (DEP, 2001) guideline.

2.2.3 Risk Assessment

The appropriate use of assessment criteria is an important component in the assessment of identified contaminated sites. It is particularly important to be able to select the most appropriate criteria for use in a range of environmental settings and land-use scenarios which take into consideration the protection of human health, ecology, groundwater, structures and aesthetics. Refer to the *Assessment Levels for Soil, Sediment and Water* (DEP, 2001) guidelines, for further details.

An assessment of risk must be made in the early stages of a DSI, and may warrant its own individual report, separate to the DSI report. A preliminary assessment of human health and ecological risks may be undertaken during the preliminary site investigation, by comparing concentrations of contaminants against existing health and ecological levels. However, where a potential for risk is identified, a site specific risk assessment may be required to characterise and quantify the risk and to develop appropriate risk management strategies.

It should be noted that undertaking a risk assessment is one of a number of options for identifying and managing risks associated with contaminated sites.

Where a proponent/practitioner chooses, site-specific response/remediation levels can be developed from appropriate risk assessment methodologies.

Schedule B(4) *Guideline on Health Risk Assessment Methodology* and Schedule B(5) *Guideline on Ecological Risk Assessment* of the NEPM (NEPC, 1999) detail the processes involved in human health risk and ecological risk assessment, respectively.

The Health Department WA should be contacted for specific guidance on health risk assessment.

If a site investigation indicates that the site poses unacceptable risks to human health or the environment, on-site or off-site, and under either the present or the proposed land use, then a Site Management Plan needs to be developed and implemented.

2.3 STAGE THREE – SITE MANAGEMENT PLAN

2.3.1 Site Management Plan Requirements

The development of a Site Management Plan (SMP) involves the selection of an effective management strategy which is practical, achieves the desired outcomes and is socially and environmentally acceptable.

The SMP should address:

- specific data gaps identified during detailed site investigations;
- identify the additional information required for the selection and/or design of remedial and/or management options (e.g. active remediation, risk mitigation);
- identify the required baseline data for sites subject to monitored natural attenuation (passive remediation); and
- document the community consultation process undertaken, and demonstrate how the community's input was taken into consideration when choosing the management strategy for the site (refer to the *Community Consultation* (DEP, 2001) guideline for further information.).

Where remediation, passive or active, of the site is the chosen management strategy, the SMP should:

- detail the chosen remediation strategy including ongoing monitoring (e.g. monitored natural attenuation);
- provide an outline of remediation objectives;
- compare the chosen remedial strategy against other available remedial strategies and justify the choice. The Environmental Protection Authority's (EPA, 2000) *Guidance for the Assessment of Environmental Factors: Guidance Statement for Remediation Hierarchy for Contaminated Land No. 17* should be considered for remedial strategy comparison;
- provide details of decommissioning and removal of infrastructure, where applicable;
- provide details of location(s) of any off-site disposal sites used, volumes of waste requiring off-site disposal, soil/groundwater handling requirements and vehicle washdown;
- establish environmental safeguards to protect on-site and off-site receptors (e.g. dust management, odour and noise control, waste management, site security); and
- establish performance indicators, to be validated through monitoring to avoid contamination rebound in the long term and to ensure successful remediation.

For large-scale projects, a stand alone SMP may be necessary, whereas in small-scale projects a chapter within the DSI report may adequately address the requirements of the SMP.

The fundamental goal of contaminated site management is to mitigate the threat to, and provide protection for, human health and the environment, as well as ensuring the site is acceptable and safe for the beneficial use of the land and groundwater, whether it be a continuation of its existing use or potential future uses.

The information to be considered when preparing a SMP is provided in Appendix C of this guideline.

2.3.2 Remediation Method

The decision-making process involved in selecting the appropriate remedial method(s) or management strategies for a site should be summarised in the SMP to ensure that all relevant factors relating to the site have been taken into consideration. The *Guidance for the Assessment of Environmental Factors: Guidance Statement for Remediation Hierarchy for Contaminated Land No. 17* (EPA, 2000) recommends the following preferred hierarchy of remedial approaches for managing contaminated soils:

- on-site treatment of the soil so that the contaminant is either destroyed or the associated risk is reduced to an acceptable level; and/or
- off-site treatment of excavated soil which, depending on the residual levels of contamination in the treated material, is then returned to the site.

Disposal of contaminated material to an approved waste disposal site facility or landfill or 'cap and contain' management options will only be considered if:

- treatment of the contaminated material is shown or demonstrated not to be practicable;
- options to dispose to landfill or 'cap and contain' are undertaken in an environmentally acceptable manner; and
- the risk of disturbance of the contaminant exceeds the risk of leaving it undisturbed and contained on site (only relates to on-site containment).

Any 'cap and contain' management options should be considered against the *Guidelines for the Assessment of On-Site Containment of Contaminated Soils* (ANZECC, 1999).

Where a remedial and/or management method is not consistent with the above hierarchy, the report should detail the reasons for deviating from the preferred hierarchy and justify the chosen option against other available technologies/management options.

The various remediation or management options should be presented to, and discussed with, the community as part of the community consultation process. The SMP should document the community's input in the decision-making process involved in the selection of preferred remedial and/or management options. Further guidance is provided in the *Community Consultation (DEP, 2001)* guideline.

Natural attenuation is often presented as a remedial method for groundwater. Although it is recognised that natural attenuation may be an effective, inexpensive clean-up option and in some cases the most appropriate way to remediate a site, it is not the DEP's preferred method of management or remediation of groundwater. As with any remedial option, natural attenuation should be evaluated for its appropriateness based on the risks, the site characteristics, and the potential to achieve remediation at a site. Before considering natural attenuation, the capacity for the aquifer to attenuate the contaminants of concern needs to be demonstrated.

To be accepted as a viable remedy, natural attenuation needs to be used in the context of a carefully controlled and monitored site clean-up approach, including primary and secondary source removal. Because the rates of natural degradation processes are typically slow, long term groundwater monitoring is necessary to demonstrate that contaminant concentrations are decreasing at a rate sufficient to ensure that they will not become a threat to human health or the environment, and that transport through the subsurface is as predicted.

Where contamination has migrated beyond the boundaries of the subject site (e.g. via groundwater, dust, deposition of tailings, soil etc), and is impacting, or has the potential to impact, the beneficial use of neighbouring properties, minimising the impact and restoring the identified beneficial use, within the shortest timeframe possible, are key objectives when considering remedial/management options.

Informing the local community (e.g. neighbouring residents/affected parties) of the contamination status, the outcomes of investigative works, and seeking input into remedial/management decision-making is also of paramount importance. Refer to the DEP's *Community Consultation* (2001) guideline for assistance.

All remediation carried out must be validated as a means of accountability. Confirmation of site validation is required before a certificate of contamination audit can be issued by the DEP. The *Development of Sampling and Analysis Programs* (DEP, 2001) guideline provides further guidance on site validation.

2.4 STAGE FOUR - REMEDIATION, VALIDATION AND ONGOING MANAGEMENT

2.4.1 Remediation and Validation Reporting

Post-remediation validation enables the success of the remediation to be assessed. The remediation and validation report should clearly demonstrate that the land is suitable for its current or intended use, that the beneficial use of groundwater or surface water is not compromised and that all the objectives of the remediation have been achieved and accounted for.

The remediation and validation report should:

- document methods of remediation including excavation of soil (volumes), the off-site destination and/or treatment of contaminated media;
- detail the validation sampling undertaken to prove that the previously identified contaminants no longer pose a risk to the environment and/or human receptors;
- compare monitoring data with pre-determined remediation levels or site specific generated criteria;
- identify and include proof of any necessary approvals and licences required by regulatory authorities;
- provide details of completed remediation; and
- document proposed land use(s) and suitability of the site for the landuse(s).

Where remedial targets have not been met, reasons must be stated and a management strategy proposed to ensure that the land and groundwater, on-site and off-site, is not subjected to unacceptable risk.

2.4.2 Ongoing Management/Monitoring Reporting

Many contaminated sites will require some form of post-remediation monitoring to avoid problems associated with contamination rebound. Ongoing monitoring is also required where groundwater is contaminated, to determine the performance of the remedial works or support natural attenuation, or where on-site containment ('cap and contain') is proposed.

The development of an ongoing monitoring program is recommended to ensure the effective management of the contamination.

The ongoing monitoring program should document the following:

- identify all responsible parties and detail commitments to the monitoring program;
- provide timeframes (e.g. commencement and expected length of program);
- monitoring locations;
- frequency of monitoring;
- methodology of monitoring, including field and laboratory techniques;
- monitoring parameters;
- any pre-determined trigger levels for further action, i.e. to trigger active remediation;
- frequency of reporting; and
- parties to be reported to (this may include certain community groups).

3. INFORMATION REQUIRED FOR REPORTING

3.1 MANDATORY REPORTING

Checklists are provided in Appendix A to Appendix D that list the information which should be considered when reporting to the DEP on the various stages of investigation, remediation and validation. The checklists cover a broad spectrum of information and, in most cases, does not need to be followed as a definitive checklist. The DEP acknowledges that the level of information required for reporting is site specific and relates to a number of variables such as the magnitude of contamination, the contaminated media involved and the complexity of the issues.

Some information is however, mandatory. The provision of this information is required by the DEP regardless of the site. The following information is **mandatory**:

- site identification (including certificates of title, co-ordinates of site boundaries);
- executive summary (including the Site Summary Form);
- scope of work;
- basis for adoption of assessment levels;
- quality assurance/quality control (QA/QC) protocols for field and laboratory work;
- results; and
- conclusions and recommendations.

The DEP requires the certificates of title (hardcopy) and the co-ordinates of site boundaries (eastings/northings) to establish a legal description of a site. If this information is not provided, assessment of the report(s) will not proceed.

Where a practitioner chooses to deviate from the mandatory information requirements of the checklist, the deviations should be highlighted and clear reasons should be given for the deviation from the standard format.

Consideration of the information provided in the checklists will facilitate consistent reporting and aid in the efficient and accurate assessment of contaminated land and groundwater by the DEP. Individual checklists are provided for each of the major stages of investigation.

Where data reporting is not considered consistent, in either content or format, with this guideline, the DEP may return the report without assessing the information.

3.2 SITE SUMMARY FORM – RECORD OF KNOWN OR SUSPECTED CONTAMINATED SITES

A Site Summary Form is provided in Appendix E which lists the information required to enable the DEP to maintain an accurate record of known or suspected contaminated sites, including the Public Database of Confirmed Contaminated Sites. **The Site Summary Form should be completed and incorporated into the front of any report submitted to the DEP for assessment.**

An electronic copy of the Site Summary Form is available on the DEP's website: www.environ.wa.gov.au

The DEP may return reports where the Site Summary Form has been omitted or not adequately completed.

4. GENERAL PRESENTATION REQUIREMENTS

4.1 GENERAL REQUIREMENTS

As recommended by the National Environment Protection Council (NEPC, 1999), reports should be printed on A4 size paper, with a durable cover and ring binding to facilitate easy opening. Photographs should be presented as original prints or superior quality colour copies that adequately display the points of interest.

Information should be presented in a logical sequence with appropriate subject headings to guide the reader through the document.

Where it is deemed by the proponent/practitioner that more than one regulatory authority may be required to review the reports, multiple copies should be provided to the DEP.

The report should clearly differentiate between factual data and the practitioner's opinion and conclusions relating to the contamination status and environmental condition of the site. Assumptions made by the practitioner in relation to the assessment, including sampling density, sample locations, choice of analytes, off-site impacts and potential groundwater contamination should also be highlighted.

The following documentation should accompany the reports, where relevant:

- Site Summary Form;
- Hardcopy(s) of Certificates of Title (including survey plan);
- a list of abbreviations;
- QA/QC protocols for field and laboratory work;
- chain of custody documents for all samples;
- analytical results exhibiting NATA endorsement; and
- borelogs and test pit logs.

Where sites comprise multiple contaminant types it is beneficial, both to the proponent/practitioner and to the regulatory authorities, to provide tabulated information on:

- actual/potential sources of contamination;
- actual/potential contaminants;
- number of locations sampled for each source/area of contamination; and
- analysis completed for each source/area of contamination.

This information provides a summary of site findings and is useful in developing, or determining the appropriateness of, a sampling and analysis program for the site. Examples of how this information can be presented are provided in Appendix F, Table F-1 and F-2.

4.2 SITE DRAWINGS

All drawings should have, or show, as a minimum:

- a north-facing arrow;
- date drawing was drafted, name of draftsman;
- a scale appropriate to the size of the project and the level of detail required; and
- site boundaries (it is useful to superimpose the site plan onto the certificate of title survey plan, particularly where the site is comprised of a number of certificate of titles).

Where applicable, drawings should include:

- location of past and present infrastructure/equipment, including buildings, under ground and above ground storage tanks, sumps;
- location of past and present on-site or nearby off-site disposal sites;
- distribution of imported fill;
- presence of above and below ground services;
- areas covered by impermeable seal (concrete, paving, bitumen and buildings);
- direction of surface drainage and runoff;
- direction of groundwater flow;
- geological and aquifer cross sections;
- soil sample locations (on-site and off-site);
- groundwater monitoring bore locations (including up-hydraulic gradient/background);
- colour coded or differentiated contamination concentration contours; and
- excavation boundaries.

Where the size of the project and the level of detail warrants drawings larger than A3, these should be inserted into the report using a clear plastic pocket.

An example of appropriate data presentation is provided in Appendix F, Figure F-1.

The inclusion of free hand drawings into final reports for assessment by the DEP is not acceptable.

4.3 PRESENTATION OF ANALYTICAL RESULTS

Analytical results should be presented as originally received from the laboratory, generally as an appendix. A summary of these results should be presented in tabulated form within the body of the report as well as onto site drawings, where appropriate.

Tabulated results should include the following:

- sample location (sample identification number);
- depth of sample;
- date and time sampled;
- analytical parameters;
- laboratory results;
- levels against which results are compared; and
- highlighted results (by underlining, shading or bold) where results exceed comparative levels.

An example of appropriate presentation of data is provided in Appendix F, Table F-3.

Presenting analytical results on a site drawing(s) can often provide a clear representation of contamination issues associated with the site. Sample locations, sample identification numbers, depths and concentrations of contaminants can be displayed on a site drawing using a number of techniques to expedite assessment and minimise cross referencing.

Schedule B(2) *Guideline on Data Collection, Sample Design and Reporting* of the NEPM (NEPC, 1999) should be referenced for detailed guidance on the presentation of data.

5. GLOSSARY

Analyte	Refers to any chemical compound, element or other parameter as a subject for analysis.
ANZECC	Australian and New Zealand Environment and Conservation Council.
Aquifer	Rock or sediment in a geological formation, or group of formations, or part of a formation which is capable of being permeated permanently or intermittently and can thereby transmit water.
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand.
Assessment	Study of a site to determine possible and actual contaminants. May involve a desktop review of the site and may also include the collection and analysis of soil, groundwater or sediment samples.
Assessment Levels	Guideline concentrations of contaminants adopted by the DEP to use as a comparison against which to assess the presence and severity of contamination at a site.
Background Concentrations	Naturally occurring ambient concentrations in the local areas of a site.
Beneficial Use	The use of the environment, or of any portion thereof, which is – (a) conducive to public benefit, public amenity, public safety, public health or aesthetic enjoyment; or (b) identified and declared under Section 35(2) of the <i>Environmental Protection Act 1986</i> (as amended) to be a beneficial use to be protected under an approved policy.
Bioavailability	Availability of contaminants in a form in which organisms or biota can assimilate contaminants e.g. contaminants being in a dissolved state or capable of being solubilised once ingested.
Bore	A hole drilled into an aquifer for the purpose of monitoring or extracting groundwater. Another common term is ‘well’.
BTEX	Benzene, Toluene, Ethylbenzene, Xylene.
Clean Fill	Material that will have no harmful effects on the environment and which consists of rocks or soil arising from the excavation of undisturbed material. For material <u>not</u> from a “clean excavation”, it must be validated to have contaminants below Ecological Investigation Levels.

Community Consultation	Consultation with those individuals or groups who have an interest in a (potentially) contaminated site, its assessment and/or remediation, or may be affected by it, including all stakeholders in the local community and the wider community.
Competent Professional	Possessing the skills, knowledge, experience, and judgement to perform the assigned tasks or activities satisfactorily.
Composite Sample	The bulking and thorough mixing of equal quantities of soil samples collected from more than one sample location to form a single soil sample for chemical analysis.
Contaminant	A substance which has the potential to present a risk of harm to human health or any environmental value.
Contaminant Rebound	Occurs when residual non-aqueous phase liquid (NAPL), sorbed or otherwise immobilised contaminants, are re-dissolved into the groundwater.
Contaminated	In relation to land or underground water, means that a substance is present in, on or under that land or in that underground water, at a concentration that presents, or has the potential to present, a risk of harm to human health or any environmental value.
Data Quality Objective (DQO)	Qualitative and quantitative statements which specify the quality of the data required.
Dense Non-Aqueous Phase Liquid (DNAPL)	Non-aqueous substances which have an average density greater than water (specific gravity greater than 1) and therefore generally sink in water.
DEP	Department of Environmental Protection.
Detailed Site Investigation (DSI)	An investigation which confirms and delineates potential or actual contamination through a comprehensive sampling program.
Development (of bores)	The removal of fines (including drilling mud) from the aquifer immediately surrounding the bore and creating a filter zone around the bore that prevents further movement of aquifer particles into the bore.
Diffuse Source	Widespread sources of contamination such as the contents of landfill sites, residential areas or large industrial complexes containing a number of point sources.
DME	Department of Minerals and Energy.
Ecosystem	Unit including a community of organisms, the physical and chemical environment of that community, and all the interactions among those organisms and between the organisms and their environment.

EIL_{soil}	Ecological Investigation Level. EIL for soil is the concentration of a contaminant below which adverse impacts upon site-specific ecological values are unlikely to occur.
Environmental Value	Beneficial use or an ecosystem health condition, which requires protection from activities which may degrade, impair or destroy it.
FID	Flame Ionisation Detector.
Groundwater (also Underground Water)	All waters occurring below the land surface.
HIL_{soil}	Health Investigation Levels. HILs are utilised to assess contamination where: <ul style="list-style-type: none"> (a) there is no adverse impact, or little potential for any adverse impact, to the environment, or the environmental value or beneficial use of an environmental receptor; and therefore (b) the adverse impacts arising from contamination at a site are to human health only.
Hydraulic Gradient	The change in the static head (of groundwater) per unit of distance in a given direction.
Hydrogeology	The study of groundwater, especially relating to the distribution of aquifers, groundwater flow and groundwater quality.
Interim Sediment Quality Guidelines-Low (ISQG-Low)	Probable-effects concentrations below which biological effects would rarely occur.
Interim Sediment Quality Guidelines-High (ISQG-High)	Probable-effects concentrations below which biological effects would possibly occur. Concentrations at or above the ISQG-High represent a probable-effects range within which effects would be expected to frequently occur.
Investigation Levels	The concentration of a contaminant above which further investigation, evaluation and possibly remediation will be required.
Landfill	For the purposes of disposing of contaminated material, landfill means a site used for disposal of solid material by burial in the ground that is licensed as a landfill under the <i>Environmental Protection Act 1986</i> .
Light Non-Aqueous Phase Liquid (LNAPL)	Non-aqueous substances which have an average density less than water (specific gravity of less than 1) and therefore generally float on water, e.g. petrol.
Local Community	Those individuals and/or groups residing in the locality where a contaminated site assessment and/or remediation is to be conducted and who may be affected by the activities and/or possible site contamination physically (e.g. through risks to health or the environment, loss of amenity) or non-physically (e.g. due to concern about possible contamination).

NATA	National Association of Testing Authorities.
Natural Attenuation	Reliance on natural processes, including various physical, chemical or biological processes, that, under favourable conditions, act without human intervention to reduce the mass, toxicity, mobility, volume or concentration of contaminants in soil, sediment or groundwater. These <i>in situ</i> processes include biodegradation, dispersion, dilution, sorption, volatilisation, chemical or biological stabilisation, transformation or destruction of contaminants.
NEPC	National Environment Protection Council.
NEPM	National Environment Protection Measure.
NHMRC	National Health and Medical Research Council.
PID	Photoionisation Detector.
Point Source	Localised source of contamination such as storage tanks, pumps and drums.
Practitioners	Suitably qualified professionals with experience in environmental investigations and management.
Preliminary Site Investigation (PSI)	An investigation consisting of a desktop study, a detailed site inspection and, where appropriate, limited sampling. The preliminary site investigation should be of such scope as to be sufficient to indicate whether contamination is present or likely to be present and to determine whether a detailed site investigation should be conducted. Information gathered during a PSI is used to design a DSI.
Public Drinking Water Source Area (PDWSA)	An area allocated for the collection/abstraction of water for public drinking water supply.
Receptor	The entity that may be adversely affected by contact with or exposure to a contaminant of concern.
Remediation	Action taken to eliminate, limit, correct, counteract, mitigate or remove any contaminant or the negative effects on the environment or human health of any contaminant.
Residual/Remaining Soil/Groundwater	Soil/groundwater remaining after contaminated soil/groundwater has been removed.
Response Level	Concentration of a contaminant at a specific site based on a site assessment for which some form of response is required, to provide an adequate margin of safety to protect public health and/or the environment.
Risk Assessment	Process of estimating the potential impact of a chemical, biological or physical agent on humans, plants, animals and the ecology.
Sample Pattern	The location of sampling points within a sampling area.

SAP	Sampling and Analysis Program.
Saturated Zone	The zone within an aquifer in which all the pores and rock fractures are filled with water.
Sediment	Loose particles of sand, clay, silt and other substances that settle at the bottom of a body of water. Sediment can derive from the erosion of soil or from the decomposition of plants and animals.
Separate Phase Hydrocarbons (also referred to as Phase-Separated Hydrocarbons)	Differences in the physical and chemical properties of water and Non-Aqueous Phase Liquids (NAPLs) results in a physical interface between the liquids, which prevents the liquids from mixing.
Site Stakeholder	An area of land or underground water. One who has an interest in a project or who may be affected by it.
Underground Storage Tank (UST)	A tank that: <ul style="list-style-type: none"> a) is currently, or has historically been used for the storage of environmentally hazardous substances such as, but not limited to, petroleum products, acids and alkalis; and b) is fully or partially buried.
Underground Water Pollution Control Area (UWPCA)	An area gazetted under the <i>Metropolitan Water Supply and Drainage Act 1909</i> to protect groundwater resources used for public drinking water supply. Within these areas restrictions apply to activities which may pollute the groundwater.
Validation	The process of demonstrating that a site has been remediated successfully. Involves the collection and analysis of samples to demonstrate that contaminant concentrations are below acceptable limits and do not pose a risk to human health or the environment.
Watertable	The surface of an unconfined aquifer or confining bed at which the pore water pressure is atmospheric. It can be measured by installing groundwater bores into the zone of saturation and measuring the water level in those bores.
Water Reserve	An area gazetted under the <i>Country Areas Water Supply Act 1947</i> to protect groundwater resources used for public drinking water supply. Within these areas restrictions apply to activities which may pollute the groundwater.
Well	Refer to Bore.
Wider Community	Individuals and/or groups, not necessarily residing in the locality of a contaminated site assessment/remediation, who may have an interest in the assessment/remediation.
WRC	Water and Rivers Commission.

6. REFERENCES

6.1 CITED REFERENCES

Australian and New Zealand Environment and Conservation Council (ANZECC) (1999) *Guidelines for the Assessment of On-site Containment of Contaminated Soil*.

Department of Environmental Protection (DEP) (2001) *Assessment Levels for Soil, Sediment and Water*.

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Department of Environmental Protection (DEP) (2001) *Potentially Contaminating Activities, Industries, and Landuses*.

Department of Environmental Protection (DEP) (1997) *Public Position Paper. Assessment and management of contaminated land and groundwater in Western Australia*.

Department of Environmental Protection (DEP) (2001) *Reporting of Known or Suspected Contaminated Sites*.

Department of Environmental Protection (DEP) (2001) *Site Classification Scheme*.

Environmental Protection Authority (EPA) (2000) *Guidance for the Assessment of Environmental Factors: Guidance Statement for Remediation Hierarchy for Contaminated Land No. 17*.

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

6.2 OTHER USEFUL REFERENCES

American Society for Testing and Materials (ASTM) (1993) *Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process*.

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

Australian and New Zealand Environment and Conservation Council (ANZECC) (1992) *Australian Water Quality Guidelines for Fresh and Marine Waters*.

Department of Environmental Protection (DEP) (2000) *Contaminated Site Auditor Accreditation Scheme*.

National Health and Medical Research Council (NHMRC) and Agricultural and Resource Management Council of Australia and New Zealand (ARMCANZ) (1996) *Australian Drinking Water Guidelines*.

New South Wales Environment Protection Authority (1997) *Contaminated Sites Guidelines for Consultants Reporting on Contaminated Sites*.

Queensland Department of Environment (1998) *Draft Guidelines for the Assessment & Management of Contaminated Land in Queensland*.

Standards Australia (AS/NZ) (1997) *AS/NZ 4482.1 Guide to the sampling and investigation of potentially contaminated soil. Part 1: Non-volatile and semi-volatile compounds*.

Standards Australia (AS/NZ) (1998) *AS/NZ 5667.11 Water quality – Sampling. Part 11: Guidance on sampling of groundwaters*.

Victorian Environment Protection Authority (1992) *Environmental Audit System Contaminated Land, Explanatory Notes MW 90/04*.

Victorian Environment Protection Authority (1992) *Guidelines for Environmental Auditors, Contaminated Land, Issue of Certificates of Environmental Audit MW91/14*.

Water and Rivers Commission (WRC) (1999) *Draft Guideline – The Assessment of Subsurface Contamination*.

APPENDIX A

PRELIMINARY SITE INVESTIGATION CHECKLIST OF REPORTING REQUIREMENTS

APPENDIX A. PRELIMINARY SITE INVESTIGATION

Report Sections	Information to be included, where relevant	Comments
A-1 Executive Summary	<ul style="list-style-type: none"> • Background • Objectives of the investigation • Scope of work • Summary of analytical results (where applicable) • Summary of conclusions and recommendations • Site Summary Form 	Mandatory information
A-2 Scope of Work	<ul style="list-style-type: none"> • Clear statement of the scope of work 	Mandatory information
A-3 Site Identification	<ul style="list-style-type: none"> • Street number, lot number, street name and suburb • Common title/name of site (e.g Tom Brown's Tyres) • Certificates of title (copy of document including survey plan) • Co-ordinates of site boundaries (Northings/Eastings – specify datum set) • Locality map • Current site plan showing infrastructure, scale bar, north arrow, local environmentally significant features • Local Government Authority 	Mandatory information
A-4 Site History	<ul style="list-style-type: none"> • Land owner - past and present • Zoning - previous, present and proposed • Land use - previous, present and proposed (including chronological list of site uses, indicating information gaps and unoccupied periods) • Heritage (including Aboriginal heritage pursuant to <i>Aboriginal Heritage Act 1972</i>) • Surrounding land use and zoning – historical, present and proposed • Review of aerial photographs – current and historical • Site photographs (with date, location indicated on site plan, direction photo was taken) • Inventory of chemicals, identified potential contaminants, wastes and by-products associated with site uses • Possible contamination sources and potential impacts • Description of manufacturing processes • Details and locations of past and present underground and aboveground storage tanks • Product spill and loss history • Discharges to land, water and air • Disposal locations (e.g. soakwell, landfill) • Relevant complaint history • Local knowledge of site representatives, residents, staff (both present and former) • Summary of local literature about the site, including newspaper articles • Details of relevant licences, approvals and trade waste agreements • Local usage of ground/surface waters, and location of groundwater bores • Integrity assessment (assessment of the accuracy of information) 	Include readily available information, where applicable

PRELIMINARY SITE INVESTIGATION (CONT.)

Report sections	Information to be included, where relevant	Comments
<p style="text-align: center;">A-5 Site conditions and surrounding environment</p>	<ul style="list-style-type: none"> • Topography • Condition at site boundary such as type and condition of fencing, soil stability and erosion • Visible signs of contamination, such as discolouration or staining of soil, bare soil patches - both on-site, and off-site adjacent to site boundary • Visible signs of vegetation stress • Presence of drums, wastes and fill material • Conditions of buildings and roads • Odours • Quality of surface water • The proportion of site sealed and unsealed, integrity of seal, e.g. is the concrete hardstand cracked? • Location and description of infrastructure, e.g. buildings • Preferential pathways for contaminants, e.g. underground services, drains • Flood potential • Residents in close proximity to site • Details of any relevant local sensitive environment, e.g. water courses, wetlands, local habitat areas 	<p style="text-align: center;">Include readily available information, where applicable</p>
<p style="text-align: center;">A-6 Geology and Hydrogeology</p>	<ul style="list-style-type: none"> • Soil stratigraphy using recognized geological classification method • Location and extent of imported and locally derived fill • Description of actual/potential contaminants • Detailed description of the location, design and construction of all on-site wells • Description and location of springs and wells within a 1km radius of the site • Known or expected depth to groundwater table • Presence of multi-layered aquifer (investigations may result in cross-contamination of aquifers if detailed knowledge of site conditions and contaminants are not known) • Direction and rate of groundwater flow • Permeability of strata on the site • Direction of surface water runoff • Groundwater discharge location • Ambient groundwater quality • Groundwater/surface water interaction • Groundwater conditions (e.g unconfined, confined, ephemeral and perched) • Beneficial use of groundwater in the vicinity such as public drinking water supply and source areas, domestic irrigation, aquatic ecosystems, and the potential impacts on these uses • Location of sensitive receptors/users • Preferential migratory pathways 	<p style="text-align: center;">This is generally a desktop assessment - include readily available information, where applicable.</p>
<p style="text-align: center;">A-7 Sampling and analysis plan and sampling methodology</p>	<ul style="list-style-type: none"> • Refer to the <i>Development of Sampling and Analysis Programs (DEP, 2001)</i> guideline. 	<p style="text-align: center;">Mandatory information, where sampling was undertaken</p>

PRELIMINARY SITE INVESTIGATION (CONT.)

Report sections	Information to be included, where relevant	Comments
<p style="text-align: center;">A-8 Field quality assurance and quality control (QA/QC)</p>	<ul style="list-style-type: none"> • Decontamination procedures carried out between sampling events • Logs for each sample collected including time, location, initials of sampler, duplicate type, chemical analyses to be performed, site observations • Chain of custody identifying (for each sample), the sampler, nature of the sample, collection date and time, analyses to be performed, sample preservation method, departure time from the site • Statement of duplicate frequency • Field blank results • Background sample results • Rinsate sample results • Field instrument calibrations (where applicable) 	<p style="text-align: center;">Mandatory information, where sampling was undertaken</p> <p>Where an organisation has developed a protocol document which has been ratified by the DEP, the organisation need only reference it in the report, or highlight where deviations from the standard procedures have occurred.</p>
<p style="text-align: center;">A-9 Laboratory QA/QC</p>	<ul style="list-style-type: none"> • A copy of signed chain-of-custody forms acknowledging receipt date and time, identity of samples included in shipments • Record of holding times and a comparison with methods specification • Analytical methods used • Laboratory accreditation for analytical methods used • Sample splitting techniques • Description of surrogates and spikes used • Per cent recoveries of spikes and surrogates • Instrument and method detection limits • Matrix or practical quantification limits • Standard solution results • Reference sample results/ Reference check sample results • Laboratory duplicate and blanks results 	<p style="text-align: center;">Mandatory information, where sampling was undertaken.</p>
<p style="text-align: center;">A-10 QA/QC data evaluation</p>	<ul style="list-style-type: none"> • Evaluation of all QA/QC information listed above against the stated data quality objectives (DQO), including discussion of: documentation completeness, data completeness, data comparability, data representativeness, precision and accuracy of both sampling and analysis for each analyte in each environmental matrix informing data users of the reliability, unreliability or qualitative value of the data • Data comparability checks, which should include collection and analysis of samples by different personnel, use of different methodologies, collection and analysis by the same personnel using the same methods but at different times, spatial and temporal changes (because of the environmental dynamics) • Relative per cent differences for intra- and inter-laboratory duplicates 	<p style="text-align: center;">Mandatory information, where sampling was undertaken</p>
<p style="text-align: center;">A-11 Basis for adoption of assessment levels</p>	<ul style="list-style-type: none"> • Table listing all selected assessment levels and references • Rationale for and appropriateness of the selection of assessment levels • Assumptions and limitations of assessment levels • Adjustment of assessment levels for composite sampling 	<p style="text-align: center;">Mandatory information</p>

PRELIMINARY SITE INVESTIGATION (CONT.)

Report sections	Information to be included, where relevant	Comments
<p style="text-align: center;">A-12 Results</p>	<ul style="list-style-type: none"> • Summary of previous results, if appropriate • Summary of all results (in a table that shows essential details such as numbers and sampling depths, assessment levels, highlights all results exceeding the levels) • Site plan showing all sample locations, sample identification numbers and sampling depths • Site plan showing the extent of soil and groundwater contamination exceeding selected assessment levels for each sampling depth 	<p style="text-align: center;">Mandatory information, where sampling was undertaken</p>
<p style="text-align: center;">A-13 Site characteristics</p>	<ul style="list-style-type: none"> • Assessment of type of all environmental contamination e.g. soil, soil gas and groundwater • Assessment of extent of soil and groundwater contamination, including off-site effects • Assessment of the chemical degradation • Assessment of possible exposure routes and exposed populations (human and ecological) • Assessment of receiving environment's sensitivity 	<p style="text-align: center;">Include readily available information, where applicable</p>
<p style="text-align: center;">A-14 Community Consultation</p>	<ul style="list-style-type: none"> • Details of stakeholders (individuals and groups) consulted • Summary of information provided to stakeholders (e.g. minutes of meetings, informative flyers) • Input and comments received from stakeholders • Details of how stakeholder input was considered in decision-making • Refer to <i>Community Consultation</i> (DEP, 2001) guideline 	<p style="text-align: center;">Include information where community consultation was undertaken.</p>
<p style="text-align: center;">A-15 Conclusions and recommendations</p>	<ul style="list-style-type: none"> • Brief summary of all findings • Assumptions used in reaching the conclusions • Extent of uncertainties in the results • A clear statement that the consultant considers the subject site to be suitable for the proposed use (where applicable) • Recommendations of further sampling and/or remedial measures considered by the consultant to deem the site suitable for the proposed use (where applicable) • A statement detailing all limitations and constraints on the use of the site (where applicable) 	<p style="text-align: center;">Mandatory information</p>
<p style="text-align: center;">A-16 HESP</p>	<ul style="list-style-type: none"> • Confirm that Health, Safety & Environmental Plan (HSEP) has been completed and submitted to WorkSafe WA 	<p style="text-align: center;">A copy of the HSEP is not required by the DEP.</p>

APPENDIX B

DETAILED SITE INVESTIGATION CHECKLIST OF REPORTING REQUIREMENTS

APPENDIX B. DETAILED SITE INVESTIGATION

Report sections	Information to be included, where relevant	Comments
B-1 Executive Summary	<ul style="list-style-type: none"> • Background • Objectives of the investigation • Scope of work • Summary of analytical results (where applicable) • Summary of conclusions and recommendations • Site Summary Form 	Mandatory information
B-2 Scope of Work	<ul style="list-style-type: none"> • Clear statement of the scope of work 	Mandatory information
B-3 Site Identification	<ul style="list-style-type: none"> • Street number, lot number, street name and suburb • Common title/name of site (e.g Tom Brown's Tyres) • Certificate of title (copy of document including survey plan) • Co-ordinates of site boundaries (Northings/Eastings – specify datum set) • Locality map • Current site plan showing infrastructure, scale bar, north arrow, local environmentally significant features • Local Government Authority 	The Summary Site Form is adequate if detailed information was provided to the DEP in a referenced previous report.
B-4 Site History	<ul style="list-style-type: none"> • Land owner - past and present • Zoning - previous, present and proposed • Land use - previous, present and proposed (including chronological list of site uses, indicating information gaps and unoccupied periods) • Heritage (including Aboriginal heritage pursuant to <i>Aboriginal Heritage Act 1972</i>) • Surrounding land use and zoning – historical, present and proposed • Review of aerial photographs – current and historical • Site photographs (with date, location indicated on site plan, direction photo was taken) • Inventory of chemicals, wastes and by-products associated with site uses • Possible contamination sources and potential impacts • Description of manufacturing processes • Details and locations of current and former underground and aboveground storage tanks • Product spill and loss history • Discharges to land, water and air • Disposal locations (e.g. soakwell, landfill) • Relevant complaint history • Local knowledge of residents, staff (both present and former) • Summary of local literature about the site, including newspaper articles • Details of relevant licences, approvals and trade waste agreements • Historical land use of adjacent land • Local usage of ground/surface waters, and location of groundwater bores • Integrity assessment (assessment of the accuracy of information) 	A brief summary of the site history is adequate if detailed information was provided to the DEP in a referenced previous report.

DETAILED SITE INVESTIGATION (CONT.)

Report Sections	Information to be included, where relevant	Comments
<p style="text-align: center;">B-5 Site conditions and surrounding environment</p>	<ul style="list-style-type: none"> • Topography • Condition at site boundary such as type and condition of fencing, soil stability and erosion • Visible signs of contamination, such as discolouration or staining of soil, bare soil patches - both on-site, and off-site adjacent to site boundary • Visible signs of vegetation stress • Presence of drums, wastes and fill material • Conditions of buildings and roads • Odours • Quality of surface water • The proportion of site sealed and unsealed, integrity of seal, e.g. is the concrete hardstand cracked • Preferential pathways for contaminants, e.g. underground services, drains • Flood potential • Residents in close proximity to site • Details of any relevant local sensitive environment, e.g. water courses, wetlands, local habitat areas 	<p style="text-align: center;">A brief summary of the site conditions is adequate if detailed information was provided to the DEP in a referenced previous report.</p>
<p style="text-align: center;">B-6 Geology and Hydrogeology</p>	<ul style="list-style-type: none"> • Soil stratigraphy using recognized geological classification method • Location and extent of imported and locally derived fill • Description of soil contamination, actual/potential contaminants (solubility, density, stability, persistence and partitioning characteristics) • Site borehole logs or test pit logs showing stratigraphy • Detailed description of the location, design and construction of on-site wells • Description and location of springs and wells within a 1km radius of the site • Known or expected depth to groundwater table • Presence of multi-layered aquifer (investigations may result in cross-contamination of aquifers if detailed knowledge of site conditions and contaminants are not known) • Direction and rate of groundwater flow • Permeability of strata on the site • Direction of surface water runoff • Groundwater discharge location • Ambient groundwater quality • Groundwater/surface water interaction • Groundwater conditions (e.g unconfined, confined, ephemeral and perched) • Beneficial use of groundwater in the vicinity such as public drinking water supply and source areas, domestic irrigation, aquatic ecosystems, and the potential impacts on these uses • Location of sensitive receptors/users • Preferential migratory pathways 	<p style="text-align: center;">A brief summary of the geology & hydrogeology is adequate if detailed information was provided to the DEP in a referenced previous report.</p>
<p style="text-align: center;">B-7 Sampling and analysis plan and sampling methodology</p>	<ul style="list-style-type: none"> • Refer to the <i>Development of Sampling and Analysis Programs (DEP, 2001)</i> guideline. 	<p style="text-align: center;">Mandatory information, where sampling was undertaken</p>

DETAILED SITE INVESTIGATION (CONT.)

Report Sections	Information to be included, where relevant	Comments
B-8 Field quality assurance quality control (QA/QC)	<ul style="list-style-type: none"> • Decontamination procedures carried out between sampling events • Logs for each sample collected including time, location, initials of sampler, duplicate type, chemical analyses to be performed, site observations • Chain of custody identifying (for each sample), the sampler, nature of the sample, collection date and time, analyses to be performed, sample preservation method, departure time from the site • Statement of duplicate frequency • Field blank results • Background sample results • Rinsate sample results • Field instrument calibrations (when applicable) 	Where an organisation has developed a protocol document which has been ratified by the DEP, the organisation need only reference it in the report, or highlight where deviations from the standard procedures have occurred.
B-9 Laboratory quality assurance quality control (QA/QC)	<ul style="list-style-type: none"> • A copy of signed chain-of-custody forms acknowledging receipt date and time, identity of samples included in shipments • Record of holding times and a comparison with methods specification • Analytical methods used • Laboratory accreditation for analytical methods used • Sample splitting techniques • Description of surrogates and spikes used • Per cent recoveries of spikes and surrogates • Instrument and method detection limits • Matrix or practical quantification limits • Standard solution results • Reference sample results/ Reference check sample results • Laboratory duplicate and blanks results 	Mandatory information
B-10 QA/QC data evaluation	<ul style="list-style-type: none"> • Evaluation of all QA/QC information listed above against the stated data quality objectives (DQO), including discussion of: documentation completeness, data completeness, data comparability, data representativeness, precision and accuracy of both sampling and analysis for each analyte in each environmental matrix informing data users of the reliability, unreliability or qualitative value of the data • Data comparability checks, which should include collection and analysis of samples by different personnel, use of different methodologies, collection and analysis by the same personnel using the same methods but at different times, spatial and temporal changes (because of the environmental dynamics) 	Mandatory information
B-11 Basis for adoption of assessment levels	<ul style="list-style-type: none"> • Table listing all selected assessment levels and references • Rationale for and appropriateness of the selection of assessment levels • Assumptions and limitations of assessment levels • Adjustment of assessment levels for composite sampling 	Mandatory information
B-12 Results	<ul style="list-style-type: none"> • Summary of previous results, if appropriate • Summary of all results (in a table that shows essential details such as numbers and sampling depths, assessment levels, highlights all results exceeding the levels) • Site plan showing all sample locations, sample identification numbers and sampling depths • Site plan showing the extent of soil and groundwater contamination exceeding selected assessment levels for each sampling depth 	Mandatory information

DETAILED SITE INVESTIGATION (CONT.)

Report sections	Information to be included, where relevant	Comments
B-13 Site characteristics	<ul style="list-style-type: none"> • Assessment of type of all environmental contamination e.g. soil, soil gas and groundwater • Assessment of extent of soil and groundwater contamination, including off-site effects • Assessment of the chemical degradation • Assessment of possible exposure routes and exposed populations (human and ecological) • Assessment of receiving environment's sensitivity 	Include information, where applicable
B-14 Health risk assessment	<ul style="list-style-type: none"> • Data collection and evaluation of the chemical condition of the site • Toxicity assessment of contaminants, involving the nature of adverse effects related to the exposure • Exposure assessment of contaminants, involving the estimation of frequency, extent and duration of exposures in the past, present and in the future • Identification of exposure populations • Discussion of assumptions • Risk management decisions based on outcome of the assessment • Refer to Schedule B(4) <i>Guideline on Health Risk Assessment Methodology of the NEPM (NEPC, 1999)</i> and the Health Department (WA) where a detailed health risk assessment is to be undertaken 	May warrant an individual report if detailed health risk assessment is required
B-15 Ecological risk assessment	<ul style="list-style-type: none"> • Problem identification, site history, extent and degree of contamination versus most relevant generic assessment levels • Receptor identification, identifying the ecological values requiring protection e.g. what species are at risk? • Exposure assessment • Toxicity assessment, toxicity effects of contaminants and sensitivity of receptors, potential impact to the identified ecological value • Discussion of assumptions • Risk management decisions based on outcome of the assessment • Refer to Schedule B(5) <i>Guideline on Ecological Risk Assessment of the NEPM (NEPC, 1999)</i> when undertaking a detailed ecological risk assessment 	May warrant an individual report if detailed ecological risk assessment is required
B-16 Community Consultation	<ul style="list-style-type: none"> • Details of stakeholders (individuals and groups) consulted • Summary of information provided to stakeholders (e.g. minutes of meetings, informative flyers) • Input and comments received from stakeholders • Details of how stakeholder input was considered in decision-making • Brief description of community consultation undertaken during previous stages of site investigation, if details have already been submitted to DEP in previous report(s) • Refer to <i>Community Consultation (DEP, 2001) guideline</i> 	Include information where community consultation was undertaken
B-17 Conclusions and recommendations	<ul style="list-style-type: none"> • Brief summary of all findings confirming sources of contamination • Assumptions used in reaching the conclusions • Extent of uncertainties in the results • A clear statement that the consultant considers the subject site to be suitable for the proposed use (where applicable) • Recommendations of further sampling and/or remedial measures considered by the consultant to deem the site suitable for the proposed use (where applicable) • A statement detailing all limitations and constraints on the use of the site (where applicable) 	Mandatory information

DETAILED SITE INVESTIGATION (CONT.)

Report sections	Information to be included, where relevant	Comments
B-18 HSEP	<ul style="list-style-type: none">Confirm that Health, Safety & Environmental Plan (HSEP) has been completed and submitted to WorkSafe WA	A copy of the HSEP is not required by the DEP.

APPENDIX C

SITE MANAGEMENT PLAN CHECKLIST OF REPORTING REQUIREMENTS

APPENDIX C. SITE MANAGEMENT PLAN

Report sections	Information to be included, where relevant	Comments
C-1 Executive Summary	<ul style="list-style-type: none"> • Background • Objectives of the site management plan • Scope of work • Summary of previous investigations (where applicable) • Summary of conclusions and recommendations • Site Summary Form 	Mandatory information
C-2 Scope of Work	<ul style="list-style-type: none"> • Clear statement of the scope of work 	Mandatory information
C-3 Site Identification	<ul style="list-style-type: none"> • Street number, lot number, street name and suburb • Common title/name of site (e.g Tom Brown's Tyres) • Certificates of title (copy of document including survey plan) • Co-ordinates of site boundaries (Northings/Eastings – specify datum set) • Locality map • Current site plan showing infrastructure, scale bar, north arrow, local environmentally significant features • Local Government Authority 	The Summary Site Form (Appendix E) is adequate if detailed information was provided to the DEP in a referenced previous report.
C-4 Site History	<ul style="list-style-type: none"> • Land owner - past and present • Zoning - previous, present and proposed (including chronological list of site uses, indicating information gaps and unoccupied periods) • Land use - previous, present and proposed • Heritage (including Aboriginal heritage pursuant to <i>Aboriginal Heritage Act 1972</i>) • Surrounding land use and zoning – historical, present and proposed • Review of aerial photographs – current and historical • Site photographs (with date, location indicated on site plan, direction photo was taken) • Inventory of chemicals, wastes and by-products associated with site uses • Possible contamination sources and potential impacts • Description of manufacturing processes • Details and locations of current and former underground and aboveground storage tanks • Product spill and loss history • Discharges to land, water and air • Disposal locations (e.g. soakwell, landfill) • Relevant complaint history • Local knowledge of residents, staff (both present and former) • Summary of local literature about the site, including newspaper articles • Details of relevant licences, approvals and trade waste agreements • Historical land use of adjacent land • Local usage of ground/surface waters, and location of groundwater bores 	A brief summary of the site history is adequate if detailed information was provided to the DEP in a referenced previous report.

SITE MANAGEMENT PLAN (CONT.)

Report sections	Information to be included, where relevant	Comments
<p style="text-align: center;">C-5 Site conditions and surrounding environment</p>	<ul style="list-style-type: none"> • Topography • Condition at site boundary such as type and condition of fencing, soil stability and erosion • Visible signs of contamination, such as discolouration or staining of soil, bare soil patches - both on-site, and off-site adjacent to site boundary • Visible signs of vegetation stress • Presence of drums, wastes and fill material • Conditions of buildings and roads • Odours • Quality of surface water • The proportion of site sealed and unsealed, integrity of seal, e.g. is the concrete hardstand cracked • Preferential pathways for contaminants, e.g. underground services, drains • Flood potential • Residents in close proximity to site • Details of any relevant local sensitive environment, e.g. water courses, wetlands, local habitat areas 	<p>A brief summary of the site conditions is adequate if detailed information was provided to the DEP in a referenced previous report.</p>
<p style="text-align: center;">C-6 Geology and Hydrogeology</p>	<ul style="list-style-type: none"> • Soil stratigraphy using recognised geological classification method • Location and extent of imported and locally derived fill • Description of soil contamination, actual/potential contaminants (solubility, density, stability, persistence and partitioning characteristics) • Site borehole logs or test pit logs showing stratigraphy • Detailed description of the location, design and construction of on-site wells • Description and location of springs and wells within a 1km radius of the site • Known or expected depth to groundwater table • Presence of multi-layered aquifer (investigations may result in cross-contamination of aquifers if detailed knowledge of site conditions and contaminants are not known) • Direction and rate of groundwater flow • Permeability of strata on the site • Direction of surface water runoff • Groundwater discharge location • Ambient groundwater chemistry • Groundwater/surface water interaction • Groundwater conditions (e.g unconfined, confined, ephemeral and perched) • Beneficial use of groundwater in the vicinity such as public drinking water supply and source areas, domestic irrigation, aquatic ecosystems, and the potential impacts on these uses • Location of sensitive receptors/users • Preferential migratory pathways 	<p>A brief summary of the geology & hydrogeology is adequate if detailed information was provided to the DEP in a referenced previous report.</p>
<p style="text-align: center;">C-7 Basis for adoption of assessment levels</p>	<ul style="list-style-type: none"> • Table listing all selected assessment levels and references • Rationale for and appropriateness of the selection of assessment levels • Assumptions and limitations of assessment levels • Adjustment of assessment criteria for composite sampling 	<p>Mandatory information</p>

SITE MANAGEMENT PLAN (CONT.)

Report sections	Information to be included, where relevant	Comments
<p style="text-align: center;">C-8 Results</p>	<ul style="list-style-type: none"> • Summary of previous results, if appropriate • Summary of all results (in a table that shows essential details such as numbers and sampling depths, assessment levels, highlights all results exceeding the levels) • Site plan showing all sample locations, sample identification numbers and sampling depths • Site plan showing the extent of soil and groundwater contamination exceeding selected assessment levels for each sampling depth 	<p style="text-align: center;">Mandatory information</p>
<p style="text-align: center;">C-9 Site characteristics</p>	<ul style="list-style-type: none"> • Assessment of type of all environmental contamination e.g. soil, soil gas and groundwater • Assessment of extent of soil and groundwater contamination, including off-site effects • Assessment of the chemical degradation • Assessment of possible exposure routes and exposed populations (human and ecological) • Assessment of receiving environment's sensitivity 	<p style="text-align: center;">Include information, where applicable</p>
<p style="text-align: center;">C-10 Health risk assessment</p>	<ul style="list-style-type: none"> • Data collection and evaluation of the chemical condition of the site • Toxicity assessment of contaminants, involving the nature of adverse effects related to the exposure • Exposure assessment of contaminants, involving the estimation of frequency, extent and duration of exposures in the past, present and in the future • Identification of exposure populations • Discussion of assumptions • Risk management decisions based on outcome of the assessment • Refer to Schedule B(4) <i>Guideline on Health Risk Assessment Methodology of the NEPM (NEPC, 1999)</i> and the Health Department (WA) where a detailed health risk assessment is to be undertaken 	<p style="text-align: center;">A brief summary of the health risk assessment is adequate if detailed information was provided to the DEP in a referenced previous report</p>
<p style="text-align: center;">C-11 Ecological risk assessment</p>	<ul style="list-style-type: none"> • Problem identification, site history, extent and degree of contamination versus most relevant generic assessment levels • Receptor identification, identifying the ecological values requiring protection e.g. what species are at risk? • Exposure assessment • Toxicity assessment, toxicity effects of contaminants and sensitivity of receptors, potential impact to the identified ecological value • Discussion of assumptions • Risk management decisions based on outcome of the assessment • Refer to Schedule B(5) <i>Guideline on Ecological Risk Assessment of the NEPM (NEPC, 1999)</i> when undertaking a detailed ecological risk assessment 	<p style="text-align: center;">A brief summary of the ecological risk assessment is adequate if detailed information was provided to the DEP in a referenced previous report.</p>
<p style="text-align: center;">C-12 Evaluation of remedial options</p>	<ul style="list-style-type: none"> • Identify management/remedial goals • Discussion of extent of remediation required • Discussion of possible remedial options and how risk can be reduced • Rationale for the selection of recommended remedial option 	<p style="text-align: center;">Mandatory information</p>

SITE MANAGEMENT PLAN (CONT.)

Report sections	Information to be included, where relevant	Comments
<p style="text-align: center;">C-13 Community consultation</p>	<ul style="list-style-type: none"> • Details of stakeholders (individuals and groups) consulted • Summary of information provided to stakeholders (e.g. minutes of meetings, informative flyers) • Input and comments received from stakeholders • Details of how stakeholder input was considered in decision-making • Brief description of community consultation undertaken during previous stages of site investigation, if details have already been submitted to DEP in previous report(s) • Refer to <i>Community Consultation</i> (DEP, 2001) guideline 	<p style="text-align: center;">Include information where community consultation was undertaken</p>
<p style="text-align: center;">C-14 Development of Site Management Plan</p>	<ul style="list-style-type: none"> • Proposed testing to validate the site after remediation • Contingency plan if the selected remedial strategy fails • Interim site management (before remediation), including fencing, erection of warning signs, stormwater diversion • Site management plan (operational phase), including stormwater management, soil management, noise control, dust control (wheel wash where necessary), odour control, management of air emissions, occupational health and safety • Remediation schedule • Hours of operation • Contingency plans to respond to site incidents, to obviate potential effects on surrounding environment and community • Identification of regulatory compliance requirements such as licences and approvals (local and state level) • Proximity to exposure receptors/populations • Contingency plan for receptors if management plan fails • Names and phone numbers of appropriate personnel to contact during remediation • Community relations plans (where applicable) • Staged progress reporting (where applicable) • Long term site management plan • Equipment to be used • Personnel required on site • Location/source of any clean fill material to be used 	<p style="text-align: center;">Include information, where applicable</p>
<p style="text-align: center;">C-15 Conclusions and recommendations</p>	<ul style="list-style-type: none"> • Brief summary of all findings • Assumptions used in reaching the conclusions • Extent of uncertainties in the results • A clear statement that the consultant considers the subject site to be suitable for the proposed use (where applicable) • Recommendations of remedial measures considered by the consultant to make the site suitable for the proposed use (where applicable) • A statement detailing all limitations and constraints on the use of the site (where applicable) • Recommendations for further work, if applicable 	<p style="text-align: center;">Mandatory information</p>

APPENDIX D

REMEDICATION, VALIDATION AND ONGOING MANAGEMENT CHECKLIST OF REPORTING REQUIREMENTS

APPENDIX D. REMEDIATION, VALIDATION AND ONGOING MANAGEMENT

Report sections	Information to be included, where relevant	Comments
D-1 Executive Summary	<ul style="list-style-type: none"> • Background • Objectives of the remediation, validation/management • Scope of work • Summary of analytical results (where applicable) • Summary of conclusions and recommendations • Site Summary Form 	Mandatory information
D-2 Scope of Work	<ul style="list-style-type: none"> • Clear statement of the scope of work 	Mandatory information
D-3 Site Identification	<ul style="list-style-type: none"> • Street number, lot number, street name and suburb • Common title/name of site (e.g Tom Brown's Tyres) • Certificates of title (copy of document including survey plan) • Co-ordinates of site boundaries (Northings/Eastings – specify datum set) • Locality map • Current site plan showing infrastructure, scale bar, north arrow, local environmentally significant features • Local Government Authority 	The Summary Site Form (Appendix E) is adequate if detailed information was provided to the DEP in a referenced previous report.
D-4 Site History	<ul style="list-style-type: none"> • Land owner - past and present • Zoning - previous, present and proposed • Land use - previous, present and proposed (including chronological list of site uses, indicating information gaps and unoccupied periods) • Heritage (including Aboriginal heritage pursuant to <i>Aboriginal Heritage Act 1972</i>) • Surrounding land use and zoning – historical, present and proposed • review of aerial photographs – current and historical • Site photographs (with date, location indicated on site plan, direction photo was taken) • Inventory of chemicals, wastes and by-products associated with site uses • Possible contamination sources and potential impacts • Description of manufacturing processes • Details and locations of current and former underground and aboveground storage tanks • Product spill and loss history • Discharges to land, water and air • Disposal locations (e.g. soakwell, landfill) • Relevant complaint history • Local knowledge of residents, staff (both present and former) • Summary of local literature about the site, including newspaper articles • Details of relevant licences, approvals and trade waste agreements • Historical land use of adjacent land • Local usage of ground/surface waters, and location of groundwater bores 	A brief summary of the site history is adequate if detailed information was provided to the DEP in a referenced previous report.

REMEDIATION, VALIDATION AND ONGOING MANAGEMENT (CONT.)

Report Sections	Information to be included	Comments
D-5 Site conditions and surrounding environment	<ul style="list-style-type: none"> • Topography • Condition at site boundary such as type and condition of fencing, soil stability and erosion • Visible signs of contamination, such as discolouration or staining of soil, bare soil patches - both on-site, and off-site adjacent to site boundary • Visible signs of vegetation stress • Presence of drums, wastes and fill material • Conditions of buildings and roads • Odours • Quality of surface water • The proportion of site sealed and unsealed, integrity of seal, e.g. is the concrete hardstand cracked • Preferential pathways for contaminants, e.g. underground services, drains • Flood potential • Residents in close proximity to site • Details of any relevant local sensitive environment, e.g. water courses, wetlands, local habitat areas 	<p>A brief summary of the site conditions is adequate if detailed information was provided to the DEP in a referenced previous report.</p>
D-6 Geology and Hydrogeology	<ul style="list-style-type: none"> • Soil stratigraphy using recognised geological classification method • Location and extent of imported and locally derived fill • Description of soil contamination, actual/potential contaminants (solubility, density, stability, persistence and partitioning characteristics) • Site borehole logs or test pit logs showing stratigraphy • Detailed description of the location, design and construction of on-site wells • Description and location of springs and wells within a 1km radius of the site • Known or expected depth to groundwater table • Presence of multi-layered aquifer (investigations may result in cross-contamination of aquifers if detailed knowledge of site conditions and contaminants are not known) • Direction and rate of groundwater flow • Permeability of strata on the site • Direction of surface water runoff • Groundwater discharge location • Ambient groundwater chemistry • Groundwater/surface water interaction • Groundwater conditions (e.g unconfined, confined, ephemeral and perched) • Beneficial use of groundwater in the vicinity such as public drinking water supply and source areas, domestic irrigation, aquatic ecosystems, and the potential impacts on these uses • Location of sensitive receptors/users • Preferential migratory pathways 	<p>A brief summary of the geology & hydrogeology is adequate if detailed information was provided to the DEP in a referenced previous report.</p>
D-7 Sampling and analysis plan and sampling methodology	<ul style="list-style-type: none"> • Refer to the <i>Development of Sampling and Analysis Programs</i> (DEP, 2001) guidelines. 	<p>Mandatory information, where sampling was undertaken</p>

REMEDIATION, VALIDATION AND ONGOING MANAGEMENT (CONT.)

Report Sections	Information to be included	Comments
D-8 Field quality assurance quality control (QA/QC)	<ul style="list-style-type: none"> • Decontamination procedures carried out between sampling events • Logs for each sample collected including time, location, initials of sampler, duplicate type, chemical analyses to be performed, site observations • Chain of custody identifying (for each sample), the sampler, nature of the sample, collection date, analyses to be performed, sample preservation method, departure time from the site • Statement of duplicate frequency • Field blank results • Background sample results • Rinsate sample results • Field instrument calibrations (when applicable) 	Mandatory information
D-9 Laboratory quality assurance quality control (QA/QC)	<ul style="list-style-type: none"> • A copy of signed chain-of-custody forms acknowledging receipt date and time, identity of samples included in shipments • Record of holding times and a comparison with methods specification • Analytical methods used • Laboratory accreditation for analytical methods used • Sample splitting technique • Description of surrogates and spikes used • Per cent recoveries of spikes and surrogates • Instrument and method detection limits • Matrix or practical quantification limits • Standard solution results • Reference sample results/ Reference check sample results • Laboratory duplicate and blanks results 	Mandatory information
D-10 QA/QC data evaluation	<ul style="list-style-type: none"> • Evaluation of all QA/QC information listed above against the stated data quality objectives (DQO), including discussion of: documentation completeness, data completeness, data comparability, data representativeness, precision and accuracy of both sampling and analysis for each analyte in each environmental matrix informing data users of the reliability, unreliability or qualitative value of the data • Data comparability checks, which should include collection and analysis of samples by different personnel, use of different methodologies, collection and analysis by the same personnel using the same methods but at different times, spatial and temporal changes (because of the environmental dynamics) 	Mandatory information
D-11 Basis for adoption of assessment levels	<ul style="list-style-type: none"> • Table listing all selected assessment levels and references • Rationale for and appropriateness of the selection of assessment levels • Assumptions and limitations of assessment levels • Adjustment of assessment levels for composite sampling 	Mandatory information
D-12 Results	<ul style="list-style-type: none"> • Summary of previous results, if appropriate • Summary of all results (in a table that shows essential details such as numbers and sampling depths, assessment levels, highlights all results exceeding the levels) • Site plan showing all sample locations, sample identification numbers and sampling depths • Site plan showing the extent of soil and groundwater contamination exceeding selected assessment levels for each sampling depth 	Mandatory information

REMEDIATION, VALIDATION AND ONGOING MANAGEMENT (CONT.)

Report Sections	Information to be included	Comments
D-13 Site characteristics	<ul style="list-style-type: none"> • Assessment of type of all environmental contamination, soil, soil gas and groundwater • Assessment of extent of soil and groundwater contamination, including off-site effects • Assessment of the chemical degradation • Assessment of possible exposure routes and exposed populations (human and ecological) • Assessment of receiving environment's sensitivity 	Include information, where applicable
D-14 Health risk assessment	<ul style="list-style-type: none"> • Data collection and evaluation of the chemical condition of the site • Toxicity assessment of contaminants, involving the nature of adverse effects related to the exposure • Exposure assessment of contaminants, involving the estimation of frequency, extent and duration of exposures in the past, present and in the future • Identification of exposure populations • Discussion of assumptions • Risk management decisions based on outcome of the assessment • Refer to Schedule B(4) <i>Guideline on Health Risk Assessment Methodology of the NEPM (NEPC, 1999)</i> and the Health Department (WA) where a detailed health risk assessment is to be undertaken 	A brief summary of the health risk assessment is adequate if detailed information was provided to the DEP in a referenced previous report.
D-15 Ecological risk assessment	<ul style="list-style-type: none"> • Problem identification, site history, extent and degree of contamination versus most relevant generic assessment levels • Receptor identification, identifying the ecological values requiring protection e.g. what species are at risk? • Exposure assessment • Toxicity assessment, toxicity effects of contaminants and sensitivity of receptors, potential impact to the identified ecological value • Discussion of assumptions • Risk management decisions based on outcome of the assessment • Refer to Schedule B(5) <i>Guideline on Ecological Risk Assessment of the NEPM (NEPC, 1999)</i> for detailed ecological risk assessment 	A brief summary of the health risk assessment is adequate if detailed information was provided to the DEP in a referenced previous report.
D-16 Evaluation of remedial options	<ul style="list-style-type: none"> • Identify management/remedial goals • Discussion of extent of remediation required • Discussion of possible remedial options and how risk can be reduced • Rationale for the selection of recommended remedial option 	A brief summary of evaluation process is adequate if detailed information was provided to the DEP in a referenced previous report.
D-17 Community consultation	<ul style="list-style-type: none"> • Details of stakeholders (individuals and groups) consulted • Summary of information provided to stakeholders (e.g. minutes of meetings, informative flyers) • Input and comments received from stakeholders • Details of how stakeholder input was considered in decision-making • Brief description of community consultation undertaken during previous stages of site investigation, if details have already been submitted to DEP in previous report(s) • Refer to <i>Community Consultation</i> (DEP, 2001) guideline 	Include information where community consultation was undertaken

REMEDIATION, VALIDATION AND ONGOING MANAGEMENT (CONT.)

Report Sections	Information to be included, where relevant	Comments
<p style="text-align: center;">D-18 Site management plan</p>	<ul style="list-style-type: none"> • Detail site decommissioning and infrastructure removal • Proposed testing to validate the site after remediation • Contingency plan if the selected remedial strategy fails • Interim site management (before remediation), including fencing, erection of warning signs, stormwater diversion • Site management plan (operational phase), including stormwater management, soil management, noise control, dust control (wheel wash where necessary), odour control, management of air emissions, occupational health and safety • Remediation schedule • Hours of operation • Contingency plans to respond to site incidents, to obviate potential effects on surrounding environment and community • Identification of regulatory compliance requirements such as licences and approvals (local and state level) • Proximity to exposure receptors/populations • Contingency plan for receptors if management plan fails • Names and phone numbers of appropriate personnel to contact during remediation • Community relations plan (where applicable) • Staged progress reporting (where applicable) • Long term site management plan • Equipment to be used • Personnel required on site • Location/source of any clean fill material to be used 	<p style="text-align: center;">A brief summary of the site management plan is adequate if detailed information was provided to the DEP in a referenced previous report.</p>
<p style="text-align: center;">D-19 Remediation Validation</p>	<ul style="list-style-type: none"> • Rationale and justification for the validation strategy including clean-up levels and statistically based decision-making methodology, validation sampling and analysis plan • Details of a statistical analysis of validation results and evaluation against the clean-up levels • Verification of compliance with regulatory requirements set by the DEP and other regulatory agencies (local and state) 	<p style="text-align: center;">Mandatory information</p>
<p style="text-align: center;">D-20 Ongoing Monitoring</p>	<ul style="list-style-type: none"> • Ongoing site monitoring requirements (soil, groundwater, surface water, air emissions), including monitoring parameters and frequency • Results of monitoring analyses including relevant QA/QC reporting requirement stated above • Details of party(s) responsible for maintenance and monitoring program • Details of reporting frequency • Details of what should be reported and to whom 	<p style="text-align: center;">Mandatory information</p>
<p style="text-align: center;">D-21 Conclusions and recommendations</p>	<ul style="list-style-type: none"> • Brief summary of all findings • Assumptions used in reaching the conclusions • Extent of uncertainties in the results • A clear statement that the consultant considers the subject site to be suitable for the proposed use (where applicable) • Recommendations of further sampling and/or remedial measures considered by the consultant to make the site suitable for the proposed use (where applicable) • A statement detailing all limitations and constraints on the use of the site (where applicable) 	<p style="text-align: center;">Mandatory information</p>
<p style="text-align: center;">D-22 HSEP</p>	<ul style="list-style-type: none"> • Confirm that Health, Safety & Environmental Plan (HSEP) has been completed and submitted to WorkSafe WA 	<p style="text-align: center;">A copy of the HSEP is not required by the DEP.</p>

APPENDIX E. SITE SUMMARY FORM

Department of Environmental Protection
Site Summary Form



Department of
Environmental Protection

(For completion by person(s) submitting report(s) for assessment by DEP as per the requirements of the *Guideline for Reporting on Site Assessments (2001)*. **Please note that the certificate of title and site coordinates fields are mandatory fields.**

DEP File Number (if known)

Site Name

Lot No. **House No.** **Street**

Suburb **State** **Postcode**

Site boundary co-ordinates Northings Eastings

Circle relevant Datum Set:

Certificate of Title Volume: Folio:

List multiple certificates of titles, where applicable:

List all certificates of titles affected by site contamination:

Is hard copy of Certificate of Title attached? (Y or N)

Local Government Authority

Owner/Occupier Details:

Site Owner (Name & address)

Site Owner Company ACN/ABN

Site Occupier (Name & address)

Site Occupier Company ACN/ABN

Site Contact Name & relationship to site
(e.g owner, consultant for owner/occupier)

Site Contact Company Name

Site Contact Company ACN/ABN

Postal Address

Telephone **Fax**

E-mail

Contamination Status @ time of reporting:

Previous activity(s)

Present activity(s)

Future activity(s)

Identified contaminants & relevant media
(eg benzene in soil and groundwater)

History of Investigation:

Have previous site investigations been undertaken? (Y or N, if yes, provide details below)

Report title, date and author:

Brief Status Summary @ time of reporting

Declaration:

The information presented in this Site Summary Form is a true representation of the information within the attached report(s)/document(s).

Full name (print)

Position held

Signature

Date

Please ensure that a hardcopy of the current Certificate(s) of Title accompanies the Site Summary Form (e.g either attached to the form or included in any accompanying documentation). The DEP cannot proceed with the assessment of a site in the absence of the certificate of title details.

**An electronic copy of the Site Summary Form is available on the DEP's website:
www.environ.wa.gov.au**

APPENDIX F. PRESENTATION OF ANALYTICAL RESULTS

Table F-1

Example of Summary of Site Investigations

Potentially Contaminating Activity/Area	Potential contaminants	No. and Type of Sample Locations	Analysis	Summary of Results	Remediation/Management
Super underground storage tank (UST)	Pb TPH BTEX	On removal of UST: 5 soil sampling locations – walls and base of excavated pits (SB1-SB5) 1 groundwater bore installed and sampled (MW1)	Pb TPH BTEX	SB2 and SB5 exhibited TPH above ecological investigation levels at depth of 2.8m bgs and 2.4m bgs respectively. Benzene 1.4 times greater than investigation level in soil sample SB2. Lead below detection. Benzene in groundwater above assessment levels. TPH impact predominantly in C ₆ -C ₉ and C ₁₀ -C ₁₄ range.	Further soil sampling to delineate extent of TPH impact prior to excavation of soil. Excavated soil – bio-remediated on-site in accordance with Environmental Management Plan. Install additional groundwater bores to delineate plume prior to the development of ongoing monitoring plan.
Electroplating Workshop	Heavy Metals	Infrastructure in-situ: 4 soil sampling locations (SB6-SB10)	Pb, Cu, Zn, Ni, Cd	Cu and Zn above assessment levels at 0.1m bgs in soil, adjacent to western drum storage area. Zn elevated above assessment levels in all 4 samples. Pb and Cd below assessment levels. Ni below detection.	Delineation of heavy metal contamination in vicinity of western drum storage area required. Excavation of contaminated soil with disposal at an approved landfill is proposed.
Above-ground waste oil tank	TPH BTEX PAHs Phenols	Infrastructure in-situ: 2 soil sampling locations (SB11-SB12)	TPH BTEX PAHs Phenols	All parameters below assessment levels. Phenols below detection.	Waste oil tank less than 7 years old, located within concrete bund – bund integrity appears sound. Some minor staining on concrete bund floor near valve. Tank to remain in-situ. No further investigations proposed.
Fibrocement Workshop	Asbestos (lagging/circuit boards) Pesticides	Infrastructure in-situ: 6 soil sampling locations (SB13-SB19)	Asbestos Pesticides	SB13, SB15, SB16 and SB17 exhibited asbestos fibres. Pesticides below detection.	Excavation of soil and off-site disposal. Validation soil sampling.

Table F-2

Example of Field observations & PID Readings

Sample Identification	Location	Depth (m)	Soil profile description	Observations	PID Readings (ppm)	Sample Depths (m)
Test Pit 1/1 1/2 1/3	waste oil tank sump	0.0-0.1	Orange sand, brown silty sand	minor surface staining	110	0.0-0.25
		0.1-0.65	Brown silty sand, gravelly silty sand, fine to coarse	faint odour	75	0.25-0.7
		0.65-1.0	Dark brown gravelly loam, medium to coarse	no odour	<5	0.7-1.0
TP2/1 2/2 2/3	UST # 1	0.0-0.5	Orange sand, gravelly silt, fine to coarse	no odour	<5	0.0-0.5
		0.5-1.5	Gravelly silt, brown, damp, medium to coarse, FILL	slight odour, imported fill	10	0.5-1.0
		1.5-2.5	Loamy silt, dark brown, damp, reddish brown clay, plastic	slight odour	10	1.0-2.5
TP3/1 3/2 3/3 4/3	UST #2	0.0-0.5	Orange sand, gravelly silt, fine to coarse	no odour	50	0.0-0.7
		0.5-1.5	Gravelly silt, brown, damp, medium to coarse, FILL	slight hydrocarbon odour	120	0.7-1.5
		1.5-3.0	Loamy silt, medium brown, reddish brown clay, plastic	strong hydrocarbon odour	545	1.5-2.5
		3.2	Clay, dark brown, plastic	strong odour & heavy staining	800	2.5-3.2
TP4/1 4/2 4/3	fuel line to bowser	0.0-0.1	Orange sand, brown silty sand	no odour	80	0.0-0.25
		0.1-0.5	Brown silty sand, gravelly silty sand, fine to coarse	strong odour and staining	670	0.25-0.5
		0.6	Sand loamy, medium brown	moderate odour	390	0.5-0.6

Table F-3

Example of Soil Analytical Results - Heavy Metals

Sample Location and Identification	Depth (m)	Description	Date Sampled	Arsenic (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Copper (mg/kg)	Mercury (mg/kg)	Lead (mg/kg)	Zinc (mg/kg)
SP1	0.7	Open drain	12/01/00	<u>65</u>	<0.5	15	<u>200</u>	<0.05	540	96
SP2	1.2	Disposal area (east)	12/01/00	6.7	<0.5	9	49	0.07	180	112
SP3	0.3	Treatment tank #2	12/01/00	159	<0.5	127	<u>970</u>	<0.05	1100	<u>1700</u>
SP3a	0.3	Duplicate	12/01/00	153	<0.5	119	<u>967</u>	<0.05	980	<u>1660</u>
SP4	surface	landscaped verge	13/01/00	3.3	<0.5	8	<u>63</u>	<0.05	74	41
SP5	2.5	Soakwell #1	13/01/00	<u>53</u>	<0.5	<u>42</u>	<u>115</u>	0.22	450	<u>210</u>
SP6	2.7	Soakwell #3	15/01/00	<u>45</u>	<0.5	<u>53</u>	<u>179</u>	0.07	370	190
Limits of Reporting				<0.5	<0.5	<5	<5	<0.05	<5	<5
DEP Ecological Investigation Levels (EIL) (mg/kg) ¹ .				20	3	50	60	1	300	200
DEP Health Investigation Levels (HIL) A (mg/kg) ² .				100	20	(III) 12% (VI) 100	1000	15	300	7000

Note:

65 Exceeds EIL

127 Exceeds HIL A

1. *Assessment Levels for Soil, Sediment and Water (DEP 2001).*
2. *Assessment Levels for Soil, Sediment and Water (DEP 2001).* HIL A: Standard residential with garden/accessible soil (home-grown produce contributing <10% of vegetable and fruit intake; no poultry); this category includes children's daycare centers, kindergartens, pre-schools and primary schools.

