

# ASSESSMENT OF SITE CONTAMINATION REPORTS QUICK REFERENCE GUIDE

PREPARED BY:

Riverina and Murray Joint Organisation  
Riverina Eastern Regional Organisation of Councils  
Far North West Joint Organisation  
Dubbo Regional Council  
Northern Rivers Contaminated Land Program

- > How to Interpret and use Contaminated Land Reports in Council Land-Use Planning and Development Control Processes



## HOW TO READ THIS DOCUMENT

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This quick reference guide provides summary information to Councils on the process and steps for assessing site contamination. Rather than duplicate information contained in corresponding resources, links to other capacity resources or external sources are provided where applicable.

The tab structure of this document allows Council staff to quickly locate information about the process triggers, steps and key considerations, thereby enabling this guidance to be incorporated into Council business processes. Visual aids and checklists are also provided to assist Council in navigating the process.

## ACKNOWLEDGEMENTS

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This quick reference guide is one of a series of resources on contaminated land developed for Councils. These resources were developed with the use of funds under the NSW EPA Council Regional Capacity Building (CRCB) program on contaminated land.

The process of developing these resources was a collaboration between the respective CRCB projects delivered by the Riverina and Murray Joint Organisation,

Riverina Eastern Regional Organisation of Councils, Northern Rivers Contaminated Land Program, Far North West Joint Organisation and the Dubbo Regional Council.

Golder and Associates (now part of WSP) and Jones Environmental are acknowledged for their technical guidance and input in developing this resource.

## LIMITATIONS

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The following limitations are to be noted in relation to this resource:

- The legislative framework is the framework of 23 June 2023
  - o *Contaminated Land Management Act 1997*
  - o *Environmental Planning and Assessment Act 1979*
  - o *Environmental Planning and Assessment Regulation 2021*
  - o *Local Government Act 1993*
  - o *Managing Land Contamination: Planning Guidelines: SEPP55 – Remediation of Land (Contaminated Land Planning Guidelines)*
  - o *National Environment Protection (Assessment of Site Contamination) Measure 1999*
  - o *Protection of the Environment Operations Act 1997*
  - o *Protection of the Environment Operations (General) Regulation 2022*
  - o *Protection of the Environment Operations (Underground Petroleum Storage Systems) Regulation 2019*
  - o *Protection of the Environment Operations (Waste) Regulation 2014*
  - o *State Environmental Planning Policy (Resilience and Hazards) 2021*
  - o *Work Health and Safety Act 2011*
  - o *Work Health and Safety Regulation 2017.*
- Information on processes, steps and related information is of 23 June 2023
  - o *Australian Drinking Water Guidelines (NHMRC, 2022)*
  - o *Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2018)*
  - o *Consultants Reporting on Contaminated Land: Contaminated Land Guidelines (NSW EPA, 2020)*
  - o *PFAS National Environmental Management Plan 2.0 (2020)*
  - o *Contaminated Land Guidelines – Sampling Design Part 1 – Application (NSW EPA, 2022)*
  - o *Waste Classification Guidelines – Part 1: Classifying Waste (NSW EPA, 2014).*

# CONTENTS

1 ACKNOWLEDGEMENTS AND INTRODUCTION

2 STAGE 1 – PRELIMINARY SITE INVESTIGATION

3 STAGE 2 – DETAILED SITE INVESTIGATION

4 REMEDIATION ACTION PLAN

5 SITE REMEDIATION AND VALIDATION

6 CONCEPTUAL SITE MODEL

7 CONTAMINANT RESULTS AND INVESTIGATION LEVELS: ASC NEPM

8 ENVIRONMENTAL MANAGEMENT PLANS AND ONGOING MONITORING

9 UNEXPECTED FINDS PROTOCOL AND NOTIFICATION

10 CONTAMINANTS OF EMERGING CONCERN

11 GLOSSARY

12 APPENDICES - (IMPORTANT CHECKLISTS AND OTHER INFORMATION)

# ACKNOWLEDGEMENTS AND INTRODUCTION

## PURPOSE AND OBJECTIVES

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The purpose of this quick reference guide is to provide Council with a simplified approach of the site contamination report process. It outlines simple steps to assess:

- preliminary and detailed site investigations
- remediation action plans
- site remediation and validation.

This quick reference guide is one of a series of resources developed for Councils on contaminated land management. These resources are intended to guide and inform the Council development control processes that are required to:

- ensure land is suitable for its proposed use
- minimise the risk of harm to human health and the environment
- apply good practice to managing contaminants in soil to ensure the above objectives are achieved.

## INTENDED AUDIENCE, AND ROLES AND RESPONSIBILITIES

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Council staff are required to consider the assessment of site contamination in development control processes and related activities.

This quick reference guide provides some specific guidance to staff as they:

- assess development applications
- review remediation action plans and validation reports for contaminated sites.

**Measures taken during the early stages of the development control process, if followed, will streamline and reduce the compliance measures to be taken to ensure works meet legislative requirements.**

## LAYOUT

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This quick reference guide comprises the following tabs:

- Acknowledgements and introduction
- Stage 1 – Preliminary site investigation
- Stage 2 – Detailed site investigation
- Remediation action plan
- Site remediation and validation
- Conceptual site model
- Contaminant results and investigation levels: *National Environment Protection (Assessment of Site Contamination) Measure 1999*
- Environmental management plans and ongoing monitoring
- Unexpected finds protocol and notification
- Contaminants of emerging concern
- Glossary

- Checklists and other information
  - **Appendix 1** – Preliminary site investigation report checklist
  - **Appendix 2** – Detailed site investigation report checklist
  - **Appendix 3** – Remediation action plan report checklist
  - **Appendix 4** – Validation report checklist
  - **Appendix 5** – Conceptual site model checklist
  - **Appendix 6** – Health investigation levels and health screening levels
  - **Appendix 7** – Groundwater investigation levels (metal and inorganic compounds)
  - **Appendix 8** – Contamination report summary table.

The contamination report summary table in Appendix 8 is a checklist for consultants to attach to the front of any report on the assessment of site contamination. While not mandatory, Councils can ask consultants to include this checklist, which will enable staff to quickly identify whether the consultant's report is complete.

# ACKNOWLEDGEMENTS AND INTRODUCTION

## INTRODUCTION

The *State Environment Planning Policy (Resilience and Hazards) 2021 (Resilience and Hazards SEPP)* states that the consent or planning authority (that is, Council) must consider a report specifying the findings of a preliminary site investigation before giving consent for a change in land use. Council may also require a preliminary site investigation report if it believes that a potentially contaminating activity, such as those listed in Table 1 of the *Contaminated Land Planning Guidelines* (an updated version of which is reproduced as Table 1 below), may have occurred on the land or if it does not have sufficient information to determine whether the land is suitable for the proposed development. Another trigger for this assessment includes development applications where there is no change of land use but where the current or historical use of the land may have been an activity listed in Table 1 of the *Contaminated Land Planning Guidelines*.

The Resilience and Hazards SEPP also states that a preliminary site investigation and report must be carried out in accordance with the *Contaminated Land Planning Guidelines*. These guidelines require that information in consultant reports conform with the relevant statutory guidelines approved by the NSW EPA under section 105 of the Contaminated Land Management Act 1997. These guidelines require assessments to be performed in accordance with the National Environment Protection (Assessment of Site Contamination) Measure 1999.

This quick reference guide has been developed in line with the Resilience and Hazards SEPP, the *Contaminated Land Planning Guidelines*, the NSW EPA's Consultants Reporting on Contaminated Land guidelines and Council's Contaminated Land Policy.

The *Contaminated Land Planning Guidelines* state that, in some cases, Council may not have the technical expertise to conduct the appropriate evaluation of a consultant's report on the assessment of site contamination. In these instances, an independent review may be carried out by a third party, such as a certified contaminated land consultant. Alternatively, a site auditor accredited by the NSW EPA may also be engaged when Council wishes to verify information provided by the proponent. A site auditor will provide a site audit statement that details whether the land is suitable, or can be made suitable, for the proposed use.

Further information and guidance on the use of consultants in the assessment of site contamination process is provided in the Guide to Selecting a Consultant fact sheet.

Council's Contaminated Land Policy seeks early identification of contaminated land in the land-use planning and development control processes. The Council Guidance on Implementing the Contaminated Land Policy provides specific guidance on the triggers and steps to determine whether an assessment of the site contamination process in a land-use planning or development control process is required.

**Table 1:** Industries and associated chemicals that may cause contamination

INDUSTRY OR ACTIVITY	MAIN CHEMICAL GROUP	ASSOCIATED CHEMICALS
<b>Agricultural and horticultural activities</b>		See – 'chemical manufacture and use' ('fertiliser', 'fungicides', 'herbicides' and 'pesticides').
<b>Airports</b>	Hydrocarbons	Aviation fuels (total petroleum hydrocarbons, kerosene), PFAS
	Metals	Particularly lead, aluminium, magnesium, chromium, chlorinated solvents
<b>Asbestos production and disposal</b>	Asbestos	Asbestos (bonded and fibrous). Be aware of assessments in areas of <a href="#">naturally occurring asbestos</a> . <sup>1</sup>
<b>Battery manufacture and recycling</b>	Acids	Sulfuric acid
	Metals	Lead, manganese, zinc, cadmium, nickel, cobalt, mercury, silver, antimony

<sup>1</sup> <https://trade.maps.arcgis.com/apps/PublicInformation/index.html?appid=87434b6ec7dd4aba8cb664d8e646fb06>

## ACKNOWLEDGEMENTS AND INTRODUCTION

INDUSTRY OR ACTIVITY	MAIN CHEMICAL GROUP	ASSOCIATED CHEMICALS
<b>Breweries and distilleries</b>	Alcohol	Ethanol, methanol, esters
<b>Chemical manufacture and use</b>	Acid and alkali	Mercury; chlorine (chloralkali process); sulfuric, hydrochloric and nitric acids; sodium and calcium hydroxides
	Adhesives and resins	Polyvinyl acetate, phenols, formaldehyde, acrylates, phthalates
	Dyes	Chromium, titanium, cobalt, sulfur organic compounds, nitrogen organic compounds, sulfates, solvents
	Explosives	Acetone, nitric acid, ammonium nitrate, pentachlorophenol, ammonia, sulfuric acid, nitroglycerine, calcium cyanamide, lead, ethylene glycol, methanol, copper, aluminium, bis(2-ethylhexyl) adipate, dibutyl phthalate, sodium hydroxide, mercury, silver
	Fertiliser	Calcium phosphate, calcium sulfate, nitrates, ammonium sulfate, carbonates, potassium, copper, magnesium, molybdenum, boron, cadmium, arsenic
	Flocculants	Aluminium
	Foam production	Urethane, formaldehyde, styrene
	Fungicides	Carbamates, copper sulfate, copper chloride, sulfur, chromium, zinc
	Herbicides	Ammonium thiocyanate, carbamates, organochlorines, organophosphates, arsenic, mercury, triazines
	Paints	<u>Heavy metals</u> – arsenic, barium, cadmium, chromium, cobalt, lead, manganese, mercury, selenium, zinc, titanium  <u>Solvents</u> – toluene oils, either natural (for example, pine oil) or synthetic, hydrocarbon
	Pesticides	<u>Active ingredients</u> – arsenic, lead, organochlorines, organophosphates, sodium tetraborate, carbamates, sulfur, synthetic pyrethroids  <u>Solvents</u> – xylenes, kerosene, methyl isobutyl ketone, amyl acetate, a wide range of chlorinated solvents
	Pharmaceutical	<u>Solvents</u> – acetone, cyclohexane, methylene chloride, ethyl acetate, butyl acetate, methanol, ethanol, isopropanol, butanol, pyridine methyl ethyl ketone, methyl isobutyl ketone, tetrahydrofuran



# ACKNOWLEDGEMENTS AND INTRODUCTION

INDUSTRY OR ACTIVITY	MAIN CHEMICAL GROUP	ASSOCIATED CHEMICALS
<b>Chemical manufacture and use (Cont)</b>	Photography	Hydroquinone, sodium carbonate, sodium sulfite, potassium bromide, monomethyl para-aminophenol sulfate, ferricyanide, chromium, silver, thiocyanate, ammonium compounds, sulfur compounds, phosphate, phenylene diamine, ethyl alcohol, thiosulfates, formaldehyde
	Plastics	Sulfates, carbonates, cadmium, solvents, acrylates, phthalates, styrene
	Rubber	Carbon black
	Soaps, detergents	<u>General</u> – potassium compounds, phosphates, ammonia, alcohols, esters, sodium hydroxide, surfactants (sodium lauryl sulfate), silicate compounds <u>Acids</u> – sulfuric acid and stearic acid <u>Oils</u> – palm, coconut, pine, tea tree
	Solvents	<u>General</u> – ammonia <u>Hydrocarbons</u> – for example, BTEX <u>Chlorinated organics</u> – for example, tetrachloroethene (perchloroethylene) trichloroethene, trichloroethane, dichloroethane, carbon tetrachloride, methylene chloride
<b>Council depots<sup>2</sup></b>		Hydrocarbons, PAH, asbestos, heavy metals, pesticides, herbicides, PFAS
<b>Defence works</b>		Hydrocarbons, PFAS, asbestos See also – ‘chemical manufacture and use’ (‘explosives’), ‘foundries’, ‘engine works’, ‘service stations’
<b>Drum reconditioning works</b>		See – ‘chemical manufacture and use’
<b>Dry-cleaning</b>	Chlorinated solvents	Tetrachloroethene (perchloroethylene), trichloroethylene, 1,1,1-trichloroethane, carbon tetrachloride, white spirit (mixed hydrocarbons)
<b>Electrical</b>	Solvents, metals	PCBs (transformers and capacitors), solvents, tin, lead, copper, mercury
<b>Engine works</b>	Hydrocarbons, metals, solvents, acids, alkalis, refrigerants	<u>Refrigerants</u> – chlorofluorocarbons, hydro chlorofluorocarbons, hydrofluorocarbons
	Antifreeze	Particularly aluminium, manganese, iron, copper, nickel, chromium, zinc, cadmium, lead, and oxides, chlorides, fluorides and sulfates of these metals

## ACKNOWLEDGEMENTS AND INTRODUCTION

INDUSTRY OR ACTIVITY	MAIN CHEMICAL GROUP	ASSOCIATED CHEMICALS
<b>Foundries</b>	Metals	Particularly aluminium, manganese, iron, copper, nickel, chromium zinc, cadmium, lead, and oxides, chlorides, fluorides and sulfates of these metals
<b>Firefighting training and the use of firefighting foam<sup>2</sup></b>	PFAS	Hydrocarbons, solvents, chlorinated solvents, inorganics
<b>Gas works</b>	Inorganics	Asbestos, ammonia, cyanide, nitrate, sulfide, thiocyanate, aluminium, antimony, arsenic, barium, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, selenium, silver, vanadium, zinc
	Organics	BTEX, phenolics, PAHs and coke
<b>Hospitals<sup>2</sup></b>	Waste	Asbestos, various
	Radioactive material	Diagnostic and therapeutic isotopes
<b>Iron and steel work</b>	Organics, metals	BTEX; phenolics; PAHs; metals and oxides of iron, nickel, copper, chromium, magnesium, manganese and graphite
<b>Landfill sites</b>	Gases, metals, organics	Methane, carbon dioxide, ammonia, sulfides, heavy metals, organic acids, hydrocarbons, asbestos
<b>Marinas</b>	Antifouling paints	Copper, tributyltin See also – ‘engine works’, ‘metal treatments’ (‘electroplating’ metals)
<b>Metal treatment</b>	Electroplating	<u>Metals</u> – nickel, chromium, zinc, aluminium, copper, lead, cadmium, tin <u>Acids</u> – sulfuric, hydrochloric, nitric and phosphoric acids <u>General</u> – sodium hydroxide, 1,1,1-trichloroethane, tetrachloroethylene, toluene, ethylene glycol, cyanide compounds
	Liquid carburising baths	Sodium, cyanide, barium, chloride, potassium chloride, sodium chloride, sodium carbonate, sodium cyanate



## ACKNOWLEDGEMENTS AND INTRODUCTION

INDUSTRY OR ACTIVITY	MAIN CHEMICAL GROUP	ASSOCIATED CHEMICALS
<b>Mining and extractive industries</b>		<p>Arsenic, mercury and cyanides. See also – ‘chemical manufacture and use’ (‘explosives’).</p> <p>Aluminium, arsenic, copper, chromium, cobalt, lead, manganese, nickel, selenium, zinc and radio radionuclides.</p> <p>The list of heavy metals should be decided according to the composition of the deposit and known impurities. Consideration should be given to chemicals associated with any mineral processing that also occurred on the mine site.</p> <p>PFAS chemicals associated with firefighting equipment to protect mining infrastructure</p>
<b>Oil production and storage</b>		See – ‘service stations’
<b>Paint formulation and manufacture</b>		See – ‘chemical manufacture and use’ (‘paints’)
<b>Pesticide manufacture, formulation and use</b>		See – ‘chemical manufacture and use’ (‘pesticides’)
<b>Power stations</b>		Asbestos, PCBs, fly ash metals, water treatment chemicals
<b>Printing shops</b>		<p>Acids, alkalis, solvents, chromium, trichloroethene, methyl ethyl ketone</p> <p>See also – ‘chemical manufacture and use’ (‘photography’)</p>
<b>Railway yards</b>		Hydrocarbons, asbestos, arsenic, phenolics (creosote), heavy metals, nitrates, ammonia
<b>Research Institutions (laboratories)<sup>2</sup></b>		Various, depending on the nature of work being carried out. A case-specific evaluation is required.
<b>Scrap yards</b>		Hydrocarbons, metals, solvents, asbestos
<b>Service stations and fuel storage facilities (depots)</b>	Petroleum hydrocarbons, PAHs and lead	Aromatic hydrocarbons, BTEX, naphthalene, PAHs, phenols, lead
<b>Sheep and cattle dips</b>		Arsenic, organochlorines, organophosphates, carbamates, synthetic pyrethroids

# ACKNOWLEDGEMENTS AND INTRODUCTION

INDUSTRY OR ACTIVITY	MAIN CHEMICAL GROUP	ASSOCIATED CHEMICALS
<b>Smelting and refining</b>		Metals, fluorides, chlorides and oxides of copper, tin, silver, selenium lead, and aluminium
<b>Tanning and associated trades</b>	Various	<u>Metals</u> – chromium, manganese, aluminium <u>General</u> – ammonium sulfate, ammonia, ammonium nitrate, arsenic phenolics, formaldehyde, sulfide, tannic acid
<b>Water and sewerage treatment plants</b>	Metals and chemicals water treatment and wastewater and biosolids treatment	Aluminium, arsenic, cadmium, chromium, cobalt, lead, nickel, fluoride, lime, zinc
<b>Waste processing, storage and treatment<sup>2</sup></b>	Fire retardants, plastics	Polybrominated diphenyl ethers, PFAS, plasticisers
<b>Wood preservation</b>	Metals	Chromium, copper, arsenic, naphthalene, ammonia, pentachlorophenol, dibenzofuran, anthracene, biphenyl, ammonium sulfate, quinoline, boron, creosote, organochlorine pesticides

**Note:** It is not sufficient to rely solely on the contents of this table to determine whether or not a site is likely to be contaminated. This table is a guide only. Contamination status can only be conclusively determined after a review of the site history and, if necessary, sampling and analysis. PFAS = per- and polyfluoroalkyl substances; BTEX = benzene, toluene, ethylbenzene, xylene; PAH = polycyclic aromatic hydrocarbons; PCB = polychlorinated biphenyl.

**Source:** Table 2 in Appendix 1 of the Department of Planning and Environment's draft *Contaminated Land Planning Guidelines*, and professional opinion.

<sup>1</sup> <https://trade.maps.arcgis.com/apps/PublicInformation/index.html?appid=87434b6ec7dd4aba8cb664d8e646fb06>

<sup>2</sup> These activities are included as they are also known to commonly cause land contamination.

## STAGE 1 – PRELIMINARY SITE INVESTIGATION

The objective of the preliminary site investigation (PSI) and its associated report is to assess whether contamination potentially exists on the site and whether further investigation is needed.

A PSI should include a detailed appraisal of the site's land-use history and a visual inspection. It may also include a sampling assessment or collation of environmental information that has been collected in the past. It is important that all relevant site information (including the potential for spills and leaks) is reviewed to help determine the potential for site contamination.

A PSI report must adequately identify potential human and ecological receptors (onsite and offsite) and identify potentially affected media (soil, sediment, groundwater, surface water, soil vapour, and indoor and outdoor air). The report must also indicate all contaminants of potential concern, including those of emerging concern, that have been identified during the PSI.

When a complete site history demonstrates that site activities have not given rise to potential land contamination, further investigations or sampling may not be required. However, if contaminating activities are suspected or known to have occurred, or if there are large gaps in the site history, a detailed site investigation may be required.

Council should review council records (including any contaminated land site register, historical land titles, and historical and current land-use information) to determine if a PSI is required prior to the lodgement of a development application. Such a request can be made by Council in a development application pre-lodgement meeting. Further information on this process can be found in the *Council Guidance on Implementing the Contaminated Land*.

All contaminated land report figures and site plans should include the following details: scale bar showing north, site dimensions, relevant buildings, land use, construction features (such as drains, ditches, underground services, above- and below-ground storage areas, landfills, waste dams), topographic data, the direction of surface water flow, areas of potential contamination and other locally significant features onsite and immediately offsite. The plan should also show the historical location of structures that may have affected the distribution of contamination (for example, buildings, underground storage tanks and treatment baths).

A checklist of PSI reporting requirements is provided in the [NSW EPA's \*Consultants Reporting on Contaminated Land guidelines\*](#)<sup>1</sup>. An adapted version is also provided in Appendix 1 for Councils to use. The required information in this checklist is particularly important in instances where field sampling is carried out in a PSI.

**Note: A conceptual site model must be included in every PSI. Refer to the 'Conceptual Site Model' tab.**

<sup>1</sup> <https://www.epa.nsw.gov.au/-/media/epa/corporate-site/resources/contaminated-land/20p2233-consultants-reporting-on-contaminated-land-guidelines.pdf>





## STAGE 2 – DETAILED SITE INVESTIGATION

A detailed site investigation (DSI) is necessary when a preliminary investigation indicates that the land is contaminated or that the current or former use of the site is an activity listed in Table 1 of the *Contaminated Land Planning Guidelines*.

The objective of a DSI report is to provide complete and definitive information on issues raised in the preliminary site investigation.

**The objectives of a DSI are to obtain specific site information to:**

- define the type, extent and level of contamination
- screen the potential risk to human and environmental health posed by contaminants
- develop a remediation action plan, if required.

If the results of a DSI indicate that the contamination at the site, under either the current or proposed land use, has the potential to pose an unacceptable risk to human health or the environment (onsite or offsite), then further assessment needs to be carried out and/or a remediation action plan needs to be prepared and implemented.

A checklist of DSI reporting requirements is provided in the [NSW EPA's \*Consultants Reporting on Contaminated Land guidelines\*](https://www.epa.nsw.gov.au/-/media/epa/corporate-site/resources/contaminated-land/20p2233-consultants-reporting-on-contaminated-land-guidelines.pdf).<sup>2</sup> An adapted version is provided in Appendix 2 for Councils to use.

**Note: A detailed conceptual site model must be included in the DSI. Refer to the conceptual site model checklist at the 'Conceptual Site Model' tab.**

<sup>2</sup> <https://www.epa.nsw.gov.au/-/media/epa/corporate-site/resources/contaminated-land/20p2233-consultants-reporting-on-contaminated-land-guidelines.pdf>





# REMEDIATION ACTION PLAN

The aim of a remediation action plan (RAP) is to set objectives and document the process of remediating the site. Specifically, a RAP should:

- summarise site investigation data and present the refined conceptual site model
- set remediation goals that ensure the remediated site will be suitable for its current and/or proposed use with no unacceptable risk to human health or to the environment
- define the extent of remediation required across the site
- outline the remediation technologies and justification for the preferred approach
- document the remediation strategy and all procedures, methods and plans to mitigate or reduce potential risks to an acceptable level
- establish the environmental safeguards required to complete the remediation in an environmentally acceptable manner, including consideration of the potential for offsite impacts (such as air quality, odour and aesthetics)
- identify and include proof of the necessary approvals and licenses (for example, category 1 remediation works require development consent from Council)
- address contingencies and unexpected finds protocols.

Once remediation works are complete, a validation report should be prepared, detailing the site work conducted and how the risks have been mitigated or how they require management into the future. The validation report should be provided to Council and the NSW EPA as required. See the 'Site Remediation and Validation' tab.

A checklist of RAP reporting requirements is provided in the [NSW EPA's \*Consultants Reporting on Contaminated Land guidelines\*](#).<sup>3</sup> An adapted version is provided in Appendix 3 for Councils to use.

**Note: A detailed conceptual site model must be included. Refer to the conceptual site model checklist in the 'Conceptual Site Model' tab.**

<sup>3</sup> <https://www.epa.nsw.gov.au/-/media/epa/corporate-site/resources/contaminated-land/20p2233-consultants-reporting-on-contaminated-land-guidelines.pdf>





# SITE REMEDIATION AND VALIDATION

The objective of the site validation report is to confirm whether the objectives of the remediation action plan were achieved and that the validation sampling results statistically comply with the site remediation criteria. Where remediation action plan targets have not been achieved, the reasons for this must be stated, and additional site work or management should be proposed.

Site validation is an important prerequisite of the notice of remediation completion and is required by the *State Environmental Planning Policy (Resilience and Hazards) 2021* (for both category 1 and 2 remediation works). The extent of validation will depend on the nature and extent of the contamination, the remediation processes that were carried out, and the proposed land use.

A validation report should contain a statement about the suitability of the entire site for the proposed use. We recommend that Council officers condition that a site suitability statement be required in the validation report. This is particularly important where only a portion of the site is remediated (for example, an underground petroleum storage system tank pit). The consultant must demonstrate that the initial site investigation data, together with the validation data, provide adequate site coverage (in accordance with NSW EPA statutory guidelines, particularly the NSW EPA's *Sampling Design Part 1 – Application – Contaminated Land Guidelines*) to confirm that the whole site is suitable for the current or proposed land use.

A checklist of site remediation and validation reporting requirements is provided in the [NSW EPA's Consultants Reporting on Contaminated Land guidelines](#)<sup>4</sup>. An adapted version is also provided in Appendix 4 for Councils to use.

Where the complete removal or remediation of contamination is not feasible, and there is a need for ongoing monitoring and management, a management program should be prepared and implemented. Refer to the 'Environmental Management Plans and Ongoing Monitoring' tab.

**Note: An updated conceptual site model is required as part of a validation report and for ongoing monitoring. See the 'Conceptual Site Model' tab.**

REPORT SECTION	REQUIRED INFORMATION	PRESENT? (YES/NO /NA)	COMMENTS REQUESTS
Document control	Report date within 2 years Report version, author and reviewer, including consultant certification1 (for example, experienced contaminated land specialist, certified environmental practitioner) Details of who commissioned the report		
Executive summary	Background Objectives of the remediation Summary of the selected scope of remediation works		
Scope of work	A clear statement of the scope of work		
Site identification (where available)	Street number, street name and suburb Property identifier (for example, lot and deposited plan number). Geographic coordinates related to a nearby cadastral corner of a state survey control marker Locality map		
Site history or previous contamination assessment report (where available)	A summary is adequate if detailed information is included in an available referenced previous report. If not, refer to the PSI checklist for information that should be included		
Condition of site and surrounding environment (where available)	A summary is adequate if detailed information is included in an available referenced previous report. If not, refer to the PSI checklist for information that should be included.		
Geology, hydrogeology and hydrology (where available)	A summary is adequate if detailed information is included in an available referenced previous report. If not, refer to the DSI checklist for information that should be included.		
Previous contamination assessments (where available)	A summary of previous contamination assessment reports for the site (PSI, DSI and site assessment reports)		
Data gap assessment	Data gaps in previous assessments for the site and provisions for addressing them during the remediation works (Note: This can lead to a pre-remediation conceptual site model)		

<sup>4</sup> <https://www.epa.nsw.gov.au/-/media/epa/corporate-site/resources/contaminated-land/20p2233-consultants-reporting-on-contaminated-land-guidelines.pdf>

# CONCEPTUAL SITE MODEL

A conceptual site model (CSM) provides the framework for identifying sources of contamination, contaminant migration pathways, receptors and exposure mechanisms. The complexity of the CSM should correspond to the scale and complexity of the known or potential contamination impacts.

**A CSM is an essential part of all stages of site assessment, including the preliminary site investigation.**

## Every CSM must identify:

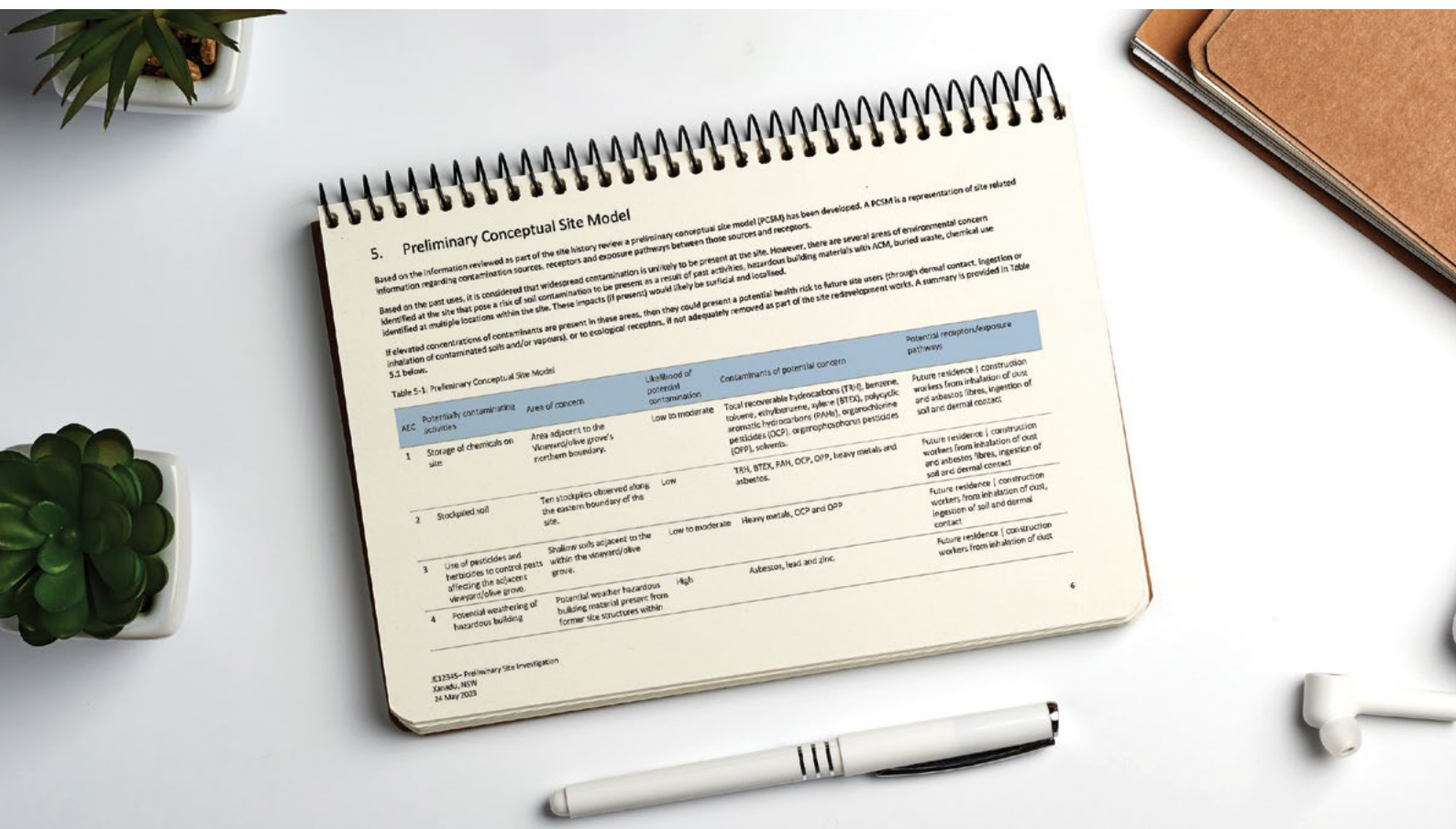
- the sources and types of contamination (both known and potential), including the mechanisms of contamination – for example
  - primary and secondary sources
  - pipe leaks, spills and so on
- potentially affected media – for example, soil, sediment, groundwater, surface water, indoor and ambient air (the pathways for contamination to move into the environment)
- receptors (human and ecological), including built structures (former, existing and planned) both onsite and offsite
- the potential and complete exposure routes over time.

A CSM can take various forms, including text, tables, graphics and flow diagrams. They can also take the form of site-specific plans and figures, including cross-sections.

A checklist of CSM reporting requirements is provided in the [NSW EPA's \*Consultants Reporting on Contaminated Land guidelines\*](https://www.epa.nsw.gov.au/-/media/epa/corporate-site/resources/contaminated-land/20p2233-consultants-reporting-on-contaminated-land-guidelines.pdf).<sup>5</sup> An adapted version is also provided in Appendix 5 for Councils to use.

For further information, Council officers can refer to the *National Environment Protection (Assessment of Site Contamination) Measure 1999* Schedule B2 section 4 for a guide to presenting CSMs.

<sup>5</sup> <https://www.epa.nsw.gov.au/-/media/epa/corporate-site/resources/contaminated-land/20p2233-consultants-reporting-on-contaminated-land-guidelines.pdf>



**5. Preliminary Conceptual Site Model**

Based on the information reviewed as part of the site history review a preliminary conceptual site model (PCSM) has been developed. A PCSM is a representation of site related information regarding contamination sources, receptors and exposure pathways between those sources and receptors.

Based on the past uses, it is considered that widespread contamination is unlikely to be present at the site. However, there are several areas of environmental concern identified at the site that pose a risk of soil contamination to be present as a result of past activities, hazardous building materials with ACM, buried waste, chemical use identified at multiple locations within the site. These impacts (if present) would likely be surficial and localised.

If elevated concentrations of contaminants are present in these areas, then they could present a potential health risk to future site users (through dermal contact, ingestion or inhalation of contaminated soils and/or vapours), or to ecological receptors, if not adequately removed as part of the site redevelopment works. A summary is provided in table 5.2 below.

Table 5-1: Preliminary Conceptual Site Model

AEC	Potentially contaminating activities	Area of concern	Likelihood of potential contamination	Contaminants of potential concern	Potential receptors/exposure pathways
1	Storage of chemicals on site	Area adjacent to the Vineyard/olive grove's northern boundary.	Low to moderate	Total recoverable hydrocarbons (TRH), benzene, toluene, ethylbenzene, xylene (BTEX), polycyclic aromatic hydrocarbons (PAHs), organochlorine pesticides (OCP), solvents.	Future residence   construction workers from inhalation of dust and asbestos fibres, ingestion of soil and dermal contact.
2	Stockpiled soil	Ten stockpiles observed along the eastern boundary of the site.	Low	TRH, BTEX, PAH, OCP, DPP, heavy metals and asbestos.	Future residence   construction workers from inhalation of dust and asbestos fibres, ingestion of soil and dermal contact.
3	Use of pesticides and herbicides to control pests affecting the adjacent vineyard/olive grove.	Shallow soils adjacent to the within the vineyard/olive grove.	Low to moderate	Heavy metals, OCP and DPP	Future residence   construction workers from inhalation of dust, ingestion of soil and dermal contact.
4	Potential weathering of hazardous building	Potential weather hazardous building material present from former site structures visible.	High	Asbestos, lead and zinc.	Future residence   construction workers from inhalation of dust.



## CONTAMINANT INVESTIGATION LEVELS: ASC NEPM

The [NSW EPA website contains a list](#) of statutory guidelines made or approved by the NSW EPA that must be considered when assessing site contamination.<sup>6</sup>

The *National Environment Protection (Assessment of Site Contamination) Measure 1999 (ASC NEPM)* is the national guidance document for the assessment of site contamination in Australia. Its desired outcome is to provide adequate protection for human health and the environment. Due to the complexity of site conditions, contaminant properties and/or the discovery of unexpected contamination, site assessment may proceed in various stages (preliminary site investigation, detailed site investigation, remediation).

The requirement for detailed investigation or remediation depends on various factors, such as the proposed land use, site history, conceptual site models, risk assessment and identification of data gaps during investigations. A tier 1 site assessment should consider health investigation levels (HILs), health screening levels (HSLs), ecological investigation levels (EILs)

and ecological screening levels (ESLs). The ecological criteria relate to various land uses and soil types for the protection of soil processes, plant species and organisms that inhabit or contact soil (*ASC NEPM* Schedule B5b provides guidance on deriving site-specific EILs). HILs typically apply to the surface to 3 metres; HSLs, between depths 0 metres to greater than 4 metres; and EILs and ESLs, to the surface 2 metres in non-arid areas.

Results tables from consultants should refer to the criterion and clearly indicate any exceedances. Where an investigation criterion has been exceeded, the consultant report should explain the exceedance and contain recommendations for either remediating or managing the chemical contamination such that it does not pose a risk to human health or the environment. Importantly, these recommendations must also consider all exposure scenarios related to the contamination identified, and the assumptions regarding these recommendations must also be outlined.

**The HILs and HSLs are provided in Appendix 6.**

## GROUNDWATER INVESTIGATION LEVELS AND DRINKING WATER GUIDELINES

The groundwater investigation levels and limits presented in the *ASC NEPM* were sourced from guidance in force at the time of the Measure's amendment in 2013. The *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* published in 2018 (by Water Quality Australia) have since superseded those published in 2000 (by the Australian and New Zealand Environment and Conservation Council and the Agriculture and Resource Management Council of Australia and New Zealand) as the reference for groundwater investigation levels for the protection of ecological systems in fresh and marine water receiving bodies. The *Australian Drinking Water Guidelines* have also been updated. Links to online web portals and documents for guideline values are shown in Table 2.

(See following page)



<sup>6</sup><https://www.epa.nsw.gov.au/your-environment/contaminated-land/statutory-guidelines>

# CONTAMINANT INVESTIGATION LEVELS: ASC NEPM

**Table 2:** Groundwater guideline references and links

RELEVANCE TO GROUNDWATER INVESTIGATION LEVELS	GUIDELINE	LINKS
<b>Protection of ecological systems in fresh and marine water receiving bodies</b>	<i>Australian and New Zealand Guidelines for Fresh and Marine Water Quality</i> (2018)	<a href="https://www.waterquality.gov.au/anz-guidelines/guideline-values/default/water-quality-toxicants/search">https://www.waterquality.gov.au/anz-guidelines/guideline-values/default/water-quality-toxicants/search</a>
<b>Protection of agricultural stock and crops for primary industries. Chemical, physical and biological parameters for screening irrigation, general-use and livestock drinking water</b>	<i>Australian and New Zealand Guidelines for Fresh and Marine Water. Volume 3: Primary Industries – Rationale and Background Information</i> (2000) sections 9.2 and 9.3	<a href="https://www.waterquality.gov.au/sites/default/files/documents/anzecc-armcanz-2000-guidelines-vol3.pdf">https://www.waterquality.gov.au/sites/default/files/documents/anzecc-armcanz-2000-guidelines-vol3.pdf</a>
<b>Protection of human health. Drinking water quality. Relevant to groundwater quality where a consumer or private water supplier uses bore water without treatment</b>	<i>Australian Drinking Water Guidelines 6</i> (2011; version 3.8 updated September 2022)	<a href="https://www.nhmrc.gov.au/about-us/publications/australian-drinking-water-guidelines">https://www.nhmrc.gov.au/about-us/publications/australian-drinking-water-guidelines</a>

Some common guideline values are presented in Appendix 7. These have been taken from the guidelines listed in Table 2. They are accurate at the time of publication; however, they are subject to change over time. Refer to the online portals above for current information and detail as to how these values should be used when considering how groundwater has been assessed.

Additionally, refer to these guidelines to consider contaminants not included in Appendix 7, such as nonmetallic inorganics, halogenated hydrocarbons, polychlorinated biphenyls, phenols, phthalates, pesticides, herbicides and surfactants.

# ENVIRONMENTAL MANAGEMENT PLANS AND ONGOING MONITORING

An environmental management plan (EMP) may be required when:

- there is residual contamination onsite that needs to be managed and monitored, and where restrictions of use apply to land (for example, residual groundwater contamination that has been cleaned up to the extent practicable and is being monitored for natural attenuation)
- full remediation of a contaminated site is not feasible or reasonable (for example, low-level legacy persistent contamination)
- it is proposed that contamination be contained onsite or that contaminants be capped (for example, an onsite containment cell).

The NSW EPA has issued the practice note [Preparing Environmental Management Plans for Contaminated Land \(2022\)](#)<sup>7</sup> to assist with the preparation, review, implementation or regulation of EMPs for long-term management of land contamination. The EMP practice note is a non-statutory guideline and is not legally binding.

## AN EMP MUST BE LEGALLY ENFORCEABLE BY COUNCIL (OR THE NSW EPA)

Two mechanisms that Council may use to ensure that an EMP is legally enforceable are:

- by imposing restrictions or public positive covenants on land under Section 88B of the *Conveyancing Act 1919*, with the landowners' consent. The covenant imposes restrictions and provides information (an EMP) for land purchases. Council can ensure that an EMP and its resultant conditions are maintained through the Supreme Court.
- by issuing conditions of development consent that require an EMP and its maintenance. Further information can be found in the *Contaminated Land and Land Use Planning and Development Control* quick reference guide.

## ROLES AND RESPONSIBILITIES

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The following stakeholders have certain roles and responsibilities with respect to EMPs:

- **Contaminated land consultants** will generally prepare an EMP on behalf of the person responsible for remediation (who is usually the polluter, landholder, land manager or developer). A summary of the EMP should be included in a remediation action plan or where further contamination management may be required, as identified by the consultant.
- **Local Councils**, in their role as environmental and planning authorities, can approve and enforce an EMP when determining the conditions of development consent. As the consent authority, Council (or another authority) can require an EMP as part of the development consent process under the *Environmental Planning and Assessment Act 1979* or as part of a management or ongoing maintenance order under the *Contaminated Land Management Act 1997 (CLM Act)*. Council can identify the existence of an EMP through a notification on a section 10.7 planning certificate issued under the *Environmental Planning and Assessment Act 1979*.
- The **NSW EPA**, in their role as environmental regulator, may require a landowner or manager to prepare an EMP as part of an environment protection licence or by management order or ongoing maintenance order under the *CLM Act*. The NSW EPA can also require that an EMP be submitted as part of a voluntary management proposal when contaminated land is being remediated or managed under the *CLM Act*.
- An **NSW EPA-accredited site auditor** may be engaged to review the environmental assessment works conducted or to issue a site audit statement (expressing the conclusions of the site audit), which indicates that a site is suitable for a particular use or uses if managed in line with an EMP. **Note:** A site auditor must not include the implementation of an EMP as a condition on a site audit statement nor accept the implementation of an EMP as a means of managing contamination, unless certain conditions have been met.
- **Site owners, land managers and occupiers, and owner's corporations** should be familiar with their responsibilities for implementing an EMP for contaminated land and seek appropriate advice if necessary.

<sup>7</sup> <https://www.epa.nsw.gov.au/-/media/epa/corporate-site/resources/contaminated-land/22p3473-emps-for-contaminated-land-practice-note.pdf>

## REVIEWING AN EMP FOR CONTAMINATED LAND

An EMP documents the mitigation measures and/or monitoring requirements where full remediation of the contamination at a site is not feasible or where onsite containment of contamination is proposed.

An EMP should clearly state:

- the objectives of the EMP
- the key stakeholders and how they have been engaged in the development of the EMP
- who is responsible for implementing and maintaining the EMP
- whether the EMP has an active or passive system of management. A passive system is preferable because it typically requires only site inspections, minimal maintenance and potentially, for example, groundwater monitoring. An active management system requires regular maintenance or a remediation system, such as a groundwater interception trench with extraction and treatment, or a soil vapour extraction system. When a site audit statement is issued, the form of EMP and its system of management (active or passive) must be stated
- a mechanism for monitoring its implementation
- the timeframes for completing the actions required by the EMP, and who will undertake those actions
- notifications that the EMP requires. The EMP should detail a protocol including what notifications are required, who is to make them, who needs to be notified and when such notifications should be made
- the public register on which the EMP is recorded and how the public can access this register.

### FURTHER INFORMATION

can be found in the following resources:

- [Preparing Environmental Management Plans for Contaminated Land](#) (NSW EPA practice note, 2022) <sup>8</sup>
- [Post-remediation Considerations: Guideline on Implementing Institutional Controls](#) (CRC CARE, 2019) <sup>9</sup>
- [Contaminated Land Management: Guidelines for the NSW Site Auditor Scheme](#) (3rd edition, NSW EPA, 2017) <sup>10</sup>
- [Consultants Reporting on Contaminated Land: Contaminated Land Guidelines](#) (NSW EPA, 2020).<sup>11</sup>



## ONGOING MONITORING

Where ongoing monitoring (onsite and/or offsite) is required, the consultant may recommend a monitoring program to meet the requirements of an order under the *CLM Act* or to demonstrate the ongoing remediation of contaminants. A management and monitoring program should detail the proposed monitoring strategy, parameters to be monitored, monitoring locations, frequency of monitoring, and reporting requirements.

**FURTHER INFORMATION** is provided in the [Consultants Reporting on Contaminated Land guidelines](#).<sup>12</sup>

<sup>8</sup> <https://www.epa.nsw.gov.au/-/media/epa/corporate-site/resources/contaminated-land/22p3473-emps-for-contaminated-land-practice-note.pdf>

<sup>9</sup> <https://remediationframework.com.au/download-nrf-guidelines/25-guideline-on-implementing-institutional-controls/file>

<sup>10</sup> <https://www.epa.nsw.gov.au/-/media/epa/corporate-site/resources/contaminated-land/17p0269-guidelines-for-the-nsw-site-auditor-scheme-third-edition.pdf>

<sup>11</sup> <https://www.epa.nsw.gov.au/-/media/epa/corporate-site/resources/contaminated-land/20p2233-consultants-reporting-on-contaminated-land-guidelines.pdf>

<sup>12</sup> <https://www.epa.nsw.gov.au/-/media/epa/corporate-site/resources/contaminated-land/20p2233-consultants-reporting-on-contaminated-land-guidelines.pdf>

# UNEXPECTED CONTAMINATION FINDS PROTOCOL AND NOTIFICATION

An unexpected find occurs when contamination is identified at a location where it had not been previously identified or expected. This requires a reconsideration of the controls in place to manage the contamination of concern.

An unexpected contamination find protocol must be included in remediation action plans when they are developed.

Council may be notified of an unexpected find of land contamination. The three possible notification scenarios are included in Table 3. Model conditions of consent to ensure that Councils are notified of any unexpected finds are provided in (Figure 1) (see following page).

**Table 3:** Possible notification scenarios for unexpected contamination finds

PATHWAY	SITUATION	PROTOCOL TO NOTIFY COUNCIL
<b>Complying development</b>	Notification from a site for which a complying development certificate has been issued.	The protocol to notify Council (and NSW EPA) is a requirement of the <i>State Environmental Planning Policy (Exempt and Complying Development Codes) 2008</i> .
<b>Category 2 land remediation (without Council consent)</b>	A site where category 2 remediation works are occurring and where Council has requested that they be notified of unexpected contamination finds during the course of category 2 remediation activities.	When Council receives a notification of intent to carry out category 2 remediation works, Council should respond with a requirement that a protocol for unexpected contamination finds (that includes a process to notify Council) is included in the remediation action plan and/or the construction environmental management plan.  <b>It is essential that this category 2 requirement is made by Council within 30 days following the initial notification.</b>
<b>Statutory planning: category 1 land remediation (with Council consent)</b>	A development site may notify Council, as the consent authority, if a development consent condition requires notification of an unexpected contamination find.	Standard remediation consent conditions may require a notification to Council to be included in the unexpected finds protocol.  <b>Council should review the remediation action plan to ensure it has included, in the unexpected contamination finds protocol, a process for notifying Council.</b>



# UNEXPECTED CONTAMINATION FINDS PROTOCOL AND NOTIFICATION

**Figure 1:** Model condition of consent for an unexpected contamination finds protocol

## **NEW INFORMATION/UNEXPECTED FINDS**

1. In the event that **[REMEDICATION AND/OR CONSTRUCTION WORKS]** cause the generation of odours or uncovering of previously unidentified contaminants, works must immediately cease, Council and the Principal Certifying Authority **[AND/OR ACCREDITED SITE AUDITOR IF REQUIRED BY COUNCIL]** must be notified in writing within **[INSERT TIME FRAME]** and an appropriately qualified environmental consultant appointed to undertake an assessment of the potential contaminant and works required to make the site safe from potential human health and environmental harm.
2. If the Duty to Report contamination to the NSW Environment Protection Authority under Section 60 of the *Contaminated Land Management Act 1997* is triggered, Council must be notified within **[INSERT NUMBER]** days of the notification to the NSW Environment Protection Authority.

**Note:** Model conditions to address the management and notification of any new information or unexpected finds potentially encountered during the construction or remediation stages.

**Source:** Hunter Joint Organisation. (2020). *Register of contaminated land consent conditions*.

The notification of an unexpected find should detail the actions that the developer or proponent of the remediation has already undertaken to make the site safe and should detail any incident response actions that were taken. The notification should also detail the steps the proponent will undertake to assess the nature and extent of contamination and to then remediate the contamination if required.

Where there is insufficient detail in the notification, Council may consider recommending or directing the site operator, either directly or through the principal certifying authority following a notification, that:

- access to the potentially contaminated area be prevented by a suitable barricade and appropriate signage applied until the nature and extent of the contamination is assessed
- affected parties and stakeholders (onsite and offsite, if required) be notified of the unexpected contamination find
- other activities onsite be conducted only upon approval from the NSW EPA or Council. Approval from SafeWork NSW may also be required should there be an apparent or actual impact on worker health and safety. Note that other provisions may require a site operator or person conducting business or an undertaking to notify SafeWork NSW
- a suitably qualified and experienced environmental consultant be engaged by the site operator to assess, manage and remove the identified hazard. In the case of an unexpected asbestos find, a certified occupational hygienist and certified asbestos removalist should be engaged to ensure that exposure to asbestos is adequately managed and site safety is maintained. An asbestos clearance certificate should be provided following the asbestos removal and validation. A report should be prepared, documenting the results of the assessment and commenting on the suitability of the site for the proposed land use. Where applicable, the report should include analysis results and waste disposal records.

Depending on the nature and level of contamination, remediation of the land may be required before further development or land-use approval can continue.

**Note:** The amendments to the *State Environmental Planning Policy (Exempt and Complying Development Codes) 2008* that introduced the requirements for notification of contamination to the NSW EPA and Council are new provisions that do not affect section 60 notification requirements under the *CLM Act*. The notifications under the *State Environmental Planning Policy (Exempt and Complying Development Codes) 2008* are to ensure that unexpected contamination finds are appropriately managed during complying development.

# CONTAMINANTS OF EMERGING CONCERN

**Contaminants of emerging concern (CECs) are chemicals and substances that do not have endorsed or established national guidelines relating to their environmental assessment or management.**

Councils should contact the [NSW EPA Hub](#)<sup>13</sup> to discuss **contaminated land issues** where a relevant CEC has (or has not) been assessed by an environmental consultant.

Council can seek further advice and information or discuss instances of potential **harm to human health** from CECs by contacting their local public health unit. The Murrumbidgee Public Health Unit can assist with environmental health issues related to contaminated land and CECs, especially in relation to drinking water quality. They can be contacted by phone on **1300 066 055** or by email at [MLHD-Publichealth@health.nsw.gov.au](mailto:MLHD-Publichealth@health.nsw.gov.au).

Council can seek further advice and information or discuss instances of local environmental harm from CECs by contacting the Australian Government Department of Climate Change, Energy, the Environment and Water regarding [chemical assessments](#)<sup>14</sup> at [CasAdmin@environment.gov.au](mailto:CasAdmin@environment.gov.au).

[The CSIRO has detailed](#)<sup>15</sup> endocrine-disrupting chemicals, pharmaceuticals and personal care products, nanoparticles, per- and polyfluoroalkyl substances (PFASs), and microplastics as consumer and industrial chemicals that have been in use for a considerable time without regulatory controls and prior to their potential environmental risks being understood.

The CSIRO and universities research these CECs using advanced chemistry, biomonitoring, toxicology, epidemiology and ecotoxicology to understand a CEC's environmental fate and transport and its potential impact on human health and the environment. Contaminated land assessments have not routinely considered these substances and are unlikely to do so until established guidelines are endorsed or unless requested by a landowner or regulator.



<sup>13</sup> <https://www.epa.nsw.gov.au/-/media/epa/corporate-site/resources/about/21p3118-guide-to-the-hub.pdf>

<sup>14</sup> <https://www.dcceew.gov.au/environment/protection/chemicals-management/chemical-assessments>

<sup>15</sup> <https://www.csiro.au/en/research/natural-environment/ecosystems/emerging-contaminants>

<sup>16</sup> <https://www.dcceew.gov.au/environment/protection/publications/pfas-nemp-2>

<sup>17</sup> <https://www.epa.nsw.gov.au/your-environment/contaminated-land/pfas-investigation-program>



## CONTAMINANTS OF EMERGING CONCERN

PFAS is an example of a CEC that has had a dedicated national process to establish guidelines – the *PFAS National Environmental Management Plan 2.0 (PFAS NEMP)*.<sup>16</sup> The *PFAS NEMP* provides nationally agreed guidance on the management of PFAS contamination in the environment through the support of collaborative action on PFAS by federal, state and territory, and local governments.

PFAS contamination is of particular interest to regional Councils in NSW that maintain roles as a **drinking water authority, catchment manager, landfill owner** and **regional airport operator**; that have Council land used by the **Rural Fire Service**; or that have land that neighbours Defence sites, airports or other sites where firefighting training activities have historically taken place.

The [NSW Government PFAS Investigation Program](#),<sup>17</sup> led by the NSW EPA, is focused on sites where it is likely that large quantities of PFAS have been used.

Schedule B4 of the *National Environment Protection (Assessment of Site Contamination) Measure 1999* describes a process for consultants (risk assessors) to use new evidence where they seek to use toxicity assessment information from literature, research and evidence adopted by international organisations.

**NSW Health also has a role in providing expert opinion and assistance on contaminants that can impact human health.**



<sup>16</sup> <https://www.dceew.gov.au/environment/protection/publications/pfas-nemp-2>

<sup>17</sup> <https://www.epa.nsw.gov.au/your-environment/contaminated-land/pfas-investigation-program>

## **Conceptual site model (CSM):**

A description of a site – including the environmental setting, geological, hydrogeological and soil characteristics – together with the nature and distribution of contaminants. Potentially exposed populations and exposure pathways are identified. Presentation is usually graphical or tabular with accompanying explanatory text.

## **Contamination:**

The condition of land or water where any chemical substance or waste has been added as a direct or indirect result of human activity at above background levels and represents, or potentially represents, an adverse health or environmental impact.

## **Ecological investigation levels (EILs):**

The concentrations of contaminants above which further appropriate investigation and evaluation will be required. EILs depend on specific soil physicochemical properties and land-use scenarios and generally apply to the top 2 metres of soil. EILs may also be referred to as ‘soil quality guidelines’ in Schedules B5b and B5c of the National Environment Protection (Assessment of Site Contamination) Measure 1999.

## **Ecological screening levels (ESLs):**

The concentrations for petroleum hydrocarbons above which further appropriate investigation and evaluation will be required. ESLs broadly apply to coarse- and fine-grained soils and various land uses. They are generally applicable to the top 2 metres of soil.

## **Groundwater investigation level (GIL):**

The concentration of a groundwater parameter at which further investigation (at the point of extraction) or a response (at the point of use) is required. Includes Australian water quality guidelines, drinking water guidelines, guidelines for managing risk in recreational water criteria and site-specific derived criteria.

## **Health investigation levels (HILs):**

The concentrations of a contaminant above which further appropriate investigation and evaluation will be required. HILs are generic to all soil types.

## **Health screening levels (HSLs):**

The concentrations for petroleum hydrocarbons above which further appropriate investigation and evaluation will be required. HSLs depend on physicochemical properties of soil (as these affect hydrocarbon vapour movement in soil) and the characteristics of building structures. HSLs apply to different soil types, land uses and depths (from below surface level to above 4 metres) and have a range of limitations.

## **Investigation levels and screening levels:**

The concentrations of a contaminant above which further appropriate investigation and evaluation will be required. Investigation and screening levels provide the basis of tier 1 risk assessment.

(Continued)



### **NSW Environment Protection Authority (EPA):**

The statutory position established in NSW.

### **Risk:**

The probability in a certain timeframe that an adverse outcome will occur in a person, group of people, plants, animals and/or the ecology of a specified area that is exposed to a particular dose or concentration of a chemical substance – that is, risk depends on both the level of toxicity of the chemical substance and the level of exposure to it.

### **Risk assessment:**

The process of estimating the potential impact of a chemical, physical, microbiological or psychosocial hazard on a specified human population or ecological system under a specific set of conditions and for a certain timeframe.

### **Tier 1 assessment:**

A risk-based analysis comparing site data with investigation and screening levels for various land uses to determine the need for further assessment or development of an appropriate management strategy.



# CHECKLISTS AND OTHER INFORMATION

## APPENDIX 1 – PRELIMINARY SITE INVESTIGATION REPORT CHECKLIST

REPORT SECTION	REQUIRED INFORMATION	PRESENT? (YES/NO /NA)	COMMENTS (ACTIONS, REQUESTS, RED FLAGS)
<b>Document control</b>	Report date within 2 years		
	Report version, author and reviewer, including consultant certification <sup>1</sup> (for example, experienced contaminated land specialist, certified environmental practitioner)		
	Details of who commissioned the report		
<b>Executive summary</b>	Background		
	Objectives of the investigation		
	Scope of works		
	Sampling summary (where appropriate)		
	Summary of key findings		
	Summary of conclusions and recommendations		
<b>Objectives</b>	Objectives of the investigation report and the broader objectives of the site investigation process and proposed development or activity		
<b>Scope of works</b>	Scope of work performed (and work not undertaken, if relevant)		
<b>Site identification and details</b>	Site name and description		
<b>Site identification (where available)</b>	Street number, street name and suburb		
	Property description (for example, lot and deposited plan or strata plan number; less commonly, volume and folio; or, in rare cases, book and number). Current certificates of title (identifying portion or full title). Current owners/occupiers		
	Geographic coordinates related to a nearby cadastral corner of a state survey control marker. Site area and dimensions		
	Current site plan with scale bar, showing north, local water drainage and other local environmentally significant features		
	Locality map		



## CHECKLISTS AND OTHER INFORMATION

REPORT SECTION	REQUIRED INFORMATION	PRESENT? (YES/NO /NA)	COMMENTS (ACTIONS, REQUESTS, RED FLAGS)
<b>Site identification (where available) (Cont.)</b>	Trigger for assessment (for example, change in land use)		
	Controls and permissions: state or local government statutory controls assigned to the site; legal permission to access site required or obtained; consent of adjoining landowners and/or occupiers to access land (if required)		
<b>Site history (where available)</b>	Zoning and land use (previous, present and proposed). Summary of Council rezoning, relevant development and building approvals records		
	Interviews with owner, occupier, staff and/or neighbours (present and former) who have a historical knowledge of the site		
	Historical land title search. Chronological list of site uses, indicating information gaps and unoccupied periods		
	Review of aerial photographs (historical preferable to current). Review of the historical use of adjacent land		
	Site layout plans showing locations of past and present industrial processes, storage areas, waste disposal areas and areas of unknown use		
	Possible contaminant sources and potential migration pathways relevant to offsite processes.		
	Potential chemical substances associated with activities, and their environmental fate (for example, volatile, semi-volatile, miscible, soluble, persistent, organic, inorganic or bio-accumulative) <sup>2</sup>		

## CHECKLISTS AND OTHER INFORMATION

REPORT SECTION	REQUIRED INFORMATION	PRESENT? (YES/NO /NA)	COMMENTS (ACTIONS, REQUESTS, RED FLAGS)
<b>Site history (where available) (Cont.)</b>	<p>Details and locations of current and former site infrastructure, including:</p> <ul style="list-style-type: none"> <li>• current and former underground and above-ground storage tanks, fill points, and dispensing and transfer lines</li> <li>• chemical storage areas and waste disposal locations</li> <li>• product spills, losses, incidents, and accidents, including fires, with an indication of the chemicals spilled, frequency, estimates of quantity, extent of fire damage and structures affected</li> <li>• description of manufacturing processes, raw materials, chemicals and fuels associated with site use (if applicable)</li> <li>• discharges to land, water and air (authorised and unauthorised)</li> <li>• location of onsite and nearby wells and groundwater monitoring wells</li> </ul>		
	<p>Local site knowledge of residents and staff (present and former)</p>		
	<p>Details of building and related permits, licences, approvals, trade waste agreements and regulatory search, including:</p> <ul style="list-style-type: none"> <li>• complaint history – regulatory actions and legal actions</li> <li>• state and local government records on contamination for the site and surrounding areas</li> <li>• state and local government environmental records, including licensing conditions, regulatory notices, inspection records, complaints and licence breaches</li> <li>• state and local government dangerous goods records, including licensing requirements, goods licensed to store, storage licences, inspection records, complaints and licence breaches</li> </ul>		
	<p>Verification of information sources (assessment of the integrity and accuracy of the information)</p>		

## CHECKLISTS AND OTHER INFORMATION

REPORT SECTION	REQUIRED INFORMATION	PRESENT? (YES/NO /NA)	COMMENTS (ACTIONS, REQUESTS, RED FLAGS)
<b>Condition of site and surrounding environment (where available)</b>	Site inspection details, <sup>3</sup> including: <ul style="list-style-type: none"> <li>• the location and condition of all visible features, including current buildings, surface structures, roads, foundations, positions of former buildings, tanks, pits, wells, drains and bores</li> <li>• site features and infrastructure information – construction of buildings, including materials (for example, wood frame), openings and height (for example, one storey or multistorey)</li> <li>• the condition and type of surface cover (for example, bare ground, asphalt, concrete or gravel) and the estimated percentage of the site occupied by buildings, landscaped areas, paved and non-paved areas, underground petroleum storage systems, above-ground storage tanks</li> <li>• visible signs of contamination, such as discolouration or staining of soil, bare patches (both onsite and offsite adjacent to the site boundary)</li> <li>• visible signs of plant stress, quality of surface water, odours, presence of fill and flood potential</li> <li>• presence of stockpiled material, imported soil or fill material, as well as any signs of settlement, subsidence or disturbed ground.</li> <li>• evidence that chemical substances have migrated or are likely to have migrated to a neighbouring site and are or are likely to be causing contamination of the neighbouring property</li> <li>• evidence of possible naturally occurring contaminants</li> </ul>		
	Photographs of the site and surrounding adjacent land showing significant features, topography, nature of the surface and existing structures		



## CHECKLISTS AND OTHER INFORMATION

REPORT SECTION	REQUIRED INFORMATION	PRESENT? (YES/NO /NA)	COMMENTS (ACTIONS, REQUESTS, RED FLAGS)
<b>Condition of site and surrounding environment (where available) (Cont.)</b>	Topography, elevation, lithology and a summary of expected geology, hydrology, and hydrogeology. Include readily available information such as the anticipated underlying soil type and characteristics, surface water bodies and flow direction, depth to groundwater and groundwater flow direction		
	Current site use and surrounding land use, including type and density of land use (for example, industrial, commercial, residential or vacant green land)		
	Conditions at the site boundary, such as the type and condition of fencing, soil stability and erosion		
	Details of any relevant local sensitive environment (for example, rivers, lakes, creeks, wetlands, local habitat areas, and endangered flora and fauna)		
<b>Conceptual site model</b>	Conceptual site model <sup>4</sup>		
<b>Sampling and analysis quality plan (SAQP) and sampling methodology (summary of requirements)</b>	Detailed sampling, analysis and data quality objectives (DQO)		
	Rationale for the: <ul style="list-style-type: none"> <li>• sampling pattern.</li> <li>• sampling density, including an estimated size of the residual hotspots that may remain undetected</li> <li>• sampling locations, including locations shown on a site map</li> <li>• sampling depth</li> <li>• samples for analysis and samples not analysed</li> <li>• assessment criteria</li> <li>• analytical methods</li> <li>• analytes for samples</li> </ul>		

## CHECKLISTS AND OTHER INFORMATION

REPORT SECTION	REQUIRED INFORMATION	PRESENT? (YES/NO /NA)	COMMENTS (ACTIONS, REQUESTS, RED FLAGS)
<b>Field quality assurance and quality control QA/QC</b>	Include only if there is to be no further site investigations		
<b>Laboratory QA/QC</b>	Include only if there is to be no further site investigations		
<b>QA/QC data evaluation</b>	Include only if there is to be no further site investigations		
<b>If sampling is undertaken<sup>5</sup></b>			
<b>Result</b>	Summary of previous results (if applicable)		
	Summary of all results in a table that: <ul style="list-style-type: none"> <li>shows all essential details including sample numbers and sampling depth</li> <li>shows assessment criteria</li> <li>highlights all results exceeding the assessment criteria (usually colour coded)</li> </ul>		
	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 criteria for each sampling depth		
<b>Site characterisation</b>	Assessment of type of all environmental contamination, particularly soil and groundwater		
	Assessment of extent of soil and groundwater contamination, including offsite effects		
	Assessment of the chemical degradation products		
	Assessment of possible exposure routes and exposed populations (human, ecological, etc)		

## CHECKLISTS AND OTHER INFORMATION

REPORT SECTION	REQUIRED INFORMATION	PRESENT? (YES/NO /NA)	COMMENTS (ACTIONS, REQUESTS, RED FLAGS)
<b>Conclusions and recommendations</b>	Summary of all findings and a brief discussion of results		
	Detail of the assumptions used in reaching the conclusions		
	Detail of the extent of uncertainties in the results (and how they affect the conclusion or necessitate further work)		
	Where remedial action has been taken, a list summarising the activities and physical changes to the site		
	Conclusion addressing the stated objective. This may be in the form of a statement that the consultant considers the subject site to be (or not to be) suitable for the proposed use (where this conclusion can be reached)		
	Recommendations for further work (if appropriate)		

Source: NSW Environmental Protection Authority. (2020). *Consultants reporting on contaminated land: Contaminated land guidelines*; National Environment Protection Council. (November 2010). *ASC NEPM field checklist* [spreadsheet], 'Site Information' and 'SAP, QAQC' tabs.

<sup>1</sup> See the *Guide to Selecting a Consultant* fact sheet.

<sup>2</sup> Refer to *National Environment Protection (Assessment of Site Contamination) Measure 1999* Schedule B1 and Australian Standards AS 4482.1 and AS 4481.2.

<sup>3</sup> Refer to *National Environment Protection (Assessment of Site Contamination) Measure 1999* Schedule B1.

<sup>4</sup> Refer to the conceptual site model checklist (Appendix 5).

<sup>5</sup> See the 'Stage 2 – Detailed Site Investigation' tab for a review of the sampling and analysis quality plan (SAQP) including its data quality objectives, and the laboratory QA/QC and the QA/QC data evaluation.

# CHECKLISTS AND OTHER INFORMATION

## APPENDIX 2 – DETAILED SITE INVESTIGATION REPORT CHECKLIST

REPORT SECTION	REQUIRED INFORMATION	PRESENT? (YES/NO /NA)	COMMENTS (ACTIONS, REQUESTS, RED FLAGS)
<b>Document control</b>	Report date within 2 years		
	Report version, author and reviewer, including consultant certification <sup>1</sup> (for example, experienced contaminated land specialist, certified environmental practitioner)		
	Details of who commissioned the report		
<b>Executive summary</b>	Background		
	Objectives of the investigation		
	Scope of works		
	A summary of key findings, observations, and sampling results (where appropriate)		
	Summary of conclusions and recommendations		
<b>Objectives</b>	Objectives of the investigation/report and the broader objectives for the site/ investigation		
<b>Scope of work</b>	A clear statement of the scope of work performed (or work not undertaken, where relevant)		
<b>Site identification (where available)</b>	Street number, street name and suburb <sup>2</sup>		
	Property identifier (for example, lot and deposited plan number)		
	Geographic coordinates related to a nearby cadastral corner of a state survey control marker		
	Locality map		
<b>Site history or previous contamination assessment report (where available)</b>	Historical site contamination should be detailed in this section. A summary is adequate if detailed information is included in an available referenced previous report. If not, refer to the PSI checklist for information that should be included		
<b>Condition of site and surrounding environment (where available)</b>	A summary is adequate if detailed information is included in an available referenced previous report. If not, refer to the PSI checklist for information that should be included.		

## CHECKLISTS AND OTHER INFORMATION

REPORT SECTION	REQUIRED INFORMATION	PRESENT? (YES/NO /NA)	COMMENTS (ACTIONS, REQUESTS, RED FLAGS)
<b>Geology, hydrogeology and hydrology (where available)</b>	Soil stratigraphy (layers/horizons) using recognised classification methods (for example, <i>Australian Standard AS 1726-2017: Geotechnical Site Investigations</i> )		
	Location and extent of imported and locally derived fill		
	Site borehole logs or test pit logs showing stratigraphy		
	Detailed description of the location, design and construction of onsite wells		
	Description and location of springs and wells in the vicinity		
	Depth to groundwater table		
	Direction and rate of groundwater flow		
	Direction of surface water run-off		
	Background water quality		
	Preferential water courses		
	Summary of local meteorology		
<b>Sampling and analysis quality plan</b>	Sampling and analysis quality plan <sup>2</sup>		
<b>Sampling methodology<sup>3</sup></b>	Detailed description of the sampling methods, including the following: <ul style="list-style-type: none"> <li>• sample containers and type of seal used</li> <li>• sampling devices and equipment (for example, auger type)</li> <li>• equipment decontamination procedures</li> <li>• sample handling procedures</li> <li>• sample preservation methods and reference to recognised protocols: <ul style="list-style-type: none"> <li>○ water sample preservation (for example, American Public Health Standards or AS/NZS 5667.1-1998)</li> <li>○ soil sample preservation (for example, US EPA SW-846; ASC NEPM Schedule B3)</li> </ul> </li> </ul>		
	Detailed description of field sample screening protocols		

## CHECKLISTS AND OTHER INFORMATION

REPORT SECTION	REQUIRED INFORMATION	PRESENT? (YES/NO /NA)	COMMENTS (ACTIONS, REQUESTS, RED FLAGS)
<b>Basis for assessment criteria and adopted assessment criteria for the site</b>	A table listing all selected assessment criteria		
	Rationale for and appropriateness of the selected criteria		
	Assumptions and limitations of criteria		
<b>Field QA and QC (where available)</b>	Details of sampling team/personnel		
	Decontamination procedures carried out between sampling events		
	Logs for each sample collected. including time, location, initials of sampler, duplicate locations, duplicate type, chemical analyses to be performed, site observations and weather conditions		
	Chain of custody fully identified for each sample, including the sampler, nature of the sample, collection date, analyses to be performed, sample preservation method, departure time from the site and dispatch to courier		
	Sample splitting techniques		
	Statement of duplicate frequency		
	Field blank results		
	Background sample results		
	Rinsate sample results		
	Laboratory-prepared trip spike results for volatile analytes		
	Trip blank results		
Field instrument calibrations			
<b>Laboratory QA/QC (laboratory certificates attached to the report)</b>	A copy of signed chain-of-custody forms acknowledging receipt date and time, and the identity of samples included in shipments		
	Record of holding times and a comparison with method specifications		
	Analytical methods used		
	Laboratory accreditation for analytical methods used		
	Laboratory performance in inter-laboratory trials for the analytical methods used (where available)		

## CHECKLISTS AND OTHER INFORMATION

REPORT SECTION	REQUIRED INFORMATION	PRESENT? (YES/NO /NA)	COMMENTS (ACTIONS, REQUESTS, RED FLAGS)
<b>Laboratory QA/QC (laboratory certificates attached to the report) (Cont.)</b>	Description of surrogates and spikes used		
	Per cent recoveries of spikes and surrogates		
	Instrument detection limit		
	Method detection limit		
	Matrix or practical quantification limits		
	Standard solution results		
	Reference sample results		
	Reference check sample results		
	Daily check sample results		
	Laboratory duplicate results		
	Laboratory blank results		
	Laboratory standard charts		
<b>Data evaluation QA/QC</b>	An evaluation of all QA/QC information listed above against the stated data quality objectives, including a discussion of: <ul style="list-style-type: none"> <li>• documentation completeness</li> <li>• data completeness</li> <li>• data comparability</li> <li>• data representativeness</li> <li>• precision and accuracy for both sampling and analysis for each analyte in each environmental matrix informing data users of the reliability, unreliability or qualitative value of the data</li> </ul>		
	Data comparability checks, which should include an assessment of bias, which may arise from various sources, including: <ul style="list-style-type: none"> <li>• collection and analysis of samples by different personnel</li> <li>• use of different methodologies</li> <li>• collection and analysis by the same personnel using the same methods but at different times</li> <li>• spatial and temporal changes (because of environmental dynamics)</li> </ul>		
	Relative per cent differences for intra- and inter-laboratory duplicates		



## CHECKLISTS AND OTHER INFORMATION

REPORT SECTION	REQUIRED INFORMATION	PRESENT? (YES/NO /NA)	COMMENTS (ACTIONS, REQUESTS, RED FLAGS)
<b>Conceptual site model</b>	The model should outline the potential sources of contamination; consider potentially affected media and actual or potential exposure pathways; and identify human and ecological receptors. Update the model once site sampling results are received		
<b>Results</b>	A summary of all results in a table that: <ul style="list-style-type: none"> <li>• shows all essential details, including sample numbers and sampling depth</li> <li>• shows assessment criteria</li> <li>• highlights all results exceeding the assessment criteria (usually colour-coded)</li> </ul>		
	A site plan showing all sample locations, sample identification numbers and sampling depths		
	A site plan showing the extent of soil and groundwater contamination exceeding selected assessment criteria for each sampling depth		
	Summary/discussion of the analytical results and summary of previous results (if applicable)		
	Appropriate statistical procedures when comparing site data with the investigation and screening levels <sup>4</sup>		
<b>Site characterisation and discussion of results (where available)</b>	Assessment of the types of all environmental contamination, particularly soil and groundwater		
	Assessment of aesthetic issues. Assessment of secondary toxicity (if conducting an ecological risk assessment)		
	Assessment of the potential effects of contaminants on human health and built structures (for example, arising from risks to service lines from hydrocarbons in groundwater, or risks to concrete from acid sulfate soils)		
	Assessment of the extent of soil and groundwater contamination, including offsite effects		
	Assessment of possible exposure routes and exposed populations (human, ecological and so on)		
	Assessment of chemical degradation products (if applicable)		

# CHECKLISTS AND OTHER INFORMATION

REPORT SECTION	REQUIRED INFORMATION	PRESENT? (YES/NO /NA)	COMMENTS (ACTIONS, REQUESTS, RED FLAGS)
<b>Waste Management (if applicable)</b>	Waste classification details in accordance with the <a href="#">NSW EPA's Waste Classification Guidelines</a> . <sup>5</sup> Waste disposal documentation (for example, weighbridge dockets)		
<b>Conclusions and recommendations</b>	Summary of all findings		
	Detail of the assumptions used in reaching the conclusions		
	Detail of the extent of uncertainties in the results		
	Where remediation action has been taken, a list summarising the activities and physical changes to the site		
	A clear statement that the consultant considers the subject site to be suitable (or not) for the proposed use (where applicable)		
	Recommendations for further work (where applicable)		
<b>Appendices</b>	Attached appendices: <ul style="list-style-type: none"> <li>• site figures</li> <li>• tables showing laboratory analytical results</li> <li>• land title records, council records and certificates, Bureau of Meteorology records</li> <li>• groundwater record search results</li> <li>• EPA record search results</li> <li>• construction drawings and development plans for the site</li> <li>• field borehole and test pit logs</li> <li>• laboratory documents including, chain-of-custody forms and certificates of analysis</li> <li>• field equipment calibration certificates</li> <li>• groundwater monitoring event field forms, gas field forms</li> <li>• well survey data</li> <li>• ProUCL software results</li> </ul>		

**Note:** PSI = preliminary site investigation; ASC NEPM = National Environment Protection (Assessment of Site Contamination) Measure 1999; QA = quality assurance; QC = quality control.

**Source:** NSW Environmental Protection Authority. (2020). *Consultants reporting on contaminated land: Contaminated land guidelines*; National Environment Protection Council. (November 2010). *ASC NEPM field checklist* [spreadsheet], 'SAP, QAQC', 'Soil', 'Groundwater', 'Surface Water' and 'Soil Gas' tabs; NSW Environmental Protection Authority. (2017). *Contaminated land management: Guidelines for the NSW site auditor scheme* (3rd ed.).

<sup>1</sup> See the *Guide to Selecting a Consultant* fact sheet.

<sup>2</sup> Refer to PSI checklist (Appendix 1) for information that should be included.

<sup>3</sup> Key NSW EPA approved methods guidance for:

- water – <https://www.epa.nsw.gov.au/your-environment/water/polices-guidelines-and-programs>
- air – <https://www.epa.nsw.gov.au/your-environment/air/industrial-emissions/modelling-assessing-air-emissions>
- noise – <https://www.epa.nsw.gov.au/your-environment/noise/regulating-noise/noise-guide-local-government>.

<sup>4</sup> Refer to ASC NEPM Schedule B1 sections 2–4.

<sup>5</sup> <https://www.epa.nsw.gov.au/your-environment/waste/classifying-waste/waste-classification-guidelines>

# CHECKLISTS AND OTHER INFORMATION

## APPENDIX 3 – REMEDIATION ACTION PLAN REPORT CHECKLIST

REPORT SECTION	REQUIRED INFORMATION	PRESENT? (YES/NO /NA)	COMMENTS (ACTIONS, REQUESTS, RED FLAGS)
<b>Document control</b>	Report date within 2 years		
	Report version, author and reviewer, including consultant certification <sup>1</sup> (for example, experienced contaminated land specialist, certified environmental practitioner)		
	Details of who commissioned the report		
<b>Executive summary</b>	Background		
	Objectives of the remediation		
	Summary of the selected scope of remediation works		
<b>Scope of work</b>	A clear statement of the scope of work		
<b>Site identification (where available)</b>	Street number, street name and suburb		
	Property identifier (for example, lot and deposited plan number).		
	Geographic coordinates related to a nearby cadastral corner of a state survey control marker		
	Locality map		
<b>Site history or previous contamination assessment report (where available)</b>	A summary is adequate if detailed information is included in an available referenced previous report. If not, refer to the PSI checklist for information that should be included		
<b>Condition of site and surrounding environment (where available)</b>	A summary is adequate if detailed information is included in an available referenced previous report. If not, refer to the PSI checklist for information that should be included.		
<b>Geology, hydrogeology and hydrology (where available)</b>	A summary is adequate if detailed information is included in an available referenced previous report. If not, refer to the DSI checklist for information that should be included.		
<b>Previous contamination assessments (where available)</b>	A summary of previous contamination assessment reports for the site (PSI, DSI and site assessment reports)		
<b>Data gap assessment</b>	Data gaps in previous assessments for the site and provisions for addressing them during the remediation works (Note: This can lead to a pre-remediation conceptual site model)		

## CHECKLISTS AND OTHER INFORMATION

REPORT SECTION	REQUIRED INFORMATION	PRESENT? (YES/NO /NA)	COMMENTS (ACTIONS, REQUESTS, RED FLAGS)
<b>Remediation criteria</b>	A table listing all selected remediation criteria and references		
	A rationale for the selection of criteria, including assumptions and limitations of the criteria and any deviations from the approved guidelines		
	Development of a rationale for any site-specific remediation criteria through a site-specific risk assessment <sup>1</sup>		
	Refer to the <i>PFAS NEMP</i> <sup>2</sup> or guidance on environmental levels that indicate the need for action		
<b>Results</b>	A summary is adequate if detailed information is included in an available referenced previous DSI report. In this case, provide previous tabulated results relating to the remediation action plan that: <ul style="list-style-type: none"> <li>• show all essential details, such as sample identification numbers and sampling depths</li> <li>• show remediation assessment criteria</li> <li>• highlight all results exceeding any remediation criteria</li> </ul>		
	Sample descriptions for all media, where applicable (for example, soil, sediment, surface water, groundwater and biota)		
	Site plan showing all sample locations		
	Site plans showing the extent of soil and groundwater contamination exceeding selected remediation criteria for each sampling depth, including sample identification numbers and sampling depths of all samples analysed		
	Site plans showing the proposed extent of remediation		
<b>Site characterisation (where available)</b>	A summary is adequate if detailed information is included in an available referenced previous report		
	Assessment of the types of all environmental contamination		
	Assessment of the extent of all identified contamination, including offsite areas		
<b>Conceptual site model</b>	Conceptual site model <sup>3</sup>		



## CHECKLISTS AND OTHER INFORMATION

REPORT SECTION	REQUIRED INFORMATION	PRESENT? (YES/NO /NA)	COMMENTS (ACTIONS, REQUESTS, RED FLAGS)
<b>Remediation options</b>	Description of remediation objectives		
<b>Assessment and remediation strategy (where available)</b>	A review of possible remediation options		
	Rationale for the selection of the recommended remediation option, in accordance with the preferred hierarchy of site remediation and/or management <sup>4</sup>		
	Description of the remediation works to be undertaken		
	Description of criteria for acceptance of fill material – must be virgin excavated natural material, excavated natural material or otherwise classified under a resource recovery order and assessed as suitable for use at the site		
	A validation plan that includes proposed testing to validate the site during and after remediation, including a sampling and analysis quality plan		
	Contingency plan if the selected remediation strategy fails		
	Interim site management plan before remediation, including fencing, erection of warning signs, stormwater diversion and so on. Site management plan during remediation. Detailed construction environment management plans consisting of the following (remediation technology-specific) plans: <ul style="list-style-type: none"> <li>• noise control</li> <li>• dust control</li> <li>• odour control</li> <li>• soil management</li> <li>• stormwater management</li> <li>• unexpected finds protocol</li> <li>• contingency plans to respond to site incidents, to remove potential effects on the surrounding environment and community</li> </ul>		
	Description of regulatory compliance requirements, such as licences and approvals or financial assurance		
<b>Waste management (if applicable)</b>	Waste classification reporting requirements in accordance with <a href="#">NSW EPA's Waste Classification Guidelines</a> . <sup>5</sup> Description of material handling and tracking plan. Statements regarding materials being disposed via an appropriately licensed facility or re-used under an order or exemption. Waste disposal docket or other waste documentation for any disposed waste <sup>6</sup>		

## CHECKLISTS AND OTHER INFORMATION

REPORT SECTION	REQUIRED INFORMATION	PRESENT? (YES/NO /NA)	COMMENTS (ACTIONS, REQUESTS, RED FLAGS)
<b>Remediation technology pilot trial (if applicable)</b>	Details and results from treatability trials, and proof of performance testing, to demonstrate that the remediation option chosen was suitable for the site (for major remediation projects). If trials have not been completed, include an indicative scope of the proposed trial		
<b>Conclusions and recommendations</b>	Conclusions addressing the stated objectives, and a summary of the proposed remediation activities		
	Any assumptions used in reaching the conclusions		
	A clear statement as to why the consultant considers that the site can be made suitable for the proposed use if the remediation action plan is implemented		
	A summary of proposed limitations and constraints on the use of the site post-remediation. The proposed environmental management plan for long-term management of residual contamination at the site (where applicable)		
	Recommendations for further work, if appropriate		

**Note:** PSI = preliminary site investigation; DSI = detailed site investigation; ASC NEPM = National Environment Protection (Assessment of Site Contamination) Measure 1999; PFAS NEMP = PFAS National Environmental Management Plan.

**Source:** NSW Environmental Protection Authority. (2020). *Consultants reporting on contaminated land: Contaminated land guidelines*; National Environment Protection Council. (November 2010). *ASC NEPM field checklist* [spreadsheet], 'SAP, QAQC', 'Soil', 'Groundwater', 'Surface Water' and 'Soil Gas' tabs; NSW Environmental Protection Authority. (2017). *Contaminated land management: Guidelines for the NSW site auditor scheme* (3rd ed.).

<sup>1</sup> Refer to ASC NEPM Schedules B4, B5a, B5b, B5c, B6 and B7.

<sup>2</sup> National Chemicals Working Group, Heads of the EPAs of Australia and New Zealand. (January 2020). *PFAS National Environmental Management Plan* (version 2.0).

<sup>3</sup> Refer to the conceptual site model checklist (Appendix 5).

<sup>4</sup> National Environment Protection Council. (n.d.). *Key principles for the remediation & management of contaminated sites* [draft].

<sup>5</sup> <https://www.epa.nsw.gov.au/your-environment/waste/classifying-waste/waste-classification-guidelines>

<sup>6</sup> For waste management requirements, refer to section 4.3.7 ('Waste Management') of the NSW Environmental Protection Authority's *Contaminated Land Management: Guidelines for the NSW Site Auditor Scheme*.

# CHECKLISTS AND OTHER INFORMATION

## APPENDIX 4 – VALIDATION REPORT CHECKLIST

REPORT SECTION	REQUIRED INFORMATION	PRESENT? (YES/NO /NA)	COMMENTS (ACTIONS, REQUESTS, RED FLAGS)
<b>Document control</b>	Report date within 2 years		
	Report version, author and reviewer, including consultant certification <sup>1</sup> (for example, experienced contaminated land specialist, certified environmental practitioner)		
	Details of who commissioned the report		
<b>Executive summary</b>	Background		
	Objectives of the investigation		
	Scope of works		
	A summary of sampling (where appropriate)		
	Summary of conclusions and recommendations		
<b>Scope of work</b>	A clear statement of the scope of work		
<b>Site identification (where available)</b>	Street number, street name and suburb		
	Property identifier (for example, lot and deposited plan number)		
	Geographic coordinates related to a nearby cadastral corner of a state survey control marker		
	Locality map		
<b>Site history or previous contamination assessment report (where available)</b>	A summary is adequate if detailed information is included in an available referenced previous report. If not, refer to the DSI checklist for information that should be included		
<b>Condition of site and surrounding environment (where available)</b>	A summary is adequate if detailed information is included in an available referenced previous report. If not, refer to the DSI checklist for information that should be included.		
<b>Previous results</b>	A summary of previous results		
<b>Conceptual site model</b>	Conceptual site model <sup>1</sup>		
<b>Implementation of remediation action plan (where available)</b>	A summary of the remediation plan. Remediation objectives and criteria, including a table listing all selected remediation criteria and references		

## CHECKLISTS AND OTHER INFORMATION

REPORT SECTION	REQUIRED INFORMATION	PRESENT? (YES/NO /NA)	COMMENTS (ACTIONS, REQUESTS, RED FLAGS)
<b>Implementation of remediation action plan (where available) (Cont.)</b>	A description of remediation activities with any deviations from the remediation action plan (for example, volumes and characteristics of material treated or disposed, and the design of permanent treatment installations)		
	Plans showing areas remediated and areas of residual contamination or subsurface structures		
	A summary and evidence (for example, documentation) of compliance with regulatory requirements set by the regulatory authority and local government		
	Contractor reports, dates of operation, field inspection checklists and photolog (as appropriate)		
<b>Sampling and analysis quality plan, and sampling methodology</b>	Sampling and analysis quality plan, and sampling methodology <sup>2</sup>		
<b>Validation results and discussion</b>	A summary of all results in a table: <ul style="list-style-type: none"> <li>• showing all essential details, such as sample identification numbers and sampling depths</li> <li>• showing remediation criteria</li> <li>• highlighting all results exceeding remediation criteria (not just the highest)</li> </ul>		
	Sample descriptions for all media, where applicable (for example, soil, sediment, surface water, groundwater and biota).		
	Test pit or bore logs (well construction details, where appropriate; for example, groundwater levels expressed in Australian height datum)		
	Site plans or excavation logs showing all sample locations, photoionisation detector results, lithology changes and field observations (if appropriate)		
	Site plans showing the extent of soil and groundwater contamination exceeding remediation criteria for each sampling depth, including identification numbers and depths of all samples analysed (with concentrations of contaminants remaining onsite clearly marked)		
	Appropriate statistical procedures when comparing site data with the investigation and screening levels <sup>4</sup>		



# CHECKLISTS AND OTHER INFORMATION

REPORT SECTION	REQUIRED INFORMATION	PRESENT? (YES/NO /NA)	COMMENTS (ACTIONS, REQUESTS, RED FLAGS)
<b>Data evaluation quality assurance and quality control</b>	Assessment of the implementation of the validation plan from the remediation action plan, with justification for departures (if necessary)		
	Details of a statistical analysis of validation results and evaluation against the remediation criteria		
	Verification of compliance with regulatory requirements set by the EPA, SafeWork NSW and the consent authority		
	Identification and discussion of ongoing management or monitoring (if required)		
<b>Waste Management (if applicable)</b>	Waste classification reporting requirements in accordance with <a href="#">NSW EPA's Waste Classification Guidelines</a> . <sup>4</sup> Description of material handling and tracking plan. Statements regarding materials being disposed via an appropriately licensed facility or re-used under an order or exemption. Waste disposal dockets or other waste documentation for any disposed waste. Tank destruction certificates for underground storage tanks or a copy of notices of in-situ underground storage tank decommissioning provided to SafeWork NSW <sup>5</sup>		
<b>Conclusions and recommendations</b>	Summary of all findings		
	All conclusions addressing the stated objectives		
	Detail of the assumptions used in reaching the conclusions and the extent of uncertainties in the results		
	A clear statement that the consultant considers the site to be suitable for the proposed use (where applicable)		
	A clear statement of proposed limitations and constraints on the use of the site post-remediation. A proposed environmental management plan for long-term management of residual contamination at the site (where applicable)		
	Recommendations for further work, if appropriate, and any ongoing management or monitoring clearly stated (if required)		

**Note:** DSI = detailed site investigation; ASC NEPM = National Environment Protection (Assessment of Site Contamination) Measure 1999.

**Source:** NSW Environmental Protection Authority. (2020). *Consultants reporting on contaminated land: Contaminated land guidelines*; National Environment Protection Council. (November 2010). *ASC NEPM field checklist* [spreadsheet], 'SAP, QAQC', 'Soil', 'Groundwater', 'Surface Water' and 'Soil Gas' tabs; NSW Environmental Protection Authority. (2017). *Contaminated land management: Guidelines for the NSW site auditor scheme (3rd ed.)*.

<sup>1</sup> Refer to the conceptual site model checklist (Appendix 5).

<sup>2</sup> Refer to the preliminary site investigation checklist (Appendix 1).

<sup>3</sup> Refer to ASC NEPM Schedule B1 sections 2–4.

<sup>4</sup> <https://www.epa.nsw.gov.au/your-environment/waste/classifying-waste/waste-classification-guidelines>

<sup>5</sup> For waste management requirements, refer to section 4.3.7 ('Waste Management') of the NSW Environmental Protection Authority's *Contaminated Land Management: Guidelines for the NSW Site Auditor Scheme*.

## APPENDIX 5 – CONCEPTUAL SITE MODEL CHECKLIST

REPORT SECTION	REQUIRED INFORMATION	PRESENT? (YES/NO /NA)	COMMENTS (ACTIONS, REQUESTS, RED FLAGS)
<b>All reports and all stages of reporting</b>	Regional and local geology, hydrogeology and hydrology items from the 'CSM' tab of the <i>ASC NEPM Field Checklist</i>		
	List of potential contaminants of concern		
	Potential and known sources of contamination, onsite and offsite		
	Mechanism of contamination (for example, top-down spill, subsurface release from tank or pipe, atmospheric, or deposition)		
	Potentially affected environmental media		
	Consideration of spatial and temporal variations (for example, weather)		
	Actual or potential exposure pathways. Consideration of preferential pathways for contaminant migration		
	Human and ecological receptors		
	Frequency of exposure		
	Linkage of source, pathway and receptor, assessed in terms of potentially complete pathways and likelihood		
	Discussion of multiple lines of evidence (for complex sites)		
<b>Other sections</b>	Previous site investigations, contaminant characteristics, meteorological data, data gap identification, sources of variability and other CSM items from the 'CSM' tab of the <i>ASC NEPM Field Checklist</i>		

**Note:** A conceptual site model should be continually updated as more information and data are gained through site investigations and remediation.

**Source:** NSW Environmental Protection Authority. (2020). *Consultants reporting on contaminated land: Contaminated land guidelines*; National Environment Protection Council. (November 2010). *ASC NEPM field checklist* [spreadsheet]; NSW Environmental Protection Authority. (2017). *Contaminated land management: Guidelines for the NSW site auditor scheme (3rd ed.)*.

**APPENDIX 6 –  
HEALTH INVESTIGATION LEVELS AND HEALTH SCREENING LEVELS**

**Table A6.1:** Health investigation levels for soil contaminants

CHEMICAL	HILs (mg/kg) for soil contaminants <sup>1</sup>			
	Residential A	Residential B	Recreational C	Commercial/ industrial D
<b>Metals and inorganics</b>				
<b>Arsenic<sup>2</sup></b>	100	500	300	3,000
<b>Beryllium</b>	60	90	90	500
<b>Boron</b>	4,500	40,000	20,000	300,000
<b>Cadmium</b>	20	150	90	900
<b>Chromium (VI)</b>	100	500	300	3,600
<b>Cobalt</b>	100	600	300	4,000
<b>Copper</b>	6,000	30,000	17,000	240,000
<b>Lead<sup>3</sup></b>	300	1,200	600	1,500
<b>Manganese</b>	3,800	14,000	19,000	60,000
<b>Mercury (inorganic)<sup>4</sup></b>	40	120	80	730
<b>Methyl mercury<sup>5</sup></b>	10	30	13	180
<b>Nickel</b>	400	1,200	1,200	6,000
<b>Selenium</b>	200	1,400	700	10,000
<b>Zinc</b>	7,400	60,000	30,000	400,000
<b>Cyanide (free)</b>	250	300	240	1,500
<b>PAHs</b>				
<b>Carcinogenic PAHs (as B(a)P TEQ)<sup>6</sup></b>	3	4	3	40
<b>Total PAHs<sup>7</sup></b>	300	400	300	4,000
<b>Phenols</b>				
<b>Phenol</b>	3,000	45,000	40,000	240,000
<b>Pentachlorophenol</b>	100	130	120	660
<b>Cresols</b>	400	4,700	4,000	25,000
<b>Organochlorine pesticides</b>				
<b>DDT + DDE + DDD</b>	240	600	400	3,600
<b>Aldrin and dieldrin</b>	6	10	10	45
<b>Chlordane</b>	50	90	70	530
<b>Endosulfan</b>	270	400	340	2,000
<b>Endrin</b>	10	20	20	100
<b>Heptachlor</b>	6	10	10	50
<b>HCB</b>	10	15	10	80
<b>Methoxychlor</b>	300	500	400	2,500
<b>Mirex</b>	10	20	20	100
<b>Toxaphene</b>	20	30	30	160

# CHECKLISTS AND OTHER INFORMATION

CHEMICAL	HILs (mg/kg) for soil contaminants <sup>1</sup>			
	Residential A	Residential B	Recreational C	Commercial/ industrial D
<b>Herbicides</b>				
<b>2,4,5-T</b>	600	900	800	5,000
<b>2,4-D</b>	900	1,600	1,300	9,000
<b>MCPA</b>	600	900	800	5,000
<b>MCPB</b>	600	900	800	5,000
<b>Mecoprop</b>	600	900	800	5,000
<b>Picloram</b>	4,500	6,600	5,700	35,000
<b>Other pesticides</b>				
<b>Atrazine</b>	320	470	400	2,500
<b>Chlorpyrifos</b>	160	340	250	2,000
<b>Bifenthrin</b>	600	840	730	4,500
<b>Other organics</b>				
<b>PCBs<sup>8</sup></b>	1	1	1	7
<b>PBDE flame retardants (Br1-Br9)</b>	1	2	2	10

**Note:** HIL = health investigation level; PAH = polycyclic aromatic hydrocarbons; B(a)P = benzo(a)pyrene; TEQ = toxic equivalency quotient; DDT = dichlorodiphenyltrichloroethane; DDE = dichlorodiphenyldichloroethylene; DDD = dichlorodiphenyldichloroethane; HCB = Hexachlorobenzene; MCPA = 2-methyl-4-chlorophenoxyacetic acid; MCPB = 4-(4-chloro-o-tolyloxy)butyric acid; PCB = polychlorinated biphenyl; PBDE = Polybrominated diphenyl ether; TEF = toxic equivalency factor.

<sup>1</sup> Generic land uses are described in Schedule B7 section 3:

- HIL A (Residential A) – residential with garden/accessible soil (homegrown produce < 10% fruit and vegetable intake; no poultry); also includes childcare centres, preschools and primary schools
- HIL B (Residential B) – residential with minimal opportunities for soil access; includes dwellings with fully and permanently paved yard space such as high-rise buildings and apartments
- HIL C (Recreational C) – public open spaces, such as parks, playgrounds, playing fields (for example, ovals), secondary schools and footpaths. This does not include undeveloped public open space where the potential for exposure is lower and where a site-specific assessment may be more appropriate
- HIL D (Commercial/industrial D) – commercial/industrial, including premises such as shops, offices, factories and industrial sites.

<sup>2</sup> Arsenic: HIL assumes 70% oral bioavailability. Site-specific bioavailability may be important and should be considered where appropriate (see Schedule B7).

<sup>3</sup> Lead: HIL is based on blood lead models – Integrated Exposure Uptake Biokinetic model for HILs A, B and C, and adult lead model for HIL D where 50% oral bioavailability has been considered. Site-specific bioavailability may be important and should be considered where appropriate.

<sup>4</sup> Elemental mercury: HIL does not address elemental mercury. A site-specific assessment should be considered if elemental mercury is or is suspected to be present.

<sup>5</sup> Methyl mercury: Assessment of methyl mercury should only occur where there is evidence of its potential source. It may be associated with inorganic mercury and anaerobic microorganism activity in aquatic environments. In addition, the reliability and quality of sampling/analysis should be considered.

<sup>6</sup> Carcinogenic PAHs: HIL is based on the 8 carcinogenic PAHs and their TEFs (potency relative to B(a)P), adopted by the Canadian Council of the Ministers of the Environment; see Schedule B7). The B(a)P TEQ is calculated by multiplying the concentration of each carcinogenic PAH in the sample by its B(a)P TEF, given below, and summing these products. Where the B(a)P occurs in bitumen fragments, it is relatively immobile and does not represent a significant health risk.

PAH species	TEF	PAH species	TEF
Benzo(a)anthracene	0.1	Benzo(g,h,i)perylene	0.01
Benzo(a)pyrene	1	Chrysene	0.01
Benzo(b+j)fluoranthene	0.1	Dibenz(a,h)anthracene	1
Benzo(k)fluoranthene	0.1	Indeno(1,2,3-c,d)pyrene	0.1

<sup>7</sup> Total PAHs: HIL is based on the sum of the 16 PAHs most commonly reported for contaminated sites (World Health Organization, 1998). The application of the total PAH HIL should consider the presence of carcinogenic PAHs and naphthalene (the most volatile PAH). Carcinogenic PAHs reported in the total PAHs should meet the B(a)P TEQ HIL. Naphthalene reported in the total PAHs should meet the relevant health screening level.

<sup>8</sup> PCBs: HIL relates to non-dioxin-like PCBs only. Where a PCB source is known or suspected to be present at a site, a site-specific assessment of exposure to all PCBs (including dioxin-like PCBs) should be undertaken.

**Source:** National Environment Protection (Assessment of Site Contamination) Measure 1999 Schedules B1 Table 1A(1), B7.



# CHECKLISTS AND OTHER INFORMATION

**Table A6.2:** Health screening levels for soil contaminants (mg/kg)

CHEMICAL	HSL A & HSL B: Low- and high-density residential				HSL C: Recreational and open space				HSL D: Commercial and industrial				Csat
	0 to < 1m	1 to < 2m	2 to < 4m	4+ m	0 to < 1m	1 to < 2m	2 to < 4m	4+ m	0 to < 1m	1 to < 2m	2 to < 4m	4+ m	
<b>Sand</b>													
Toluene	160	220	310	540	NL	NL	NL	NL	NL	NL	NL	NL	560
Ethylbenzene	55	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	64
Xylenes	40	60	95	170	NL	NL	NL	NL	230	NL	NL	NL	300
Naphthalene	3	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	9
Benzene	0.5	0.5	0.5	0.5	NL	NL	NL	NL	3	3	3	3	360
F1 <sup>a</sup>	45	70	110	200	NL	NL	NL	NL	260	370	630	NL	950
F2 <sup>b</sup>	110	240	440	NL	NL	NL	NL	NL	NL	NL	NL	NL	560
<b>Silt</b>													
Toluene	390	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	640
Ethylbenzene	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	69
Xylenes	95	210	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	330
Naphthalene	4	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	10
Benzene	0.6	0.7	1	2	NL	NL	NL	NL	4	4	6	10	440
F1 <sup>a</sup>	40	65	100	190	NL	NL	NL	NL	250	360	590	NL	910
F2 <sup>b</sup>	230	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	570
<b>Clay</b>													
Toluene	480	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	630
Ethylbenzene	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	68
Xylenes	110	310	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	330
Naphthalene	5	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	10
Benzene	0.7	1	2	3	NL	NL	NL	NL	4	6	9	20	430
F1 <sup>a</sup>	50	90	150	290	NL	NL	NL	NL	310	480	NL	NL	850
F2 <sup>b</sup>	280	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	560

**Note:** HSL = health screening level; Csat = soil saturation concentration; NL = not limiting.

- Land-use settings are equivalent to those described in Table A6.1 note 1 above and in Schedule B7 of the National Environment Protection (Assessment of Site Contamination) Measure 1999. HSLs for vapour intrusion for high-density residential assume residential occupation of the ground floor. If communal car parks or commercial properties occupy the ground floor, HSL D should be used.
- The key limitations of the HSLs presented in Friebel and Nadebaum (2011b; 2011d) should be referred to prior to application.
- Detailed assumptions in the derivation of the HSLs and information on how to apply the HSLs are presented in Friebel and Nadebaum (2011a; 2011b).
- Soil HSLs for vapour inhalation incorporate an adjustment factor of 10, applied to the vapour phase partitioning to reflect the differences observed between theoretical estimates of soil vapour partitioning and field measurements (see Friebel & Nadebaum, 2011a).
- The soil saturation concentration (Csat) is defined as the soil concentration at which the porewater phase cannot dissolve any more of an individual chemical. The soil vapour that is in equilibrium with the porewater will be at its maximum. If the derived soil HSL exceeds Csat, a soil vapour source concentration for a petroleum mixture could not exceed a level that would result in the maximum allowable vapour risk for the given scenario. For these scenarios, no HSL is presented for these chemicals, and the HSL is shown as 'NL'.
- The HSLs for total petroleum hydrocarbons C<sub>6</sub>-C<sub>10</sub> in sandy soil are based on a finite source that depletes in less than 7 years, and, therefore, consideration has been given to use of sub-chronic toxicity values. The > C<sub>6</sub>-C<sub>10</sub> aliphatic toxicity has been adjusted to represent sub-chronic exposure, resulting in higher HSLs than if based on chronic toxicity. For further information, refer to both section 8.2 and Appendix J in Friebel and Nadebaum (2011a).
- The figures in this table may be multiplied by a factor to account for biodegradation of vapour. A factor of 10 may apply for source depths from 2 metres to less than 4 metres, or a factor of 100 for source depths of 4 metres and deeper. To apply the attenuation factor for vapour degradation, a number of conditions must be satisfied. First, the maximum length of the shorter side of the concrete slab and surrounding pavement cannot exceed 15 metres, as this would prevent oxygen from penetrating to the centre of the slab. Second, a measurement of oxygen in the subsurface is required to determine the potential for biodegradation. Oxygen must be confirmed to be present at > 5% to use these factors.
- For soil texture classification undertaken in accord with AS 1726, the classifications of sand, silt and clay may be applied as coarse, fine with liquid limit < 50%, and fine with liquid limit > 50%, respectively, as the underlying properties to develop the HSLs may reasonably be selected to be similar. Where there is uncertainty, either a conservative approach may be adopted, or laboratory analysis should be carried out.

<sup>a</sup> To obtain F1, subtract the sum of BTEX (benzene, toluene, ethylbenzene and xylene) concentrations from the C<sub>6</sub>-C<sub>10</sub> fraction.

<sup>b</sup> To obtain F2, subtract naphthalene from the > C<sub>10</sub>-C<sub>16</sub> fraction.

**Source:** National Environment Protection (Assessment of Site Contamination) Measure 1999 Schedule B1 Table 1A(3).

# CHECKLISTS AND OTHER INFORMATION

**Table A6.3:** Health screening levels for groundwater contaminants (mg/L)

CHEMICAL	HSL A & HSL B: Low- and high-density residential			HSL C: Recreational and open space			HSL D: Commercial and industrial			Solubility limit
	2 to < 4m	4 to < 8m	8+ m	2 to < 4m	4 to < 8m	8+ m	2 to < 4m	4 to < 8m	8+ m	
<b>Sand</b>										
Toluene	NL	NL	NL	NL	NL	NL	NL	NL	NL	61
Ethylbenzene	NL	NL	NL	NL	NL	NL	NL	NL	NL	3.9
Xylenes	NL	NL	NL	NL	NL	NL	NL	NL	NL	21
Naphthalene	NL	NL	NL	NL	NL	NL	NL	NL	NL	0.17
Benzene	0.8	0.8	0.9	NL	NL	NL	5	5	5	59
F1 <sup>a</sup>	1	1	1	NL	NL	NL	6	6	7	9.0
F2 <sup>b</sup>	1	1	1	NL	NL	NL	NL	NL	NL	3.0
<b>Silt</b>										
Toluene	NL	NL	NL	NL	NL	NL	NL	NL	NL	61
Ethylbenzene	NL	NL	NL	NL	NL	NL	NL	NL	NL	3.9
Xylenes	NL	NL	NL	NL	NL	NL	NL	NL	NL	21
Naphthalene	NL	NL	NL	NL	NL	NL	NL	NL	NL	0.17
Benzene	4	5	5	NL	NL	NL	30	30	30	59
F1 <sup>a</sup>	6	6	6	NL	NL	NL	NL	NL	NL	9.0
F2 <sup>b</sup>	NL	NL	NL	NL	NL	NL	NL	NL	NL	3.0
<b>Clay</b>										
Toluene	NL	NL	NL	NL	NL	NL	NL	NL	NL	61
Ethylbenzene	NL	NL	NL	NL	NL	NL	NL	NL	NL	3.9
Xylenes	NL	NL	NL	NL	NL	NL	NL	NL	NL	21
Naphthalene	NL	NL	NL	NL	NL	NL	NL	NL	NL	0.17
Benzene	5	5	5	NL	NL	NL	30	30	35	59
F1 <sup>a</sup>	NL	NL	NL	NL	NL	NL	NL	NL	NL	9.0
F2 <sup>b</sup>	NL	NL	NL	NL	NL	NL	NL	NL	NL	3.0

**Note:** HSL = health screening level; NL = not limiting.

- Land-use settings are equivalent to those described in Table A6.1 note 1 above and in Schedule B7 of the *National Environment Protection (Assessment of Site Contamination) Measure 1999*. HSLs for vapour intrusion for high-density residential assume residential occupation of the ground floor. If communal car parks or commercial properties occupy the ground floor, HSL D should be used.
- The key limitations of the HSLs presented in Friebel and Nadebaum (2011d) should be referred to prior to application.
- Detailed assumptions in the derivation of the HSLs and information on how to apply the HSLs are presented in Friebel and Nadebaum (2011a; 2011b).
- The solubility limit is defined as the groundwater concentration at which the water cannot dissolve any more of an individual chemical based on a petroleum mixture. The soil vapour that is in equilibrium with the groundwater will be at its maximum. If the derived groundwater HSL exceeds the water solubility limit, a soil vapour source concentration for a petroleum mixture could not exceed a level that would result in the maximum allowable vapour risk for the given scenario. For these scenarios, no HSL is presented for these chemicals, and the HSL is shown as 'NL'.
- The figures in this table may be multiplied by a factor to account for biodegradation of vapour. A factor of 10 may apply for source depths from 2 metres to less than 4 metres or a factor of 100 for source depths of 4 metres and deeper. To apply the attenuation factor for vapour degradation, a number of conditions must be satisfied. First, the maximum length of the shorter side of the concrete slab and surrounding pavement cannot exceed 15 metres, as this would prevent oxygen from penetrating to the centre of the slab. Second, a measurement of oxygen in the subsurface is required to determine the potential for biodegradation. Oxygen must be confirmed to be present at > 5% to use these factors.
- For soil texture classification undertaken in accord with AS 1726, the classifications of sand, silt and clay may be applied as coarse, fine with liquid limit < 50%, and fine with liquid limit > 50%, respectively, as the underlying properties to develop the HSLs may reasonably be selected to be similar. Where there is uncertainty, either a conservative approach may be adopted, or laboratory analysis should be carried out.

<sup>a</sup> To obtain F1, subtract the sum of BTEX (benzene, toluene, ethylbenzene and xylene) concentrations from the C<sub>6</sub>-C<sub>10</sub> fraction.

<sup>b</sup> To obtain F2, subtract naphthalene from the > C<sub>10</sub>-C<sub>16</sub> fraction.

**Source:** *National Environment Protection (Assessment of Site Contamination) Measure 1999* Schedule B1 Table 1A(4).

## APPENDIX 7 – GROUNDWATER INVESTIGATION LEVELS (METAL AND INORGANIC COMPOUNDS)

Substance	Groundwater investigation levels		
	Fresh waters <sup>(a)</sup> (µg/L)	Marine waters <sup>(a)</sup> (µg/L)	Drinking water <sup>(b)</sup> (mg/L)
<b>Metals and metalloids</b>			
Aluminium, pH > 6.5	55	–	–
Aluminium, pH < 6.5	0.8 <sup>c</sup>	–	–
Antimony	9 <sup>c</sup>	–	0.003
Arsenic	24, as As (III) 13, as As(V)	–	0.01
Barium	–	–	2
Beryllium	–	–	0.06
Boron	940	–	4
Cadmium <sup>(d)</sup>	0.2	0.7 <sup>e</sup>	0.002
Chromium (III) <sup>(d)</sup>	3.3 <sup>c</sup>	27	–
Chromium (VI)	1 <sup>f</sup>	4.4	0.05
Cobalt	1.4 <sup>c</sup>	1	–
Copper <sup>(d)</sup>	1.4	1.3	2
Lead <sup>(d)</sup>	3.4	4.4	0.01
Manganese	1,900 <sup>f</sup>	80 <sup>c</sup>	0.5
Mercury (total)	0.06 <sup>e</sup>	0.1 <sup>e</sup>	0.001
Molybdenum	34 <sup>c</sup>	–	0.05
Nickel <sup>(d)</sup>	11	70	0.02
Selenium (total)	5 <sup>e</sup>	–	0.01
Silver	0.05 <sup>c</sup>	1.4	0.1
Tributyl tin (as Sn)	–	0.006 <sup>f</sup>	–
Tributyl tin oxide (organotin)	–	–	0.001
Uranium	0.5 <sup>c</sup>	–	0.017
Vanadium	6 <sup>c</sup>	100	–
Zinc <sup>(d)</sup>	8 <sup>f</sup>	8 <sup>f</sup>	–

(Continued on next page)

## CHECKLISTS AND OTHER INFORMATION

Substance	Groundwater investigation levels		
	Fresh waters <sup>(a)</sup> (µg/L)	Marine waters <sup>(a)</sup> (µg/L)	Drinking water <sup>(b)</sup> (mg/L)
<b>Monocyclic Aromatic Hydrocarbons</b>			
Benzene	950	700 <sup>f</sup>	0.001
Toluene	180 <sup>c</sup>	180 <sup>c</sup>	0.8
Ethylbenzene	80 <sup>c</sup>	80 <sup>c</sup>	0.3
Xylenes	75 <sup>c</sup> (m-xylene) 350 <sup>c</sup> (o-xylene) 200 <sup>c</sup> (p-xylene)	75 <sup>c</sup> (m-xylene) The freshwater values can be used with care and caution.	0.6
<b>Polycyclic aromatic hydrocarbons</b>			
Naphthalene	16 <sup>c</sup>	70 <sup>f</sup>	–
Benzo(a)pyrene	0.1 <sup>e</sup>	0.1 <sup>e</sup>	0.00001
<b>PFAS</b>			
PFOA	0.019 <sup>e,g</sup>	0.019 <sup>e,g,h</sup>	0.00056
PFOS (and PFHxS for drinking water)	0.00000023 <sup>e,g</sup>	0.00000023 <sup>e,g,h</sup>	0.00007

**Note:** PFAS = per- and polyfluoroalkyl substances; PFOA = perfluorooctanoic acid; PFOS = perfluorooctane sulfonic acid; PFHxS = perfluorohexane sulfonic acid.

<sup>a</sup> Investigation levels apply to typical slightly moderately disturbed systems. See the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2018)* for guidance on applying these levels to different ecosystem conditions. Unless stated otherwise, the 95% protection level has been used.

<sup>b</sup> Investigation levels are taken from the health values of the *Australian Drinking Water Guidelines (2022)*. Aesthetic values have not been considered.

<sup>c</sup> Low or unknown reliability guideline. Refer to the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2018)* for further guidance.

<sup>d</sup> Values have been calculated using a hardness of 30 mg/L CaCO<sub>3</sub>. Refer to the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2018)* for further guidance on recalculating for site-specific hardness.

<sup>e</sup> Chemical for which possible bioaccumulation and secondary poisoning effects should be considered. The 99% protection level has been used. Refer to *Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2018)* for further guidance.

<https://www.waterquality.gov.au/anz-guidelines/guideline-values/default/water-quality-toxicants/local-conditions#bioaccumulation>

<sup>f</sup> Figure may not protect key species from chronic toxicity. Refer to *Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2018)* for further guidance.

<sup>g</sup> The PFAS values are from the PFAS National Environmental Management Plan 2.0 and have not yet been adopted in the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2018)*.

<sup>h</sup> Interim value. *The PFAS National Environmental Management Plan 2.0* suggests using the freshwater value for marine waters until further information is considered.

**Source:** *National Environment Protection (Assessment of Site Contamination) Measure 1999 Schedule B1 Table 1C.*



## APPENDIX 8 – CONTAMINATION REPORT SUMMARY TABLE

Property description and address	Page no.
For example, lot and deposited plan number, map of entire site, as well as the investigation areas	
<b>Conceptual site model</b>	
For example, contamination sources, receptors and exposure pathways between sources and receptors	
<b>Sampling and analysis quality plan</b>	
Justification for the sampling design (how will the data be representative and relevant)	
Frequency and pattern of sampling	
Justification for the analytical plan (especially if the project uses composite samples)	
Data quality objectives	
<b>Sampling methodology</b>	
Description of sample methodology	
Description of media sampled and sample depth interval (for example, borehole logs or soil description)	
<b>Notable contaminant concentrations (for example, maximum specific concentrations and validation results)</b>	
Soil and groundwater concentrations and comparison against appropriate ecological investigation levels, health investigation levels, health screening levels and groundwater investigation levels and so on.	
Discussion on quality assurance and quality control	
Statistical analysis	
<b>Nature of works carried out</b>	
For example, soil investigation, groundwater investigation, excavation, onsite remediation, removal of soil, validation sampling, backfilled with imported soil with excavated natural material classification	
<b>Nature and extent of residual contamination</b>	
Contamination identified in investigation, contamination unable to be remediated within the scope of the work, or areas not assessed	
<b>Waste removed</b>	
During remediation (details of classification and disposal)	
<b>Remediation summary</b>	
What was removed or treated? Was it successful? Is residual contamination remaining? Is there a need for an ongoing environmental management plan?	

## CHECKLISTS AND OTHER INFORMATION

### Appendix 8 (Cont.) – Contamination report summary table

Appropriately experienced and qualified practitioners	Page no.
Practitioner is appropriately experienced and qualified with adequate professional indemnity insurance for the work undertaken	
Statement of suitability	
The land is considered suitable for [residential, residential with limited soil access, open space, industrial/commercial] land use, other (describe)	
Report details	
<b>Report title:</b>	
<b>Produced by:</b>	<b>ABN:</b>
<b>Provided to</b> [insert name] <b>Council on:</b> [insert date]	
I [insert name] of [insert company name] <b>state that I have undertaken this assessment in accordance with the guidelines made and approved by the NSW Environment Protection Authority.</b>	
<b>Name:</b> [report contact]	<b>Signature:</b>
<b>Contact details:</b> [insert email address]	[insert contact phone number]