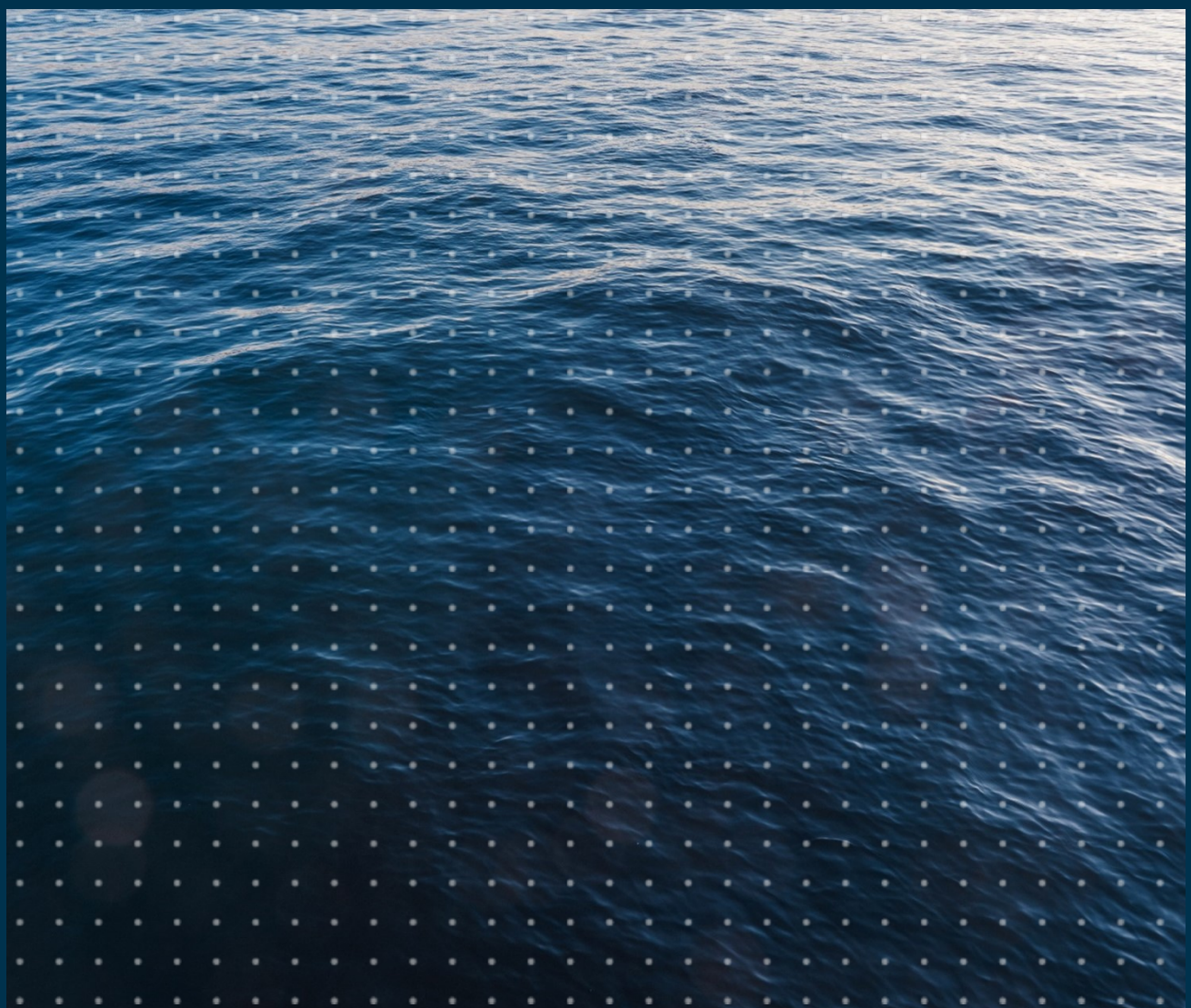
Environment Protection Authority

Review of sampling design guidelines

Response to submissions



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This document provides the EPA's responses to comments received from external consultation undertaken as part of the review of the EPA's Sampling design – contaminated land guidelines.

What are the Sampling design guidelines?

The Sampling design: contaminated land guidelines (the guidelines) help consultants design sampling programs for contaminated sites. They include ways of determining where samples are collected, how many samples are collected, and how the data are compared to relevant criteria.

Background

Assessment of site contamination is risk-based and should take a weight of evidence approach. A major objective of contamination assessment is to determine the nature and extent of contamination by collecting representative environmental samples for characterisation and chemical analysis. The type of sampling carried out, and the methods used to analyse and interpret the resulting data, significantly influence the validity of the assessment.

The NSW Environment Protection Authority (EPA) prepared the guidelines to assist contaminated land consultants, site auditors, regulators, planning authorities, landholders and developers, and inform members of the public who are interested in the outcomes of contaminated land assessment and management. They will help consultants obtain data that is representative, and carry out the analysis and interpretation of the data.

The guidelines support and build on the nationally consistent approach set out in the **National environment protection (Assessment of site contamination) measure 1999** (NEPM) (NEPC 2013) to further strengthen contaminated land management by reflecting current industry best practice.

The guidelines replace the EPA's previous sampling design guidelines: Environment Protection Authority (EPA) 1995, *Contaminated sites: sampling design guidelines*, EPA 95/59, NSW EPA, Sydney.

Review of the guidelines

Why review the guidelines?

The EPA's Sampling design guidelines were published in 1995, and have helped ensure that potentially contaminated land is assessed using appropriate sampling strategies and analysis methods. The EPA updated the guidelines to:

- include up-to-date policy and legislative requirements at both state and federal levels
- better reflect industry best practice and experience
- improve usability and readability.

The guidelines help consultants identify risks to human health and the environment when designing sampling and analysis plans. It is therefore important that the guidelines are up-to-date to ensure adherence to sound environmental management practices.

How were the guidelines reviewed?

The guidelines are statutory guidelines made under section 105 of the *Contaminated Land Management Act 1997*. This means they must be publicly exhibited when significantly amended, and the EPA must consider all submissions when finalising them.

The EPA updated the guidelines in consultation with industry experts in 2018–2020. Public consultation was undertaken on the draft revised guidelines between 21 September and 29 November 2020.

The EPA consulted with contaminated land practitioners, site auditors, regulators, planning authorities, landholders, developers and the community, to ensure the new guidelines were easy to use and fit for purpose, and contained up-to-date and relevant information.

What did we find?

The EPA received 51 submissions in response to the public consultation. Most submissions covered a number of issues, with over 700 separate comments received. Some comments were general, but many were highly technical and recommended further amending the guidelines.

Several comments were diametrically opposed, and the EPA has attempted to balance the needs of the different users of the guidelines.

This document summarises the comments received and provides the EPA's responses to the comments.

If you have any questions about this document or the consultation process, email CLM.Consultation@epa.nsw.gov.au.

How did we respond?

The EPA has amended the guidelines in response to the submissions received, in some cases significantly. Details of the amendments made are provided in this document.

The new guidelines are available at: www.epa.nsw.gov.au/your-environment/contaminated-land/statutory-guideline

Submissions and responses

Issues raised during consultation

Most submissions were positive about the guidelines and their usefulness in sampling contaminated sites, but concerns were raised about the document's ease of use and its alignment with the needs of different stakeholder groups.

Seven main themes emerged during consultation:

1. **There are two distinct audiences for the guidelines**, those with technical knowledge of the subject matter and those without. The two groups have some conflicting requirements that need to be balanced in the one document. For example, some auditors commented that the guidelines contained too much statistical theory, whilst some comments from council officers stated that the guidelines needed more background on statistics. There were several comments that the guidelines should more clearly indicate which parts of the document were intended for those with a technical background, and which parts were not. Both sets of audiences supported these comments.
2. **There is a wide range of opinions within the industry about appropriate minimum sampling densities**, for example, should they be tied to past and proposed land use, does the minimum number refer to field samples or analytical samples, how was this number chosen, is it is mandated, is the minimum number of samples required to have a 95% confidence level different to the minimum number of samples needed to adequately assess the site, that is, meet the design quality objectives?
3. **There was support for using the guidelines for waste classification and resource recovery purposes.** Several respondents noted that the guidelines would be a valuable resource to aid in waste classification and resource recovery work, but that this subject was not fully explored in the document, so it was unclear how the guidelines should be used in this field. Concerns were also raised that such use may cause confusion with the existing Waste Classification Guidelines and Resource Recovery Orders.
4. **There was support for the guidelines containing information about sampling for media other than soil**. Several respondents stated the guidelines should contain more information about sampling surface water, groundwater and vapour, as there are important differences between sampling these media and sampling soil. However, other respondents commented that the guidelines should focus solely on sampling soil, as discussion of sampling other media may cause confusion and result in possible inconsistency with other guidelines if those are amended.
5. **Many respondents supported including a checklist and flowchart** to help step readers through the sampling design process. These respondents proposed something similar to the resources provided in in *Consultants reporting on contaminated land* guidelines (EPA 2020b). It was felt that these resources would be particularly useful for council and planning staff when assessing reports.
6. **There were conflicting views about including information found in other guidelines.** Some respondents commented that including information available in other guidelines may create inconsistency issues if any of the other guidelines were updated, and these should therefore simply be referenced. There were also concerns that including this information made the sampling design guidelines bulkier without adding value. However, other respondents stated that readers were unlikely to want to search through other guidelines, and it was

beneficial to have all of the relevant information in one document for easy reference. There were also queries about where the sampling design guidelines sat in relation to other guidance such as the *Consultants reporting on contaminated land* guidelines (EPA 2020b).

7. **There was some confusion about the purpose of the two separate parts of the guidelines.** While there was general support for a two-part document, it was suggested that there was a lack of clarity about why the guidelines were presented in two parts rather than a single document. Several respondents stated that they were unclear about the purpose of each part, with some commenting that they believed that Part 1 was for laypeople and Part 2 for technical specialists.

EPA responses to issues raised

The EPA received many submissions about minor grammatical or contextual errors in the draft; these were amended where appropriate so the relevant comments have not been included in this report. Many submissions also contained comments and recommendations on matters that are outside the scope of the guidelines. Those comments also are not included in this report.

Tables 1–16 summarise the most relevant comments received on technical aspects of the guidelines, and provide the EPA's response to each issue raised.

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Table 1 Number of samples and sampling pattern, land use

Issue	Response	Change from draft guideline
The spacing of sampling locations on a grid and how this relates to the recommended number of samples should be clarified, i.e. layout of grids.	This is discussed in Part 1, section 5.2.2. Assessors can perform sampling on nodes or centres of a square grid that is placed over the site, as shown in Figure 3, otherwise samples can be collected on an offset or triangular grid, or on a herringbone pattern as recommended in TCRBE 1994	Changes have been made to Part 1, section 5.2.2 to help clarify this subject. References to herringbone and square offset sampling have been added.
Clarify that the grid spacing for certain land use settings is underpinned by a hotspot detection hypothesis, that is, the acceptable size of a hotspot is determined for these land uses.	The text of Part 1, section 5.2.5 has been changed and Table 2 now requires sampling to be performed at the same density, regardless of proposed site use. The requirement for sampling is partly underpinned by hotspot detection but is also designed to allow enough samples to be collected for statistical analysis in the event of fill of unknown origin being known or suspected at a site, or if there are uncertainties in the site history.	Table 2 in Part 1 has been revised and sampling density is no longer related to proposed land use.
Provide further guidance on when an increase in sampling grid spacing can be justified, for example, lines of evidence.	Changes to sampling grids can be made based on site history and the conceptual site model (CSM), which must be prepared in accordance with *Consultants reporting on contaminated land, Contaminated land guidelines* (EPA 2020b). If a reduced sampling density is proposed, a consultant should include observations from a site walkover in the report, and some sampling must be performed to confirm the CSM.	Part 1, section 5.2.5 has been significantly revised.
Should the known presence of fill prevent a consultant from increasing the sampling grid spacing for a given land use? If so, what is an acceptable increase?	The requirement for sampling is not only underpinned by hotspot detection but is designed to ensure enough samples can be collected for some statistical analysis, if there is limited variability in the material underlying the site.	Table 2 in Part 1 has been revised and sampling density is no longer related to proposed land use.

Does the minimum number of samples required extend to the number of test pits required?	To ensure clarity around the number of sampling locations, a change to Part 1, section 5.2.5 has been made, referring to 'sampling locations' rather than 'samples'. For example, this is to ensure that for a 0.05 ha site, 8 locations are sampled, rather than 4 locations with 2 samples at different depths at each location. If fill is known or suspected at a site, test pits should be excavated and samples collected at depths as described in Part 1, section 5.3.1. If access is limited, intrusive investigations can be conducted by other means. If fill is known to not be present at a site, consultants should use their professional judgement to decide how best to conduct intrusive investigations. For instance, if the site is being investigated for the presence of lead in the surface soils, a trowel will likely be sufficient.	Text changed in guidelines, where relevant, from 'samples' to 'sampling locations'. Text added to Part 1, section 5.3: 'To ensure the representativeness of samples, assessment of fill of unknown origin should preferably use test pits to provide a larger exposure of the fill layer, so that the small-scale variability of fill is recognised...'
When should the number of samples required be based on the land use, combined risk value (CRV) method or the maximum probable error (MPE) method?	The guidelines have been amended to require sufficient data to be collected to enable some initial statistical analysis to be performed. Refinement of the CSM will enable consultants to decide if they should collect more samples, based on the CRV or MPE method, or on a smaller grid.	The minimum number of samples required in Table 2 in Part 1 has been amended.
The worked examples for MPE and CRV do not use the recommended number of samples by land use. These examples need to be reworked. Clearly explain the assumptions behind the CRV and MPE methods. Spatial dependence does not appear to have been considered in these examples.	Spatial dependence is not considered in the CRV and MPE methods. These methods consider data that is collected probabilistically, for example, samples collected on a systematic grid for in situ sampling. Statistical parameters such as coefficient of variance (CRV method) or standard deviation (MPE method) are used to calculate the number of samples that would be needed to determine if a 95% UCL of a dataset is below a particular criterion. Therefore, the CSM should be used or refined to show that one population is being considered for statistical treatment. If necessary, the consultant should attempt to stratify the site to identify distinct populations in the data.	Table 2 in Part 1 has been revised and sampling density is no longer related to proposed land use. Minor amendments have been made to Part 1, section 7 to help clarify this, including a sentence at the end of the paragraph that begins 'Two statistical methods…' and states 'Neither of these methods are based on the area of the site, but the calculation is performed using statistical parameters.'

How many samples are required for validation? Does this need to be grid-based or judgemental, for example, when removing a tank and validating the sides? Does Figure 1 need to be updated?	For systematic sampling, the number of samples for validation will need to be determined based on the data quality objectives (DQOs) of the study and by calculating the 95% UCL and comparing the result with the validation criteria. If validating an excavation, samples should be collected from the base and walls of the excavation.	Added a new section after Part 1, section 5.4: '5.5 Validation An SAQP should be developed for validation, with validation samples collected on a systematic grid. The optimal number of samples can be determined using the CRV or the MPE methods (see Section 7) and laid out using a systematic grid as described in Section 5.2.2. For excavations, at least one validation sample should be collected from the bottom and from each of the pit walls. For large excavations, a sampling grid should be established based on field observations and the CSM for the site.'
Should minimum number of samples account for past, as well as intended, use? Can a risk-based approach be applied to sampling grids and densities?	Part 1, section 5.2.5 describes a minimum number of samples that must be collected for assessing sites where there are uncertainties in the site history or there is fill of unknown origin. Section 5 describes other methods that consultants can use when developing sampling strategies. These are based on site histories and the development of CSMs, and are therefore risk-based.	Part 1, section 5.2.5, has been significantly revised.
The acceptance criteria need to be aligned with the National Environmental Protection Measure (NEPM), that is, include criteria for standard deviation and maximum concentration.	Part 1, section 2.3 states that the DQO process is used to develop performance and acceptance criteria, and refers to the NEPM. Part 2 of the guidelines includes reference to the NEPM acceptance criteria in sections 2.3, 2.7 and 4.2.	Text added to Part 1, section 2.3: 'Part 2 of these guidelines, *Sampling design part 2 – interpretation*, provides guidance on interpreting results.'
The advice on providing one sampling location per subdivided lot should be qualified with the comment that a 12 m grid for residential land use would be more than adequate to meet this sampling density.	The text of Part 1, section 5.2.5 has been changed so the number of samples collected is no longer based on proposed land use.	Part 1, section 5.2.5 has been significantly revised.

Clarify that the minimum number of samples is based on hotspot detection and that greater or fewer samples may be required to confirm the statistical reliability of the mean.	The rationale of the minimum number of samples described in Part 1, section 5.2.5 has been changed to provide sufficient samples for statistical analysis as well as indicating the size of a hotspot that can be detected. This minimum number should be applied when there is an incomplete site history or there is fill of unknown origin at the site.	Part 1, section 5.2.5 has been significantly revised.
Clarify that for the detection of a hotspot, all field samples must be analysed, that is, the formula behind the grid spacing works on geometry, and any gaps in the grid where samples were not analysed would mean that the confidence in detecting a hotspot would significantly decrease.	Part 1, section 5.2.5 specifies that the samples are collected for analysis when it states '…can only be identified by intrusive investigations supported by the collection of analytical samples.'	Part 1, section 5.2.5 has been significantly revised. Text added to Part 1, section 6 hotspot detection: 'For hotspot detection, samples collected from all sampling locations must be submitted for laboratory analysis.'
Rewrite the discussion around hypothesis tests and decision errors to be easily understood in plain English. i.e. Define H0 as 'the site is contaminated'. Rejecting H0 means saying the site is not contaminated. False acceptance means saying the site is contaminated when it is not. Explain the α and β and what these terms mean in practice in text (they are currently only mentioned in the appendix).	The suggested definition has been added, prefaced with 'Described more simply…' A reference to the glossary for the definition of α and β has been added to the text.	Reference to the glossary for definitions of α and β. Text deleted from: 'As H_0 is that the site is contaminated ~~in the assessment of site contamination~~, the grey…' Text added to Part 1, section 7: Described more simply, H_0 means the site is contaminated and rejecting H_0 means the site is not contaminated.'
Should sampling grids for agricultural land, bushland and rural residential land be specified? If no land use is specified, which density is the default?	The text of Part 1, section 5.2.5 has been changed so the number of samples collected is no longer based on proposed land use.	Part 1, section 5.2.5 has been significantly revised.
Should the statement that 'a site must be free of hotspots' be clarified to read that it must be free from hotspots of a given size? Is there another hypothesis test which does not rely on hotspots which can be used to characterise the site?	Part 1, section 5.2.5 includes the statement that 'a site must be free of hotspots larger than a critical size, at a 95% or higher confidence level'. The hotspot size varies with site size. But the rationale for the sampling densities in Table 2 in Part 1 is that it will provide sufficient data for an initial dataset for statistical analysis.	Part 1, section 5.2.5 has been significantly revised.

Is the minimum number of samples required for larger sites cost prohibitive? If so, is there a better solution?	The text of Part 1, section 5.2.5 has been changed so the number of samples collected is no longer based on proposed land use.	Part 1, section 5.2.5 has been significantly revised.
Is the sampling depth interval set, or should it be informed by the DQOs?	The sampling depth interval is not set, and further discussion of DQOs has been added.	DQOs have been added to the text of Part 1, section 5.3.1.
The justification for the application of Table 2 is inadequate. Need to provide further justification for the specified land uses and grid sizes in Table 2. The text has been amended by EPA to clarify this, but the amendments need reviewing for accuracy and readability.	The text of Part 1, section 5.2.5 has been changed so the number of samples collected is no longer based on proposed land use.	Part 1, section 5.2.5 has been significantly revised.
Increased sampling density is recommended where 'contaminant concentrations identified during an earlier investigation are close to the critical levels of interest, recognizing the uncertainties of measurement in the concentration values'. Would increased sampling be the best solution to this problem?	The text of Part 1, section 5.2.5 has been changed so the number of samples collected is no longer based on proposed land use.	Part 1, section 5.2.5 has been significantly revised.
Is the following statement accurate? 'Ferguson 1992 suggests that systematic random designs are less efficient than aligned square grid designs for detecting hotspots of a specified size (although this finding depends on target shape and orientation and is somewhat contradicted by later findings (BSI 2013)).'	The EPA agrees that this sentence is not necessary in this context.	Reference to Ferguson 1992 deleted from Section 6, Part 1.
Does the minimum number of five samples apply to preliminary site investigations? Does Table 3 apply to preliminary site investigations?	This is explained in Table 1 in Part 1. The minimum number of samples in Table 2 of Part 1 has been increased to eight. This is in the event of incomplete site histories or when fill of unknown origin is known or suspected to be present. The minimum number is determined by a minimum number that will likely support statistical analysis. Sampling and analysis of soil samples are not necessarily required in Preliminary site investigations.	The previous Table 3 has been deleted.

	Refer to *Consultants reporting on contaminated land, Contaminated land guidelines,* (EPA 2020b).	
It is unclear if the use of hotspots in this section and throughout the guidelines is consistent with the common application in accordance with the NEPM (where the maximum concentration should not exceed an investigation threshold by more than 250%). The definition in the guidelines states that the concentration is only relatively high in concentration. It would be beneficial to clarify what 'relatively' means in this instance.	The NEPM variously describes a hotspot as: • 'localised elevated values' (schedule B1, section 3.2.1) • 'small areas of high concentrations' (schedule B2, section 13.2.1) • 'true extreme values' (schedule B2, section 13.2.3). NEPM also states that: '… the implications of localised elevated values should also be considered. The results should also meet the following criteria: • the standard deviation (SD) of the results should be less than 50% of the Tier 1 screening criteria • no single value exceeds 250% of the relevant Tier 1 screening criteria.' Review of other literature shows that there are inconsistent definitions of 'hotspot': • Ferguson 1992: '…a local area where the concentration of one or more contaminants could lead to unacceptable risks to human health or the environment.' • Gilbert 1987: 'highly contaminated local areas are present'. • AS4482.1-2005: 'Localized contaminated area, where the contaminant concentration is noticeably higher than in surrounding areas.' The definition of 'hotspot' in the guidelines is consistent with most definitions in the literature. The NEPM's requirement that detections of 250% are excluded from datasets for calculating 95% UCLs does not appear to be based on statistical theory. Therefore, the recommendation that a 'hotspot' be defined as	None

	250% or more of the assessment criteria has not been adopted.	
Consider adding a comment about the maximum recommended sampling thickness interval, that is, <200 mm.	Thickness interval for sampling is generally site specific. The NEPM states that 'At greater depths, the sampled interval should be no more than 500 mm to avoid a compositing effect' and this is repeated in the sampling design guidelines. AS 4482.1-2005 *Guide to the investigation and sampling of sites with potentially contaminated soil, Part 1: Non-volatile and semi-volatile compounds* (Standards Australia 2005) notes that 'Constituent samples should be from the smallest area or depth interval consistent with providing adequate representation of the site or interval.'	Text added to Part 1, section 5.3.1 Depth of Sampling: 'Constituent samples should be from the smallest depth interval consistent with providing adequate representation of the interval (Standards Australia 2005).'
Provide advice on whether the following information on sediment sampling should be included in the text, unless it is already contained in other guidance: 'As contaminant distribution in sediments is particularly influenced by grain size, i.e. contaminant levels are generally higher in fine-grained sediments, samples targeted to fine-grained sediments are required. Sampling design should include assessment of depositional areas, such as deeper less turbulent parts of water bodies, or point bars over cut-banks in rivers and creeks.'	*Sediment quality assessment: a practical guide* (Simpson and Batley 2016) ('the sediment guidelines') provide guidance on sediment sampling. It is noted that there are a number of factors that need to be considered when designing a sediment sampling program that are presented in the sediment guidelines. Rather than paraphrasing or repeating the sediment guidelines, the reference is included.	None
It has been queried whether determining the coordinates of the first sampling point by uniform random allocation is normal practice.	Determining the coordinates of the first sampling point by uniform random allocation is not common practice in NSW. However, consultants can choose to use this method as appropriate.	Paragraph changed in Part 1, section 5.2.2 to remove the reference to uniform random allocation.
The NEPM discusses random sampling and specific types of sampling for specific assessments, for example, searching for hotspots. Need to check that this is the same guidance provided in the sampling design guidelines.	The NEPM and Part 1, sections 5.2.2 and 5.2.3 have been reviewed and are not generally inconsistent with the sampling design guidelines.	The text of Part 1, section 5.2.2 has been amended.

Is further guidance on sampling for ongoing monitoring warranted in this guideline?	Ongoing monitoring is always site specific and depends on the CSM, so providing more information in general guidance such as the sampling design guidelines is unlikely to be applicable.	The following text has been added to Table 1 in Part 1 in the 'ongoing monitoring' row: '…assessment stage. An ongoing monitoring program is developed with consideration to the CSM, and is site specific.'
Should make distinction here regarding point source and distributed modes of contamination. Should also refer to potential for naturally occurring contamination, that is, metals, asbestos, NORM.	Descriptions of point source and distributed modes of contamination have been added to section 2.2, as well as acknowledgment that some contaminants can be naturally occurring.	New text added to end of Part 1, section 2.2.

Table 2 References

Issue	Response	Change from draft guideline
Include a graphic to illustrate different parts of the environment, and have call out boxes as to where to find information in the text.	The guidelines primarily provide advice on soil sampling. Guidance on other media is provided in referenced documents.	None
Should ASNZ 5667 Water Quality – Sampling be included for reference in the guidelines?	Reference is made to ANZG 2018 which refers to ASNZ 5667 Water Quality – Sampling. This is considered to provide adequate guidance on designing water quality sampling programs.	None
Need to add references to: • Assessment for the measurement uncertainty of analytical results • Assessment for the measurement uncertainty for sampling. Both are requirements of ISO17025: 2017	Assessing the measurement of uncertainty of analytical results and sampling is part of the DQO process. Reference to proficiency testing has been added to the worked example of the DQO process, so proficiency testing beyond that conducted by NATA is included.	Step 3.3 of the DQO process (Table 7 in Part 1) has been amended to read: Sampling and analytical methods will be consistent with existing guidance, including NEPC 2013, B2 and B3. Analytical laboratories will be NATA accredited and/or subject to proficiency testing and use analytical methods based on NEPC, USEPA and APHA methods.'
The document refers to various US EPA documents and a British Standard, but does not refer to Australian Standards for soil sampling – review whether this an omission or by intent.	The guidelines refer the reader to the NEPM and make several references to the Australian Standards AS 4482.1 and AS4482.2 (2005) although it is noted that the most recent version of the AS is dated 2017.	None

Table 3 Statistics

Issue	Response	Change from draft guideline
The statistical theory and terminology in the guidelines are difficult to understand for those with limited statistical knowledge, such as council planning officers. Checklist(s) and flowchart(s) need to be developed to enable non-technical readers to understand whether a given statistical approach is appropriate. Also consider drafting a new supporting section (appendix?) for non-technical readers. This may help link Parts 1 & 2.	Flow charts/checklists have been developed to assist the non-technical audience.	Two flow charts for consultants have been developed to assist with choosing a sampling design regime. An appendix with guidance for planners/consent authorities has been developed with a worked example of a stratified site (Appendix H in Part 1).
The 'Application' and 'Interpretation' sections of all worked examples should be linked or referenced, for example, the worked example in Appendix B of Part 1 should be linked to the relevant section in Part 2. The Interpretation part uses the same data, but does not seem to make any conclusions on whether the sampling density was appropriate given the outcomes, that is, arsenic was not at a normal distribution, and the RSD was >50%.	The worked examples in Parts 1 and 2 include conclusions on the data, and they are located throughout the appendices as relevant. The reader should follow the appendices successively to find all the conclusions. For instance, for arsenic, the different methods for determining the 95% UCL calculate that the result is greater than the HIL criterion. Appendix K notes that: 'Assuming a gamma distribution for the As data, the software package determined a 95% $\mathrm{UCL}_{\bar{x}}$ of 120.5 mg/kg – markedly different from the 95% H-$\mathrm{UCL}_{\bar{x}}$ of 167.4 mg/kg. As both exceed the HIL-A for As of 100 mg/kg, further data analysis or investigations would be recommended.'	None.
Section 6 of Part 2 (Trend analysis) should be expanded to include a discussion on correlations, for example, assessing correlation coefficient.	Correlation is already discussed in terms of the r-value (Pearson correlation coefficient).	Part 2, section 6.1: text changed to emphasise the 'r-value' before 'Pearson correlation coefficient'.
Consider adding text about the use of statistical mechanics and probability matrices – may be able to improve the random and systematic matrices used in the guidelines. Can Bayesian Decision Analysis be used for decision making, and if so, how does this relate to DQOs?	Statistical mechanics is not commonly used when assessing contaminated sites in NSW. Some references to stochastic models are found in Gilbert and elsewhere, but these are used for developing control charts for outlier tests and shifts in average concentrations. Neither appear in the UK or US guidance, or the NEPM.	None

	Any statistical methods not in the NEPM or statutory guidelines can be adopted by consultants as long as they include appropriate justification published in peer reviewed journals, **and** support use of these methods by their use in other jurisdictions or in published standards, such as Australian or international standards. A Bayesian statistical approach may be appropriate for surface water modelling, where there are many variables. A Bayesian statistical approach is rarely applied to soil or fill in NSW. The EPA is not aware of any applications of Bayesian statistics for groundwater contamination trend analysis, outside of research.	
What descriptive statistic should be mandatory for inclusion in reports, for example, no. of samples, no. of non-detects, mean/median, max, min, 80th percentile, 95th percentile?	Reporting requirements are listed in *Consultants reporting on contaminated land, Contaminated land guidelines*, (EPA 2020b). For other parameters, it will depend on the CSM for the site. For instance, for a site where the results for all potential contaminants of concern are of background levels, there would be little value in determining statistical parameters. For other sites, especially those with fill of unknown origin, the number of samples, non-detects and the 95th percentile would be valuable parameters.	None
Please reword section 7 so the information can be applied in practice.	Text has been added to section 7.	The text of Part 1, section 7 has been redrafted to clarify the purpose of sampling and how to calculate the number of samples required.

Table 4 Examples

Issue	Response	Change from draft guideline
An urban brownfield site usually comprises more than one scenario for potential contamination. Consequently, more than one data population should	A worked example has been prepared demonstrating ways in which a site would be segregated and	This has been included in Appendix H: Guide for non-technical assessors of

be expected on most sites. Please provide a worked example clearly identifying the importance of segregating different data populations so appropriate sampling and analysis can be designed and implemented.	providing the rationale for the systematic sampling regime.	reports for application of sampling design guidelines.
Need worked examples demonstrating measurement uncertainty - both for sampling and analysis.	Measurement uncertainty for both sampling and analysis should be addressed through the DQO process in accordance with the NEPM (Appendix B, Schedule B2). For laboratory analysis, Appendix B, Part 1, Table 7, row 5.3 states: 'Samples will be submitted to NATA-accredited laboratories. The laboratories' analytical LORs are suitably below the adopted criteria. Note: to achieve an acceptable limit of reporting for asbestos fines and fibrous asbestos, the method may not be NATA-accredited but undertaken using in-house methods for quantification.' For sampling uncertainty, Table 7 row 7.3 states: 'The required field QA, and the field and laboratory QC, are described in the project-level SOPs. These include both the data quality indicators (DQIs) and the associated measurement quality objectives (MQOs).'	None.
On page 59, under [point 7.1 of Table 6 of Part 1], it becomes confusing that even though there was one sample location for each of the 32 proposed lots and there were 2 samples taken (fill and natural soil) for each proposed lot, that is, 64 samples, the MPE determines that only 16 samples require laboratory analysis and the others (48 samples) are held by the lab with no further analysis. The question that remains is why take the 64 samples in the first place if only 16 were going to be analysed based on the MPE and the standard deviation. This may need some further explanation. For the average council assessment officer reviewing contamination assessment reports, the worked example becomes confusing at this process step. Further explanation as to why the MPE and SD is	Samples are often collected but not analysed immediately. These samples are 'on hold' at the laboratory, and are held to see if they are necessary to assist with decision making for the site, but the decision to analyse them is not made until after other samples are analysed. This is a compromise; on one hand it can be expensive to re-mobilise field staff to the site, but on the other hand, a project team needs to ensure they are getting sufficient sampling results to make the necessary decisions about the site.	Text added to step 7.1 (Table 7 in Part 1): The results from the first sixteen samples will be considered, and a decision on whether to utilise the remaining samples held at the laboratory will then be made. For instance, the 95% UCL should be calculated and compared with the assessment criteria. If the calculation indicates that the 95% UCL is above a criterion/criteria, a calculation can be performed to determine how many samples are required to determine that the 95% UCL is below the criterion/criteria. See section 7.'

important as it limits the number of samples being analysed would be helpful to the reader.		
It is unclear when this method should be used. Why does the formula in the worked example include +1.4 when this isn't in the original formula?	This method is used when consultants have collected some samples, but the decision they need to make is clear from the results.	The +1.4 term has been removed from the worked example and the result adjusted.
Create a new figure to show a simple random sampling pattern.	The sampling pattern in Figure 4 adequately demonstrates random sampling.	None
The lower confidence limit is used by mistake in table 7. Confirm if this should be the upper confidence limit.	This has been corrected.	Part 1, Appendix B: Reference to lower confidence limits has been removed.
For complex problems, such as multiple contaminant types and a number of impacted media, more than one decision is generally required, or estimates of multiple parameters may need to be combined. These multiple decisions or estimates may combine or impact on each other in resolving the problems. Recommend the use of flow charts, logic diagrams and influence diagrams to illustrate, document and manage these problems.	For complex problems, site-specific CSMs should be developed, and solutions are site specific and might require the use of site-specific risk assessments. In addition, factors such as cost and timing can influence these decisions. This is beyond the scope of these guidelines.	Text added to Table 6 (Appendix A): 'A site-specific CSM should be developed and then refined at each investigation level'.
Create a worked example of the sampling of heterogeneous fill.	Heterogenous fill must be sampled on a grid and in accordance with Table 2 in Part 1.	Part 1, section 5.2.5 has been changed. Heterogenous fill must be sampled on a grid and in accordance with Table 2 in Part 1.
Use an example to elaborate on what specific lines of evidence might need to be collected and how the multiple lines of evidence could be evaluated (or weighted). This is particularly important for human health and ecological risk assessment where sampling might need to be targeted to evaluate impacts on human or ecological receptors. For example, a contaminated site might have unacceptably high levels of benzene in groundwater but vapour concentration in an indoor air sample might be below detection limits. Site operators might wrongly interpret the weight of evidence approach to assign 100% weight to vapor concentrations and decide not to take any remedial action.	A worked example considering the use of multiple lines of evidence is provided in the NEPM (NEPC 2013) Schedule B1, Case Study 3.	None.

It is recommended that additional working is shown so that those with limited statistical knowledge are able to follow the calculations.	There are a number of statistical software packages which are available as free ware and can be downloaded from the internet. The USEPA website can provide references (see EPA/600/R-07/041).	An appendix with guidance for planners and consent authorities has been developed with a worked example of a stratified site. In addition, flow charts have been developed to assist when designing sampling regimes and assessing stockpiles.
Table 7 is confusing – too much information and not enough feedback on sampling design. For example, comment should be made on what the data indicates about the adequacy of sampling design. Need to clarify.	Interpretation of the results and therefore conclusions about sampling design for the worked example in Appendix B, is included in the appendices in Part 2. There are conclusions on the data, and they are located throughout the subsequent appendices as relevant. The reader will need to follow the appendices successively to find all the conclusions. Use of statistical software packages and their technical manuals can assist with understanding these calculations. The USEPA website can provide references (see EPA/600/R-07/041).	None.
Please provide a flowchart of approaches to indoor air sampling when other sources of VOCs in the building are a confounding factor.	Reference is made to CRC Care 2013 in Part 1, section 5.10.	None

Table 5 Waste and resource recovery, stockpile sampling

Issue	Response	Change from draft guideline
Provide comparison of sampling requirements for assessment of contamination (NEPM) with waste or resource recovery classification. Link to references. Provide guidance on sampling stockpiles larger than 200 m^3. Table 4 is consistent with the NEPM but inconsistent with the Excavated Natural Material Order 2014 (Table 1, < 500 t). Need to clarify which applies.	The sampling design guidelines should be used for sampling for contaminated land assessment. Consultants should discuss with clients what the objectives of the sampling and analysis program are, before deployment to the field. If the objective of a sampling and analysis program is assessment for waste classification purposes, waste classification guidance should be used. If the objective of the sampling and analysis program is contaminated site assessment, the sampling design guidelines should be	New text added to end of Part 1, section 5.4.1.

Need to explicitly state whether these guidelines are also suitable for waste classification and resource recovery purposes? If yes, need more information on how the guidelines should be used for waste classification and resource recovery. If no, then that needs to be clearly stated, including why, and the reader referred elsewhere.	used. If the objective of the sampling changes during the course of the project, then further sampling and analysis might need to be conducted, including QA/QC samples. Whatever was the objective at the time of sampling, at the time of reporting a consultant should be able to determine if the material is suitable for use at the site, if the results are being relied on for site suitability.	
When sampling a stockpile, if the use of a Student's T test can demonstrate 95% UCL, does Table 4 need to be used?	95% UCLs and standard deviations can be calculated a number of different ways, including the Student's T test. Generally a minimum number of eight samples are required to calculate the 95% UCL and standard deviation.	None
Provide advice on dealing with limited and difficult access for stockpile sampling. Should this include progressive sampling or alternative sampling methods to achieve appropriate statistical confidence levels required for both contaminated land assessment and waste classification? Provide further advice on sampling stockpiles using three-dimensional systematic sampling. The document could benefit from a greater analysis of stockpile sampling techniques, as well as their associated advantages and disadvantages. Statistical methods associated with these techniques would also be useful.	If a stockpile is large, excavators may need to be used to testpit the stockpile for visual/olfactory inspection, and to collect samples away from the surface.	Text added to second paragraph of Part 1, section 5.4.2: 'This can involve the use of excavators, drill rigs or hand augers to help access the interior of the stockpile.'
For stockpiles greater than 200 m^3, is Table 3 from *Industrial waste resource guidelines: soil sampling* (EPA Victoria 2009) an appropriate reference? Should larger stockpiles be segregated into smaller stockpiles to ensure representative sampling?	For stockpiles greater than 200 m^3 other guidance can be used as appropriate. Statistical assessments on the results can be conducted to determine how many samples are required, as described in Part 1, section 7 of the guidelines.	None
Should the number of samples required to characterise a stockpile take a risk-based approach and be adjustable according to site history and likelihood of contamination?	The history of individual stockpiles can be very different from the site history for the land where the stockpile is located. Because of this uncertainty and	Text added between second and third paragraph in Part 1, section 5.4.2: 'The history of a stockpile may be very different to the site history of the land on

	the ubiquity of fly tipping, this approach is not recommended.	which the stockpile is located. Therefore all stockpiles on a site should be inspected and sampled...'
Should information on the coefficient of variation (CV), used to assess the homogeneity of soils, be mentioned in section 5.4? Should guidance be provided on how to interpret CV values, and how this may affect the sampling frequency? Should CV be calculated for individual analytes, or averaged across all analytes?	The glossary in Part 1 includes information on the interpretation of coefficient of variation and notes that a CV of 0.5 or less is indicative of homogenous contaminant distribution, while CVs with values of more than 1–1.2 imply that the concentration distribution is heterogenous. Coefficient of variation is calculated for each analyte, just as the 95% UCL is calculated for each analyte.	Text added to the glossary in Part 1 for Coefficient of variation: 'A CV of more than 1.2 suggests that the data is lognormally distributed.' The word 'fairly' was deleted from the definition of CV. Text added to Part 1, section 5.4.3: 'For material being retained for use at the site, the number of samples required for sampling a stockpile can be derived using the methods described in Section 7, that is, the combined risk value (CRV) method (see Appendix E: Determining the number of samples by the CRV method) and the maximum probable error (MPE) method (see Appendix F: Determining the number of samples by the MPE method)'.

Table 6 Groundwater

Issue	Response	Change from draft guideline
Should the guidelines mandate the minimum number of data-points required for temporal trend analysis? If there are enough data-points then should it be mandatory to report Mann Kendall stats for trend analysis?	The need for temporal trend analysis and the minimum number of data points required depends on the CSM. This should be developed based on site-specific characteristics such as groundwater velocity and distance to receptors.	Additional text added to Section 6 of Part 2: The need for temporal trend analysis and the minimum number of data points required depends on the CSM, which should be developed based on site specific characteristics.'
There may be a risk that (former) section 5.6 will be read as stating that a minimum of three wells are required for contaminated site characterisation. Consider rewording this section to highlight the difference between the required placement of wells to	Agree.	Under Part 1, section 5.7, the paragraph beginning 'A minimum of three wells…' has been deleted and a sentence has been inserted that reads: 'Wells must be

characterise groundwater contamination, and the required placement to determine hydraulic properties and groundwater flow.		installed so the groundwater flow direction can be determined.'

Table 7 Uncertainty

Issue	Response	Change from draft guideline
Consider amending text to address the following: 'In developing the CSM, the assessor needs to distinguish between variability and uncertainty. Variability arises from true heterogeneity in the environment such as lateral variations in soil properties or lithology or changes in contaminant levels over time and space. Uncertainty represents lack of knowledge about factors, such as contaminant levels (which may be reduced with additional investigation).'	Agree	Recommended text added to Part 1, section 2.1, with some editing.

Table 8 Composite sampling

Issue	Response	Change from draft guideline
Specify the maximum number of discrete samples that are allowed to form a composite. (Is this always four, as per the NEPM?)	Yes, it is always four, as per the NEPM.	Part 1, section 5.6 has been amended to clarify this.
Provide text to explain that the guideline trigger value needs to be adjusted for composite samples. This should include formula to be applied to account for sample dilution when composite sampling is used. Have a worked example.	Agree.	Text added to end of Part 1, section 5.6: 'Where composite sampling has been used, the relevant assessment level should be divided by the number of sub-samples in the composite and compared with the laboratory result. (NEPC 2013, B2). Further information about composite samples can be found in NEPC 2013, B2) and DEC 2005a.'

What is the reasoning behind the 20 m max composite spacing? Should this be a 20 m radius?	The 20 m spacing is intended to ensure that composite samples are representative of similar materials. No, it should not be a 20 m radius but a maximum of 20 m distance between sampling locations.	Part 1, section 5.6 has been amended to clarify this.
Incremental sampling – what does it involve, is it recommended for use in NSW, is it applicable to stockpile sampling, does the information need to be revised or removed?	Agree that this should be deleted.	Deleted reference to incremental sampling from Appendix G.
Must composites be collected from the same stratigraphic material/horizon? If yes, then this should be noted in the text. Please explain why it is inappropriate to composite sample clays.	Yes, composite sub-samples must be collected from the same stratigraphic material/horizon. Composite sampling is not suitable for clay or fine-grained soils as subsamples are difficult to mix adequately.	Text in Part 1, section 5.6 has been significantly amended – is consistent with DEC 2005a and the Australian Standard.
Composite samples for assessment of semi-volatile organochlorine pesticides or substances of low volatility, for example, chlorinated cyclodiene pesticides– is this appropriate? If not, will this advice conflict with other existing EPA Guidelines, Section 2 in Appendix 2 of Lock 1996 and NEPM.	Agree, but the text in Part 1, section 5.6 already covers this when it states: • 'It cannot be used to assess pH, or volatile or semi-volatile contaminants including TRH, BTEXN, OCPs, OPPs and low molecular weight PAHs'	None
It has been argued that composite samples cannot be included in probabilistic or predictive analysis because compositing represents a form of pseudo-replication and therefore the sample result cannot be included in the population mean. Consultants' reports frequently use composite samples to reduce the number of analyses. They cut out the metals, where metals offer an opportunity to identify a 'metal fingerprint' which is useful in many cases. Compositing samples can negate the sampling plan. Need to clarify this in the text.	Agree that this argument is sometimes put forward. The EPA has limited the use of composite sampling to former orchards and market gardens.	Discussion of composite sampling in Part 1, section 5.6 has been revised and limited to former orchards and market gardens.
Should the limitations of composite sampling where information on spatial or temporal variability is needed be clarified?	Agree	Text added to second paragraph of Part 1, section 5.6: 'Subsamples for compositing should not be collected where there is spatial or temporal variability.'

Table 9 Qualitative samples and temporal variations

Issue	Response	Change from draft guideline
Consider discussing temporal nature of sampling, for example, a surface water sample not only represents that water body population spatially but also that point in time under the specific conditions present during sampling.	The guidelines primarily refer to soil sampling. Reference is made to ANZG 2018.	None
Provide further guidance on the use of qualitative or observational field samples. How should they be used, and what are their limitations?	Observational field samples can provide a line of evidence to support conclusions made about a site, based on the analytical results. For instance, the presence of anthropogenic material can indicate that material is fill. Their limitations are project specific.	Text has been added to Part 1, section 3.1 to clarify this.

Table 10 Fill

Issue	Response	Change from draft guideline
Is noting reworked soils, which may be reflective of natural materials, as fill problematic? Should this be reworded?	Agree.	‘reworked soils‘ deleted and replaced with ’fill‘ where relevant.

Table 11 Validation

Issue	Response	Change from draft guideline
Should validation sampling be grid based, not judgmental? Should it extend to validation of hotspots, not just validation beneath former structures?	Validation will depend on the CSM. For instance, areas of known contamination such as around a former AST are more likely to be judgmental (say linear) than grid-based. However, validation of a former car parking area is more likely to be grid based.	Part 1, section 5.5: Validation added.
Should the text be expanded to include validation of a continuous remedial process, for example, in-situ or ex-situ stabilisation which would be sampled based on regular volume or timing rather than area?	Agree.	Text added to Part 1, Table 1: ’Can also include validation of continuous or batch remedial processes.’

		Text added to Part 1, section 5.5: 'For the validation of continuous remedial processes, an SAQP should be developed based on the remedial methods and the CSM.'

Table 12 Datasets and presentation

Issue	Response	Change from draft guideline
Clarify how to report grouped totals of analytes where multiple results are less than LOR, for example, total PAHs. Clarify the difference between a lab's LOR and a guideline value, for example, useful for PFAS. Provide guidance on managing extreme cases of censored data, for example, >80% are <LOR.	Grouped totals of analytes such as PAHs and B(a)P TEQ are calculated by the laboratories and are reported on the lab sheets. Queries regarding the methods used to calculate these should be directed to the laboratory concerned. A laboratory's LOR is the limit of reporting and queries on methods used to determine the LOR should be directed to the laboratory. Guideline values are derived on a risk basis as described in NEPM (NEPC 2013). The DQO process requires a consultant to consider the laboratory's LOR and the guideline value. See Table 7, row 5.3 in Part 1. When the LOR is greater than the guideline value, the impact of this should be discussed in the QA/QC assessment of the data and conclusions made about the site. For instance, if the LOR is greater than the guideline value, a multiple lines of evidence approach must be taken. Issues that should be discussed in the report include: • sending samples to other laboratories that can achieve a lower LOR • whether the LOR was raised due to matrix interference • should sampling and analysis be repeated	Added to Part 2, section 2.5: 'Some statistical software packages have methods that enable a user to enter data and indicate that it is a non-detect; the software calculates statistical parameters such as 95% UCL and standard deviations for the dataset, and the output of the statistical package provides guidance on which method is recommended (USEPA 2015a). A worked example is provided in Appendix M. If statistical software is unavailable, Section 4.7 of USEPA 2006a provides more detailed guidance for analysing data with non-detects. If the direct substitution method described above is used, results for the three substitutions listed above – zero, equal to LOR and assumed fraction of LOR – should be reported.' A worked example discussing the use of the direct substitution method is provided as Appendix M, Part 2.

	• what is the CSM and if the LOR is assumed as the result, does this affect conclusions about the site. Some text has been added to Part 2, section 2.5: Non detects as advice for handling censored data.	
Correct Figure 4 in terms of visual representation of sampling locations and patterns. Clarify that data relating to these areas of potential concern would be segregated and may not be combined.	The text describing the former Figure 4 has been revised.	Figure 5 in Part 1 has been revised to read: 'Figure 5 is an example of a stratified sampling pattern, with three separate investigation areas, sampling strategies and sampling locations due to different characteristics of the site. Area 1 uses a high-density judgmental sampling strategy with many sampling locations (blue dots) clustered around an underground storage tank (grey box). Area 2 uses a medium-density systematic sampling strategy to assess fill material from an unknown source, with sampling locations (orange dots) at regular intervals in a grid. Area 3 uses a low-density systematic sampling strategy with sampling locations (green dots) further apart than those in area 2, to assess natural soil with no known contaminants. Data will be analysed as three different data sets.'
Part 2 should discuss interpreting the effectiveness of the applied sampling design in meeting the related DQOs.	Agree. Section 7 has been added to Part 2 of the guidelines to address this.	Section 7 added to Part 2.
Part 2 should include discussion on interpretation of results for quality of groundwater, surface water and soil gas. If no other guidance currently exists, expand advice on background concentrations to include information on indoor air and hazardous ground gas (HGG). For indoor air, include: evaluate surrounding environment and offsite sources, both onsite and offsite, for	The guidelines provide some information on sampling for media other than soils. However, guidance on assessment for other media should be sought in statutory guidelines such as NEPC 2013 (soil, groundwater and soil vapour), ANZG 2018 (surface water), DEC 2007 (groundwater), EPA 2020a (Hazardous ground gases).	Relevant references have been added to new section 7 of Part 2 and Section 1.4 of Part 1.

example, industrial area, major roads, smokers. For HGG include the need to evaluate natural conditions, especially naturally elevated carbon dioxide due to a range of factors including degradation of organic matter and alluvial soils.	Non-statutory guidance should also be consulted, for example, *Vapour intrusion: technical practice note* (DECCW 2010). Further soil vapour guidance is provided in *Technical Report No. 23, Petroleum hydrocarbon vapour intrusion assessment: Australian guidance*, (CRC Care 2013). Guidance for sampling of sediments is provided in Simpson and Batley 2016.	
Discuss how to deal with outlying data points. Environmental data generated from contaminated land investigations commonly contain outliers, and in some cases, these outliers can be notably greater than the remaining dataset. The inclusion of a process to document, interpret, and analyse outliers would be greatly beneficial.	This is discussed in Section 2.4 of Part 2. The discussion on outliers in the NEPM (Schedule B2, Section 13.2.3) states (in part): 'It can be tempting to dismiss unexpectedly high values as "outliers"; however, this is not good practice, as a more thorough examination of the reasons for these unexpected values may lead to new insights into the data (such as the presence of an unsuspected hotspot of contamination) or to reconsideration of underlying assumptions about the data and its distribution', and 'Discarding an outlier from a data set should be done with extreme caution as environmental datasets often include legitimate extreme values (USEPA 2006b). The decision taken should be based on scientific reasoning and be fully documented. Repeat sampling close (<1 m) to the original location may provide greater certainty in the decision process.'	The discussion on outliers in section 2.4 of Part 2 has been augmented with some text from the NEPM.

Table 13 Sampling techniques

Issue	Response	Change from draft guideline
Section 5.9.1 should distinguish between a soil vapour survey conducted to assess the extent of a VOC source in the subsurface and assessment of soil vapour that could intrude into buildings or other enclosed spaces, for example, service vaults). The	Agree.	Text in (former) section 5.9.1:deleted 'as a minimum…highest concentration.' Added reference to CRC Care 2013, and other minor changes to Part 1, section 5.10.

approaches are quite different. Check consistency with hazardous ground gases guidelines (EPA 2020a).		

Table 14 Asbestos

Issue	Response	Change from draft guideline
Does the presence of asbestos dictate an increase in the sampling density or decrease of the grid size? Need to make it explicit that asbestos does not confirm to a lognormal distribution and that hotspot analysis may not detect asbestos if appropriate methodologies are not used. THE NEPM currently refers to WA guidance on sampling for asbestos. Depending on the likelihood of asbestos, sampling density can be decreased (0.5x) or increased (up to 2x). However, these sampling densities are multipliers of the current Table A in the sampling design guidelines. Given that the new guidelines have more stringent sampling densities, should these multipliers be similarly applied? Note: the NEPM refers to the WA guideline for further information, but does not explicitly mandate the use of that guideline in determining the number of samples required.	Aside from smaller sites, where the minimum sampling density has been increased from five to eight, the EPA recommends the multipliers for asbestos detection still be applied as per previous practice.	Part 1, sections 5.2.5 and 5.3 have been updated to clarify this. Table 2 in Part 1 has been revised and sampling density is no longer related to proposed land use. The use of multipliers for asbestos has been included in Part 1, section 5.2.5.

Table 15 Sediment and surface water

Issue	Response	Change from draft guideline
There is insufficient information provided about sampling of sediment and surface water, compared to soils. This section of the guideline should at least provide a summary of information in ANZG 2018 and guidance on how to apply that information in the	The EPA considers that ANZG 2018 provides adequate guidance for sampling of surface waters. Further, any changes to ANZG 2018 might require a change to the sampling design guidelines. Therefore,	Added references to section 1.4 of Part 1.

context of NSW statutes. Also need to list relevant references for further information.	the sampling design guidelines refer the reader to other guidelines, as necessary. The references section of the guidelines refer readers to both ANZG 2018 for surface water sampling and Simpson and Batley 2016 for sediment sampling.	

Table 16 Miscellaneous

Issue	Response	Change from draft guideline
The 'multiple lines of evidence' approach is referred to several times in the guidelines, but is never defined. Consider providing a brief explanation of what it is and why it is important.	The 'multiple lines of evidence' approach is defined in the NEPM as '…the process for evaluating and integrating information from different sources of data and uses best professional judgement to assess the consistency and plausibility of the conclusions which can be drawn.' A worked example can be found in the NEPM (NEPC 2013) in Schedule B1, Case Study 3 – *Application of petroleum hydrocarbon screening levels – redevelopment of an industrial site for residential use.*	Added the definition of multiple lines of evidence from NEPM to the glossary of Part 1.

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