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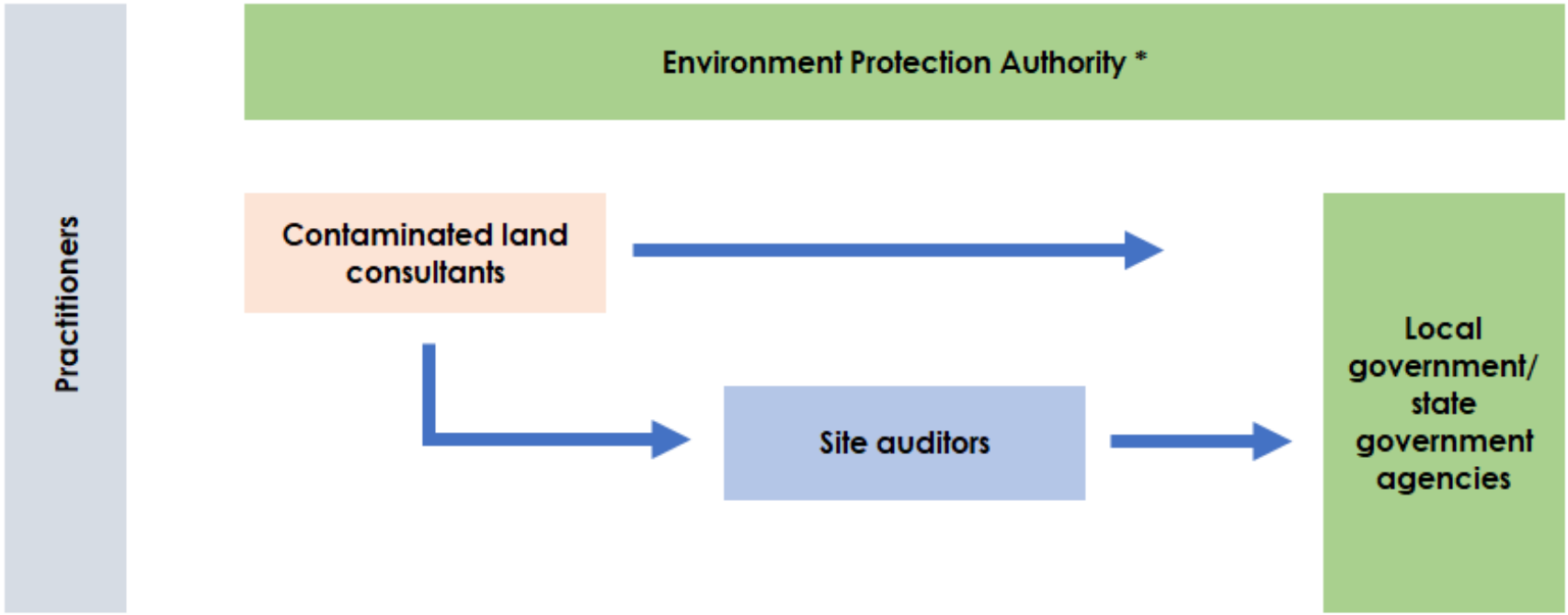
- ACLCA *Northern Region - Contaminated Land Seminars 2005, Assessment and Management 10 Years On*, Kempsey 18/11/05 and Byron Bay 24/11/05;
- OEH & HAELERN *Contaminated Land Workshop*, Ballina 23/06/11;
- EHA *Environmental Health Regional Seminar*, Lismore 28/07/15; and
- MIDROC *Contaminated Land Seminar, Local Government and the Effective Management of Contaminated Land*, Coffs Harbour 18/02/16

Northern Rivers Contaminated Land and Waste Forum

Program

9:30 – 9:50	*Registration and coffee.*
9:50 - 10:00	Welcome and introduction.
10:00 – 10:30	Overview of contaminated land process in NSW – Ross McFarland, HLA-Envirosciences.
10:30 – 11:00	Quality in the assessment and management of contaminated sites – Marc Salmon, RES.
11:00 – 11:15	*Break*
11:15 – 11:45	Legal perspective – Brian Glendenning, Harris Wheeler Lawyers.
11:45 – 12:15	Significant risk of harm and offsite issues - Arminda Ryan, NSW EPA.
12:15 – 12:45	NSW Site Auditor Scheme – David Johnson, NSW EPA.
12:45 – 1:15	*Lunch break*
1:15 – 1:45	Two Headed Worms and Other Garden Concerns – Tania Millen, GHD.
1:45 – 2:15	Cattle Tick Dip Sites Discussing Some of the Pieces of the Puzzle – Christine Pitman, E&ES.
2:15 – 2:45	Assessing and Managing Petroleum Contamination – Tony Scott, Coffey.
2:45 – 3:00	*Break*
3:00 – 4:00	Discussion.



* SPCC - 16 June 1971. EPA - 1 March 1992 (25th anniversary).

An estimated 12.6 million deaths each year are attributable to unhealthy environments

15 MARCH 2016 | GENEVA - An estimated 12.6 million people died as a result of living or working in an unhealthy environment in 2012 – nearly 1 in 4 of total global deaths, according to new estimates from WHO. Environmental risk factors, such as air, water and soil pollution, chemical exposures, climate change, and ultraviolet radiation, contribute to more than 100 diseases and injuries.

Healthier environment: healthier people

"A healthy environment underpins a healthy population," says Dr Margaret Chan, WHO Director-General. "If countries do not take actions to make environments where people live and work healthy, millions will continue to become ill and die too young."

Dozens of programs that deal with climate change, pollution clean-ups and energy efficiency would be wiped out by the administration's budget, which seeks to demolish parts of the EPA.

The regulator's funding would be cut by nearly a third under the "America first" budget proposal, which requests $5.7bn for the EPA in 2018 – a $2.6bn cut, or 31%, on its existing budget. Around one in five EPA employees would lose their jobs.

Changes to Regulations

Environmental Protection (Greentape Reduction) and Other Legislation Amendment Act 2012

(the Greentape Reduction Act)

Aim: Introduce an integrated approval process for ERAs that is proportional to environmental risk

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Northern Rivers Contaminated Land & Waste Forum

Practitioner Perspective and Wrap-up

Wednesday 21 June 2017

Marc Salmon, MEIANZ, CEnvP
Principal Environmental Scientist

marc@easterlypoint.com

Contaminated Land Program Overview

- 2 year program (June 2015 to August 2017)
- Grant funded by the NSW EPA with assistance by the NSW Environmental Trust
- Program created and supported by the Bellingen Shire Council for benefit of MIDROC region

MIDROC CONTAMINATED LAND PROGRAM

Program Objectives

Program focuses identified through interviews and regional needs analysis:

- Improve staff knowledge of contaminated land issues and responsibilities
- Standardise the approach that staff take to considering and dealing with contaminated land matters
- Improved the approach used to collect, store and present contaminated land data

TRAINING / RESOURCES / SYSTEMS

Program Achievements

Training Outputs

- Regional Seminar
- Conditions of consent
- Policy overview
- Data management
- Site investigations
- Legislation overview

eLearning Modules

- Policy and procedures review
- Consultants – Coffey Environments
- Data systems – Sutherland Shire Council

Program Achievements

Practical Assistance

Reviewing day to day matters to show staff first hand how to properly carry out various functions of council

- DA referrals
- Site investigations
- Developing affective conditions of consent or regulatory conditions
- Providing general advice and support as needed

Program Achievements

Other Practical Assistance

EPA and Council joint inspection of all active underground petroleum storage systems in the:

- Bellingen Shire
- Nambucca Shire
- Kempsey Shire

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Program Achievements

Other Practical Assistance

Assisted in securing EPA grants for the investigation and removal of inherited underground petroleum storage systems in the council road reserve:

- Bellingen Shire - $150,000
- Nambucca Shire - $240,000
- Kempsey Shire - $90,000
- (Former) Greater Taree City Council - $300,000

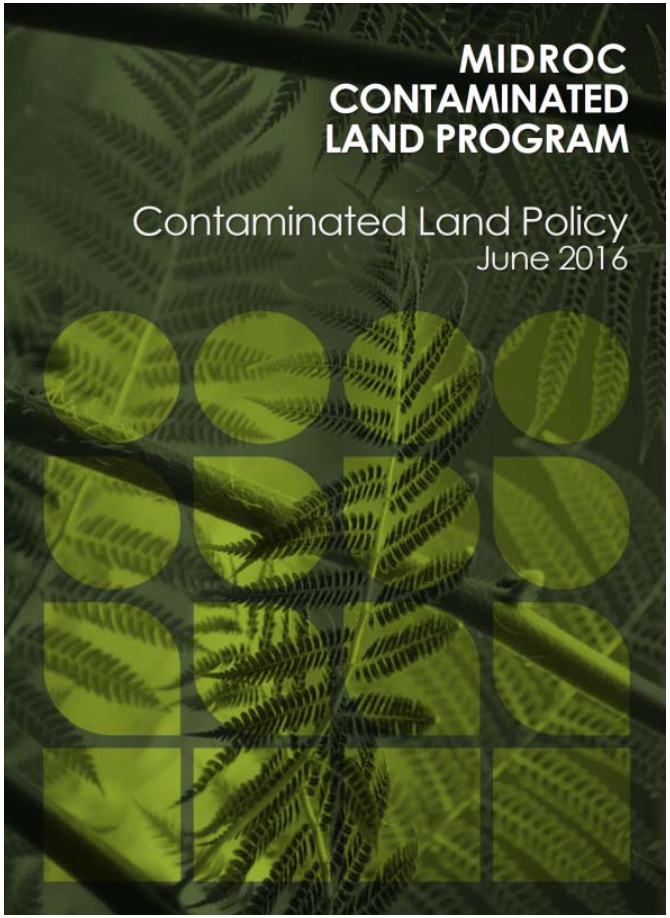
Total of $780,000 in grant funding awarded to MIDROC members

Program Achievements

Model Contaminated Land Policy

- Developed to set a regionally consistent standards for the following key matter:

1. Site assessment and remediation triggers
2. Consultant standards
3. Clear consultant auditing requirements
4. Record keeping standards
5. Guidance on planning certificates



MIDROC Contaminated Land Program

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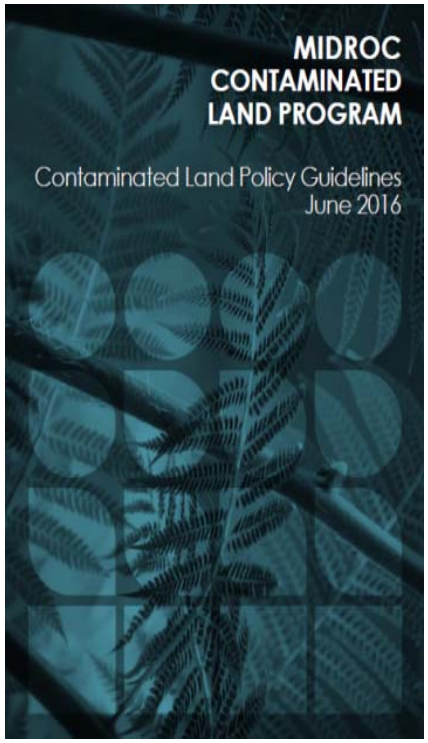
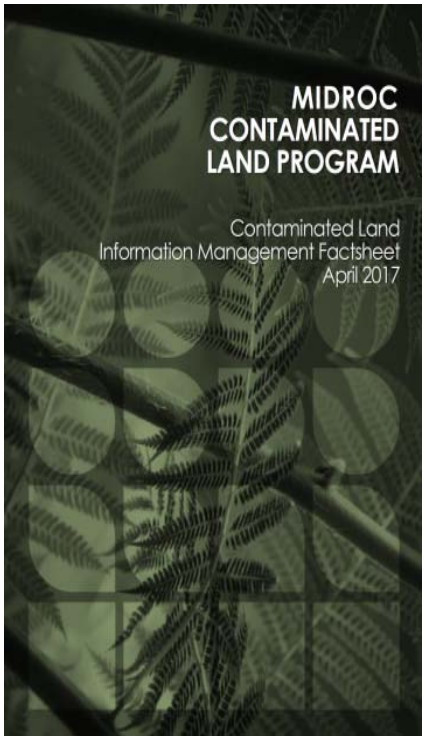
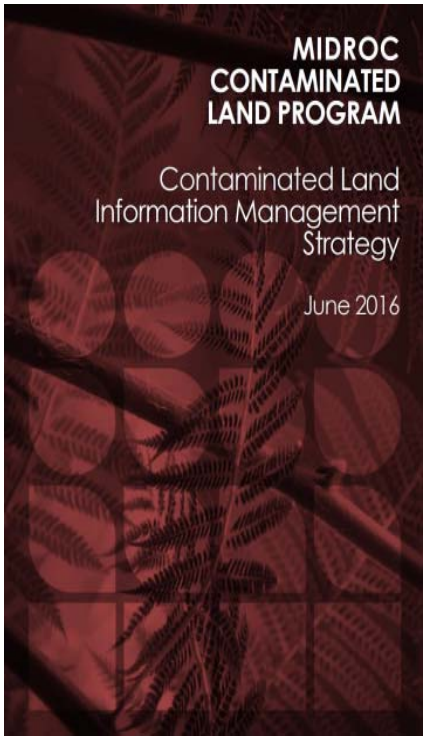
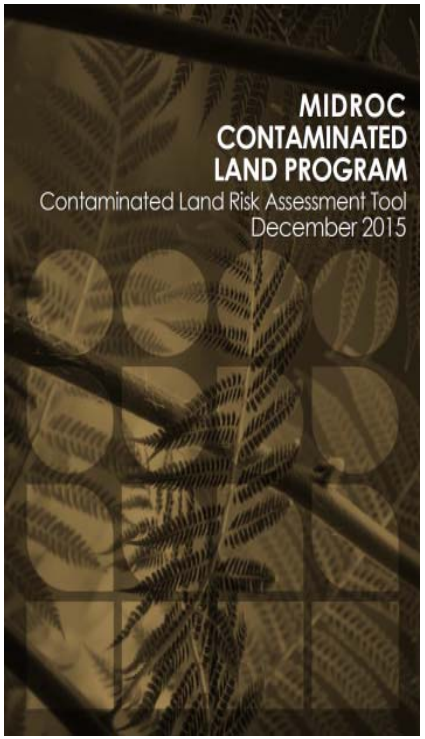
Program Achievements

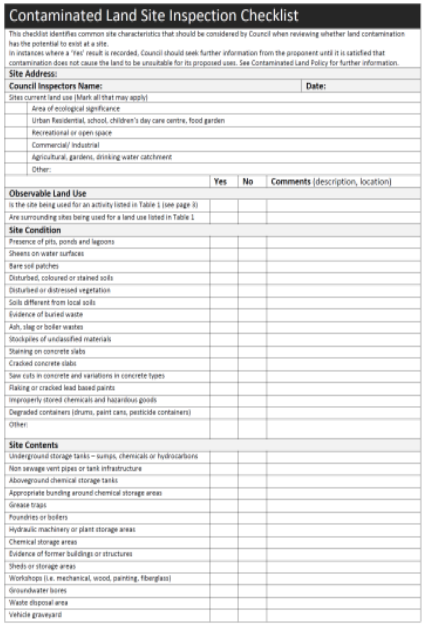
Written procedural and guidance resources











Contaminated Land Site Inspection Checklist

This checklist identifies common site characteristics that should be considered by Council when reviewing whether land contamination has the potential to exist at a site.
In instances where a 'Yes' result is recorded, Council should seek further information from the proponent until it is satisfied that contamination does not cause the land to be unsuitable for its proposed uses. See Contaminated Land Policy for further information.

Site Address:

Council Inspectors Name: **Date:**

Sites current land use (Mark all that may apply)

- Area of ecological significance
- Urban Residential, school, children's day care centre, food garden
- Recreational or open space
- Commercial/ Industrial
- Agricultural, gardens, drinking water catchment
- Other:

	Yes	No	Comments (description, location)
Observable Land Use			
Is the site being used for an activity listed in Table 1 (see page 3)			
Are surrounding sites being used for a land use listed in Table 1			
Site Condition			
Presence of pits, ponds and lagoons			
Sheens on water surfaces			
Bare soil patches			
Disturbed, coloured or stained soils			
Disturbed or distressed vegetation			
Soils different from local soils			
Evidence of buried waste			
Ash, slag or boiler wastes			
Stockpiles of unclassified materials			
Staining on concrete slabs			
Cracked concrete slabs			
Saw cuts in concrete and variations in concrete types			
Flaking or cracked lead based paints			
Improperly stored chemicals and hazardous goods			
Degraded containers (drums, paint cans, pesticide containers)			
Other:			
Site Contents			
Underground storage tanks – sumps, chemicals or hydrocarbons			
Non sewage vent pipes or tank infrastructure			
Aboveground chemical storage tanks			
Appropriate bunding around chemical storage areas			
Grease traps			
Foundries or boilers			
Hydraulic machinery or plant storage areas			
Chemical storage areas			
Evidence of former buildings or structures			
Sheds or storage areas			
Workshops (i.e. mechanical, wood, painting, fiberglass)			
Groundwater bores			
Waste disposal area			
Vehicle graveyard			

MIDROC Contaminated Land Program

Ongoing benefits for the region:

- ✓Staff will have a better understanding of the topic and what their responsibilities are in responding to these issues
- ✓A series of easy to follow resources will be available to assist staff and standardise the regional approach
- ✓MIDROC Subgroup to carry on policy and procedural updates in the long-term

Guidance in 1992

- ANZECC/NHMRC (January 1992) *Australian and New Zealand Guideline for the Assessment and Management of Contaminated Sites*.

Guidance in 1992

	Health levels (mg/kg)
Lead	300
Arsenic	100
Cadmium	20
Benzo(a)pyrene	1
PAHs	20

Guidance in 2017

Guidelines made by EPA:

- DEC (2005a) *Contaminated Sites: Guidelines for Assessing Former Orchards and Market Gardens*;
- DEC (2006) *Contaminated Sites: Guidelines for the NSW Site Auditor Scheme*;
- DEC (2007) *Contaminated Sites: Guidelines for the Assessment and Management of Groundwater Contamination*;
- EPA (1995a) *Contaminated Sites: Guidelines for the Vertical Mixing of Soil on Former Broad-acre Agricultural Land*;
- EPA (1995b) *Contaminated Sites: Sampling Design Guidelines*;
- EPA (1997) *Contaminated Sites: Guidelines for Assessing Banana Plantation Sites*;
- OEH (2011) *Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites*; and
- EPA (2015) *Guidelines on the Duty to Report Contamination under the* Contaminated Land Management Act *1997*.

Guidance in 2017

Guidelines approved by EPA:

- ANZECC/ARMCANZ (2000) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*;
- DHA/EnHealth (2012) *Environmental Health Risk Assessment: Guidelines for Assessing Human Health Risks from Environmental Hazards*;
- Lock W. H. (1996) "*Composite Sampling*" in *National Environmental Health Forum Monographs, Soil Series No. 3*;
- NEPC (2013) *National Environment Protection (Assessment of Site Contamination) Amendment Measure 2013 (No. 1)*, Schedule A and Schedules B(1) – B(9);
- NHMRC/NRMMC (2011) *Australian Drinking Water Guidelines*; and
- NSW Agricultural/CMPS&F (1996) *Guidelines for the Assessment and Clean Up of Cattle Tick Dip Sites for Residential Purposes*.

Guidance in 2017

Technical notes made by EPA:

- DEC (2005b) *Information for the Assessment of Former Gasworks Sites;*
- DECCW (2009) *Guidelines for Implementing the* Protection of the Environment Operations (Underground Petroleum Storage Systems) Regulation *2008;*
- DECCW (2010) *Vapour Intrusion: Technical Practice Note;*
- EPA (2012) *Guidelines for the Assessment and Management of Sites impacted by Hazardous Ground Gases;*
- EPA (2014a) *Best Practice Note: Landfarming;*
- EPA (2014b) *Technical Note: Investigation of Service Station Sites;*
- EPA (2015) *Technical Note: Light Non-Aqueous Phase Liquid Assessment and Remediation;* and
- EPA *(2016) Designing Sampling Programs for Sites Potentially Contaminated by PFAS.*

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Guidance in 2017

Schedule B1—Guideline on Investigation Levels for Soil and Groundwater

Schedule B2—Guideline on Site Characterisation

Appendix A Possible analytes for soil contamination
Appendix B Data quality objective (DQO) process
Appendix C Assessment of data quality
Appendix D Example data presentation on scale drawings and borehole logs
Appendix E Dioxins and dioxin-like compounds

Schedule B3—Guideline on Laboratory Analysis of Potentially Contaminated Soils

Appendix A Determination of total recoverable hydrocarbons (TRH) in soil

Guidance in 2017

Schedule B4—Guideline on Site-Specific Health Risk Assessment Methodology
Appendix A Structure of a risk assessment report

Schedule B5a—Guideline on Ecological Risk Assessment
Appendix A Summary of the EILs for fresh and aged contaminants in soil with various land uses
Appendix B Mixtures of chemicals

Schedule B5b—Guideline on Methodology to Derive Ecological Investigation Levels in Contaminated Soils
Appendix A Review and comparison of frameworks for deriving soil quality guidelines in other countries
Appendix B Method for deriving EILs that protect aquatic ecosystems

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Guidance in 2017

Schedule B5c—Guideline on Ecological Investigation Levels for Arsenic, Chromium (III), Copper, DDT, Lead, Naphthalene, Nickel and Zinc

Appendix A Raw toxicity for arsenic
Appendix B Raw toxicity for chromium (III)
Appendix C Raw toxicity for copper
Appendix D Explanation of the selection of the soil properties that control the added contaminant limits for copper
Appendix E Raw toxicity for DDT
Appendix F Raw toxicity for lead
Appendix G Raw toxicity for naphthalene
Appendix H Raw toxicity for nickel
Appendix I Raw toxicity for zinc

Guidance in 2017

Schedule B6—Guideline on the Framework for Risk-Based Assessment of Groundwater Contamination

Schedule B7—Guideline on derivation of health-based investigation levels
Appendix A1 Derivation of HILs for Metals and Inorganics

Criteria in NEPM? HILs (14 metals, cyanide, PAHs, phenols, OCPs, herbicides, pesticides, PCBs and PBDE flame retardants), soil vapour investigation levels for chlorinated VOCs, HSLs for petroleum compounds (soil, soil gas and groundwater) by depth and soil type, EILs, ESLs, TRHs management limits (17 pages), and GILs (8 pages).

Similarly for water quality guidelines. Plus EPA waste guidance, CRC CARE, other state's guidance, USEPA, European, ground gas, health documents, IARC, ITRC, et cetera, et cetera, et cetera, et cetera, et cetera …

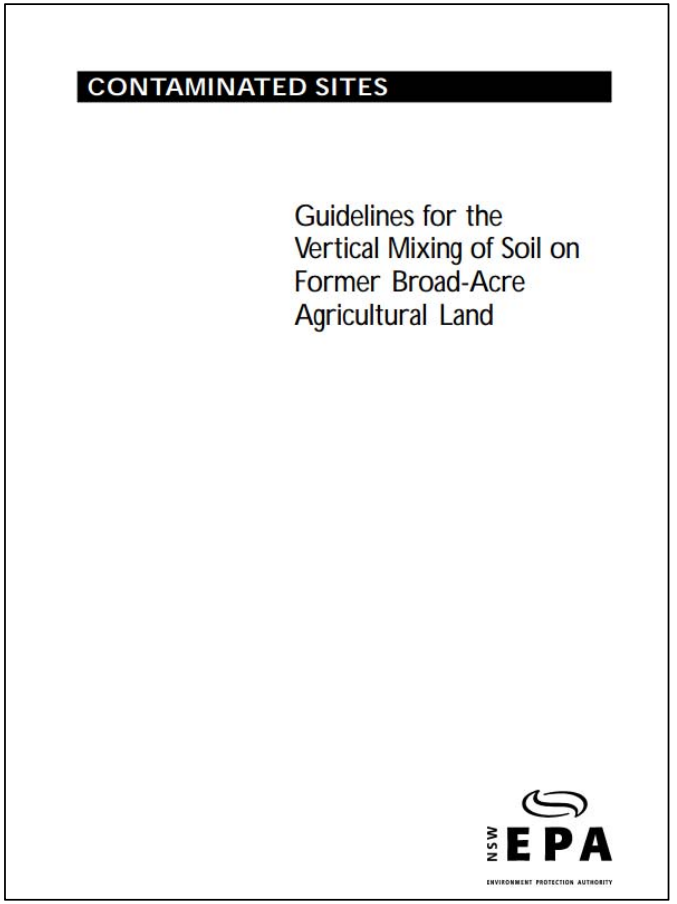
SEPP 55 - 17 Guidelines and notices: all remediation work

(1) All remediation work must, in addition to complying with any requirement under the Act or any other law, be carried out in accordance with:
(a) the contaminated land planning guidelines, and
(b) the guidelines (if any) in force under the *CLM Act*, and
(c) in the case of a category 1 remediation work - a plan of remediation, as approved by the consent authority, prepared in accordance with the contaminated land planning guidelines.

Guidance non-compliance – inappropriate use

Former broad-acre agricultural sites have generally been considered unsuitable for residential development. Previous agricultural practices, particularly the regular application of persistent chemicals, may have caused some of these sites to have elevated levels of metals and pesticides. The soil contamination at these sites is characteristically widespread, with relatively low concentrations of contaminants confined to the surface soils. But the soil contamination needs to be reduced to even lower levels so that these sites do not pose a threat to residents who live on or near them in future.

The guidelines are aimed at environmental professionals or council staff who want to investigate the feasibility of using vertical mixing, whether for large development projects or single building allotments. Vertical mixing of soil is essentially the process of remediating contaminated surface soils by mixing them with cleaner soils found at greater depths.



Vertical mixing

Why is vertical mixing allowed, when "dilution is not the solution to pollution"?

Vertical mixing

Prerequisites include that the land does not have any 'hot spots'.

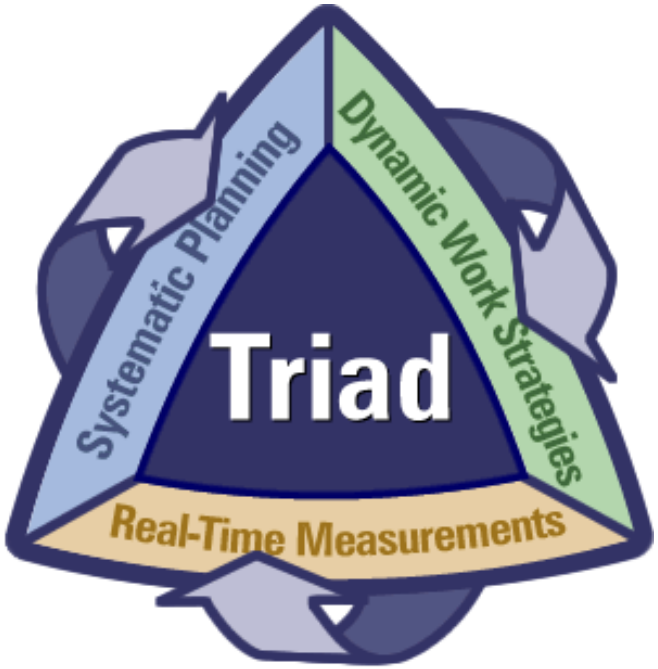
"If isolated hot spots are identified at a site, the EPA recommends further sampling to define the extent of these hot spots. Small volumes of contaminated soil should be remediated/managed by other means, e.g. excavation and treatment or, where permitted, disposal at a controlled landfill".

EPA's position:
- no vertical mixing to reduce contaminant levels except under the prerequisites in the guidelines and in line with the purpose of the guideline,
- contamination around sheds and mixing sites would be classified as hot spots, which can't be included in vertical mixing, and
- vertical mixing is only applicable for low level contaminants associated with broad acre agriculture.

Guidance non-compliance – lack of design process

NEPM describes that the investigation components of a site assessment are:

- establishing the objectives of the site assessment;
- desktop study and detailed site inspection;
- compiling a site history from relevant site-related information;
- development of a conceptual site model (CSM), identification of data gaps;
- development of data quality objectives (DQOs);
- design of a sampling strategy and optimisation of a sampling and analysis quality plan (SAQP);
- data collection (delineation of potential and known contamination);
- data validation, analysis and interpretation (including risk assessment and iterative development of the CSM); and
- coherent presentation and reporting.



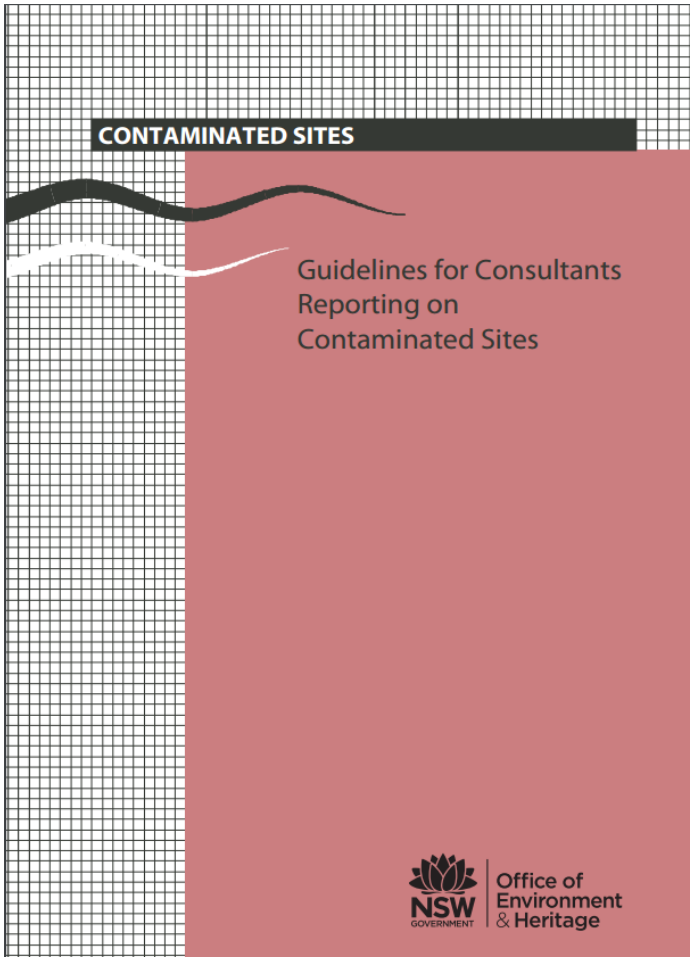
US EPA Triad is designed around the concept of managing decision uncertainty.

It draws on advancing science, technology, and practitioner experience to perfect strategies for making sitework more defensible (both scientifically and legally), more resource-effective, and more responsive to stakeholder expectations.

Guidance non-compliance – criteria

Basis for assessment criteria

- Table listing all selected assessment criteria and references
- Rationale for and appropriateness of the selection of criteria
- Assumptions and limitations of criteria



	HSL A & HSL B Low – high density residential			
CHEMICAL	0 m to <1 m	1 m to <2 m	2 m to <4m	4 m+
Toluene	160	220	310	540
Ethylbenzene	55	NL	NL	NL
Xylenes	40	60	95	170
Naphthalene	3	NL	NL	NL
Benzene	0.5	0.5	0.5	0.5
F1[9]	45	70	110	200
F2[10]	110	240	440	NL

	>C10 - C16 Fraction	F2 >C10 - C16 TRHs minus naphthalene	>C16 - C34 Fraction	>C34 - C40 Fraction
HSL commercial, sand 0 - < 1 m	-	no limit	-	-
HSL commercial, sand 1 - < 2 m	-	no limit	-	-
HSL commercial, sand 2 - < 4 m	-	no limit	-	-
HSL commercial, sand 4+ m	-	no limit	-	-
EIL, coarse grained	170	-	1,700	3,300
Management limits, coarse	1,000	-	3,500	10,000

Monocyclic Aromatic Hydrocarbons			
Benzene	950	500[C]	0.001
Toluene	-	-	0.8
Ethylbenzene	-	-	0.3
Xylenes	350 (as o-xylene) 200 (as p-xylene)	-	0.6
Styrene (Vinyl benzene)	-	-	0.03

Guidance non-compliance - sampling

Hotspot size and shape

EPA 1995 describes that the minimum sampling points required for site characterization are based on detecting circular hot spots with a 95% confidence level, using a systematic sampling pattern, in the case of Table A, a square grid sampling pattern.

Notes that Table A "is not the EPA's blanket approval and that investigators must be prepared to defend the appropriateness of applying Table A only".

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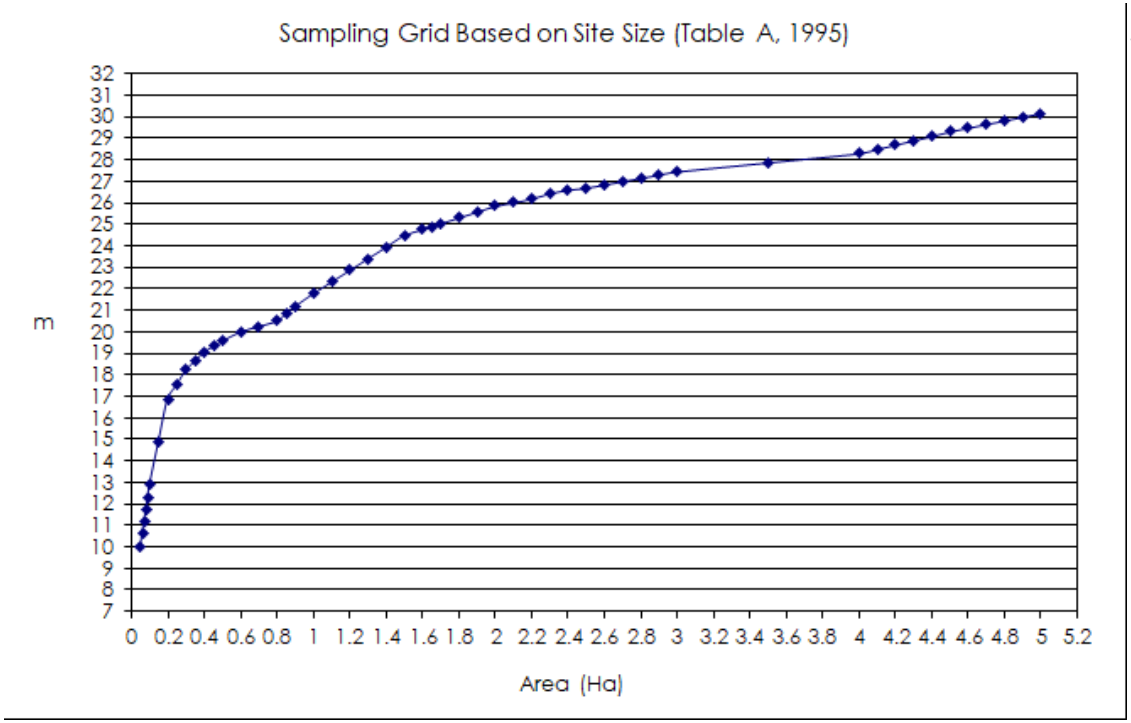


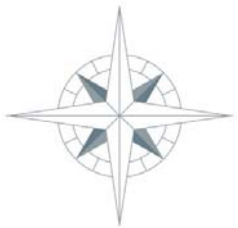
Size of the site (hectare) 1 hectare = 10,000 m^2	Number of sampling points recommended	Equivalent sampling density (points/hectare)	Diameter of the hot spot that can be detected with 95% confidence (metre)
0.05	5	100.0	11.8
0.1	6	60.0	15.2
0.2	7	35.0	19.9
0.3	9	30.0	21.5
0.4	11	27.5	22.5
0.5	13	26.0	23.1
0.6	15	25.0	23.6
0.7	17	24.3	23.9
0.8	19	23.8	24.2
0.9	20	22.2	25.0
1.0	21	21.0	25.7
1.5	25	16.7	28.9
2.0	30	15.0	30.5
2.5	35	14.0	31.5
3.0	40	13.3	32.4
3.5	45	12.9	32.9
4.0	50	12.5	33.4
4.5	52	11.6	34.6
5.0	55	11.0	35.6

Some statistics for sampling

Site assessment can be likened to two tasks; map the different geology or strata, and then characterize the different geology or strata.

The mapping occurs through the selection of sampling locations (x, y and z), and the characterization through selection of samples for appropriate analysis.

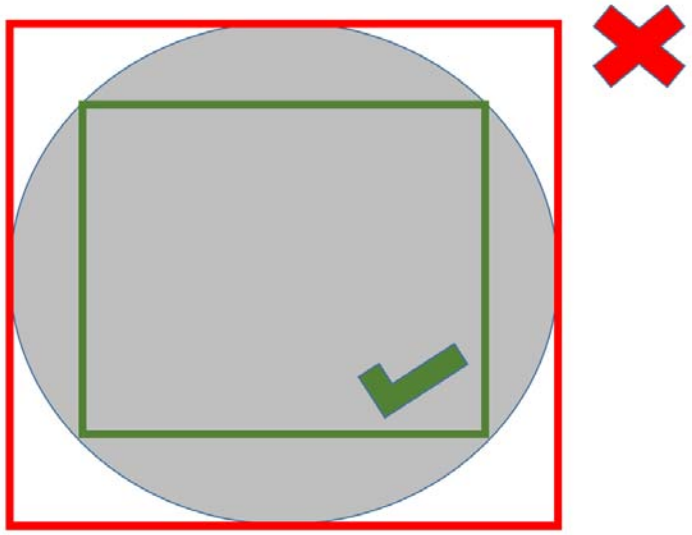
The first task can include the use of hotspot defined sampling grids, whereas the characterization includes selection of an appropriate number of samples for analysis.



Sample points required based on hotspot shape

Hotspot shape	f	Ratio	Number required	Increase in number
Circular	0.05	1.08	21.6	-
Tear drop	0.05	1.25	25	16%
Unknown	0.05	1.4 – 1.5	28 – 30	30% – 39%
Elliptical	0.05	1.8	36	67%

f = target area expressed as fraction of site size (5%); Ratio from Ferguson 1992 and Beck 2013; Number of sample point for 1 ha; Increase in number from a circular target; Ratio for unknown target varies between Ferguson 1992 and Beck 2013.



Grid = R / 0.59

(at 95% confidence)

m^2	Grid	Diameter	Number
6,000	20.0	23.6	15
6,500	20.1	23.8	16
7,000	20.3	23.9	17

The diameter of the hotspot is the critical aspect, not the number of samples. If the shape of the site means more samples to achieve the required grid, so be it. Does not include targeted locations!

Number of samples? EPA 1995/AS 4482.1 – 2005:

$$n = \frac{\left(Z_{1-\alpha} + Z_{1-\beta}\right)^2 * s^2}{(C_s - \bar{x})^2}$$

$$n = \frac{6.2 * s^2}{(C_s - \bar{x})^2}$$

With alpha (α) value and beta (β) value used to calculate the combined risk value (CRV).

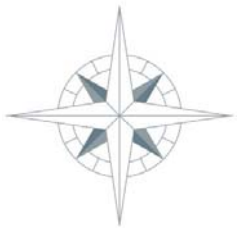
Number of samples? USEPA 2006:

$$n = \frac{\left(Z_{1-\alpha} + Z_{1-\beta}\right)^2 * s^2}{(C_s - \bar{x})^2} + \frac{Z_{1-\alpha}{}^2}{2}$$

$$n = \frac{6.2 * s^2}{(C_s - \bar{x})^2} + 1.4$$

With alpha (α) value and beta (β) value used to calculate the CRV.
Additional factor means two samples are the minimum number.

n	-	number of samples;
a	0.05	alpha at 95% confidence level;
Z_{1-a}	1.645	from table of z for selected alpha or beta;
β	0.2	beta at 80% confidence level;
$Z_{1-\beta}$	0.842	from table of z for selected alpha or beta;
s	-	sample standard deviation;
C	-	criterion; and
$\bar{x}$	-	sample arithmetic average.



Number of samples? Provost 1984 MPE method:

$$n = tp^2 * \frac{s^2}{E^2}$$

n	number of samples;
tp	t value at 95% confidence level;
s	sample standard deviation; and
E	maximum probable error (Margin of error).

Number of samples? Standardised form using RSD and MPE, e.g. USEPA ProUCL:

$$n = t_{95\%}{}^2 * \left(\frac{s/\bar{x}}{\frac{t_{95\%} * \left(s/\sqrt{n}\right)}{\bar{x}}} \right)^2$$

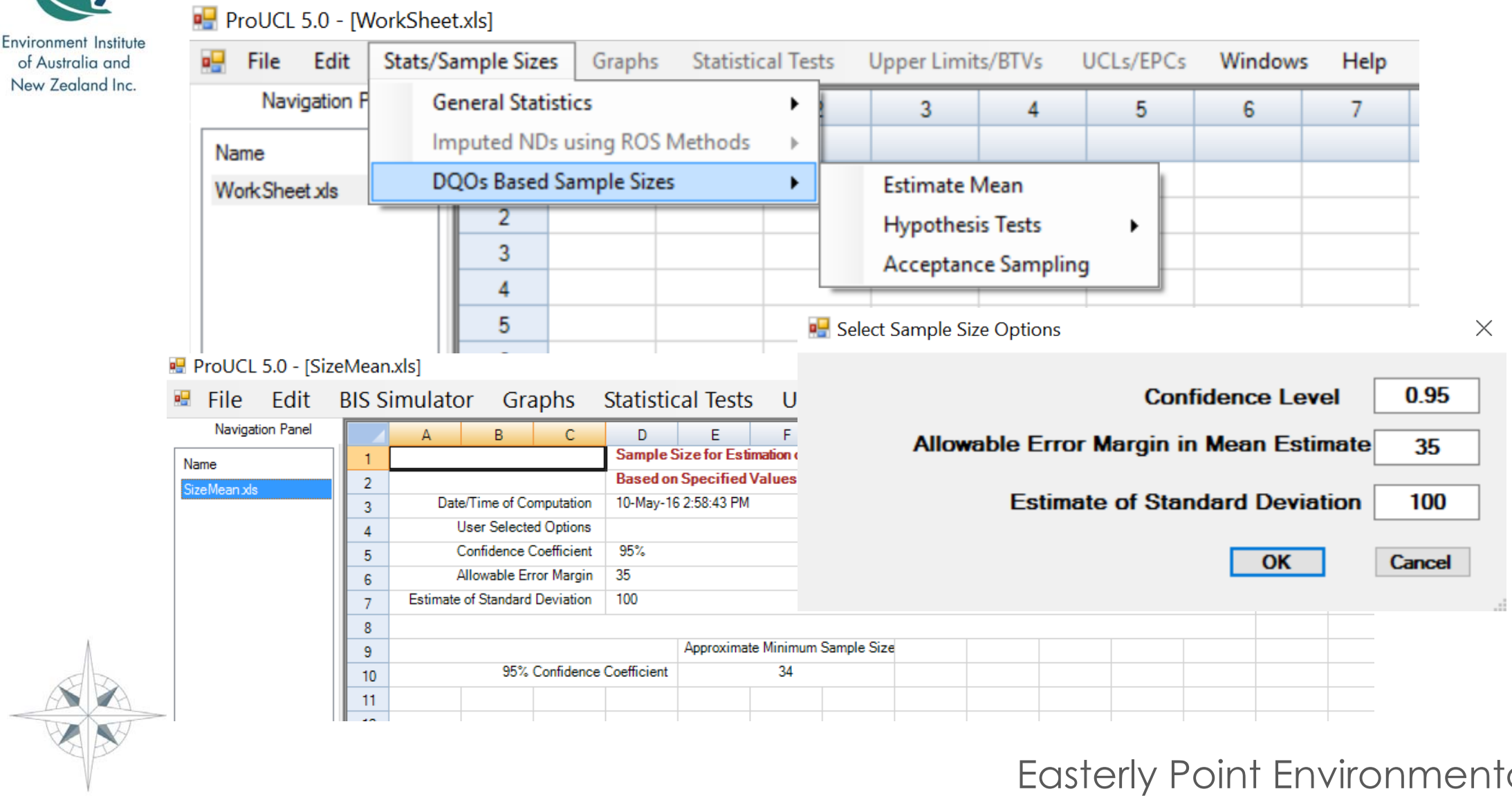
n	number of samples;
$t_{95\%}$	t value at 95% confidence level;
s	sample standard deviation; and
$\bar{x}$	sample arithmetic average.

USEPA ProUCL 5.1 sample size estimator *:

$$n = t_{95\%}{}^2 * \left(\frac{RSD}{MPE}\right)^2$$

* Sample size for estimation of mean, based on specified values of decision parameters/DQOs:

Confidence coefficient	95%
Allowable error margin	35%
Estimate of standard deviation	100%
Approximate minimum sample size	34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Upper Limits/BTVs
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Windows
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WorkSheet.xls
General Statistics
Imputed NDs using ROS Methods
DQOs Based Sample Sizes
Estimate Mean
Hypothesis Tests
Acceptance Sampling
Select Sample Size Options
Confidence Level
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Allowable Error Margin in Mean Estimate
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Navigation Panel
Name
SizeMean.xls
Sample Size for Estimation
Based on Specified Values
Date/Time of Computation
10-May-16 2:58:43 PM
User Selected Options
Confidence Coefficient
95%
Allowable Error Margin
35
Estimate of Standard Deviation
100
Approximate Minimum Sample Size
95% Confidence Coefficient
34

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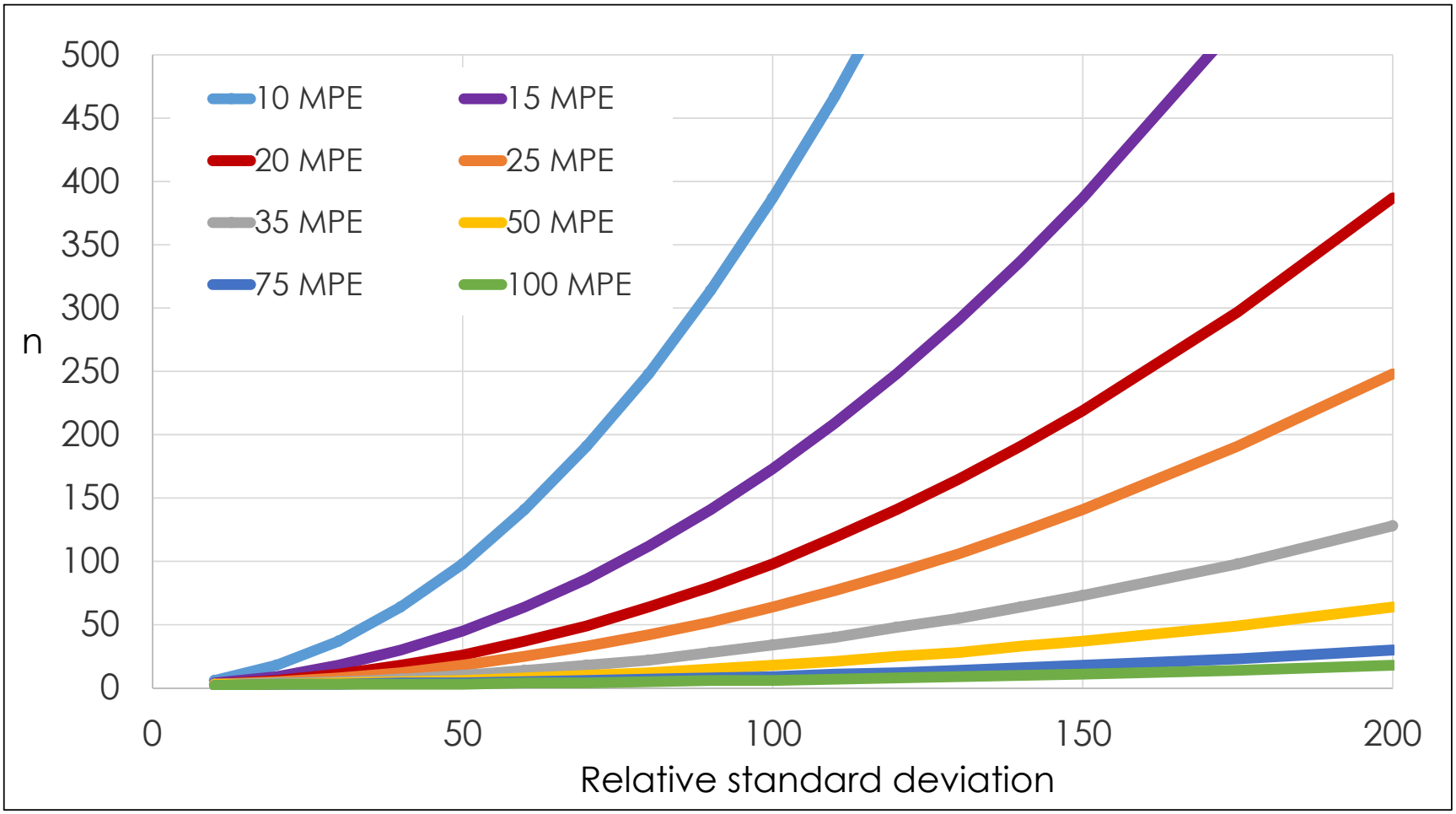
Calculated sample numbers based on RSD and MPE values:

RSD	10 MPE	15 MPE	20 MPE	25 MPE	35 MPE	50 MPE	75 MPE	100 MPE
10	6	4	3	3	3	3	2	2
20	18	9	6	**5**	4	3	3	3
30	37	18	11	**8**	**5**	4	3	3
40	64	30	18	**12**	**7**	**5**	4	3
50	98	45	26	**18**	**10**	**6**	4	3
60	141	64	37	**25**	**14**	**8**	**5**	4
70	191	86	49	**33**	**18**	**10**	**6**	4
80	248	112	64	**42**	**22**	**12**	**7**	5
90	314	141	80	52	**28**	**15**	**8**	6
100	387	173	98	64	**34**	**18**	**9**	6
110	467	209	119	77	**40**	**21**	**11**	7
120	556	248	141	91	48	**25**	**12**	8
130	652	291	165	106	55	28	**14**	9
140	755	337	191	123	64	33	16	10
150	867	387	219	141	73	37	18	11
175	1,179	525	297	191	98	49	23	14
200	1,539	685	387	248	128	64	30	18

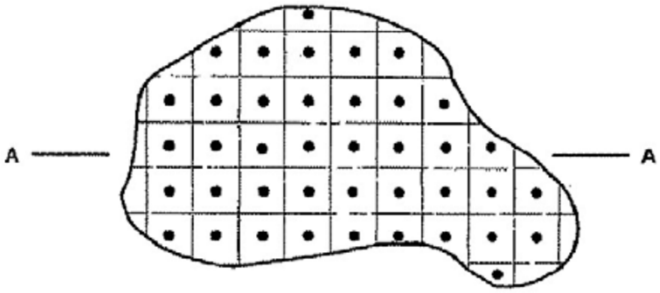

500
450
400
350
300
250
200
150
100
50
0
n
10 MPE
15 MPE
20 MPE
25 MPE
35 MPE
50 MPE
75 MPE
100 MPE
0
50
100
150
200
Relative standard deviation

How you sample is critical!

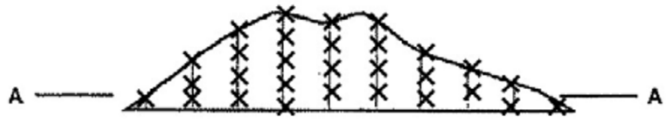
For all assessments, a "weight of evidence" approach is required.

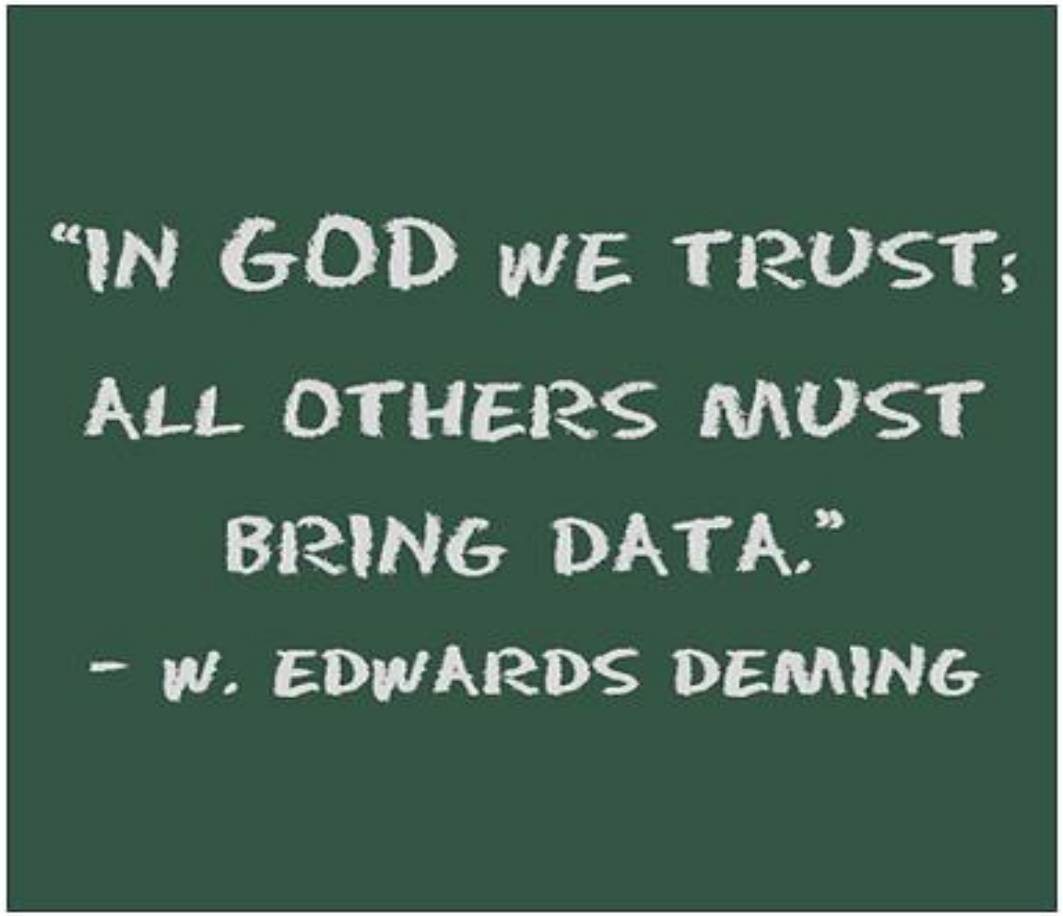
Includes appropriate sampling with use of field screening (visual, olfactory, PIDs, etc.), appropriate logging of samples and testpits/bores, sampling "inside" of stockpiles, etc., e.g. Vic EPA 2009 soil sampling guideline.

OBLIQUE VIEW



PLAN VIEW




"IN GOD WE TRUST;
ALL OTHERS MUST
BRING DATA."
- W. EDWARDS DEMING

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