Ministry for the Environment
Manatū Mō Te Taiao

PROPOSED
National Environmental Standard
>> for Assessing and Managing Contaminants in Soil

DISCUSSION DOCUMENT



New Zealand Government

Proposed National Environmental Standard for Assessing and Managing Contaminants in Soil

Discussion Document

Acknowledgements

This proposal integrates work contributed to by policy and technical advisory groups. Membership of these groups has been drawn from local government, central government, and industry. Specific acknowledgement of this assistance is made in the technical documents that support this proposal.

Cover photo (left): Courtesy of Tasman District Council.

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Environment
Manatū Mō Te Taiao

Contents

Part 2: Implementing the Proposed NES

Tables

Figures

Executive Summary

Overview of this document

New Zealand is fortunate that the scale of soil contamination is low relative to more industrialised countries. But whereas most other developed countries have enacted contaminated land-specific legislation decades ago, the perception of contaminated land issues emerged relatively late in New Zealand, such that the Resource Management Act (RMA) – when enacted in 1991 – did not specifically take it into account. It was not until the RMA amendments of 2005 took effect that contaminated land functions were assigned to local authorities.

Contaminated land practice has now evolved internationally to the stage where most developed countries exercise planning controls over the use of land that may be, or has been assessed as, contaminated. Best practice draws on a range of scientific disciplines. The question of "how clean is clean", or what level of contamination is safe, is continually under review. As New Zealand's first suite of technical guidelines was published over 10 years ago, it is appropriate to review the soil guideline values (SGVs) that should be applied. Now that the Ministry has undertaken a comprehensive review, it is efficient and pragmatic to apply the resulting SGVs as part of a national environmental standard (NES) framework. The NES proposal will not only remove the present uncertainty as to which SGV should be applied, but also maps out a practical framework for what should happen if it is found that the SGV is exceeded.

Local authorities play a pivotal role in administering land information and controlling the effects of land use. At the time of purchase, the liability for land is normally transferred to the new owner; hence it is paramount that property information is accurately categorised and publicly available to interested parties. It follows that the land tenure system depends on the public having confidence that land information is properly administered, and that potential risks are identified if known.

Contaminants in soil can pose a risk to human health and the environment. The first requirement is to systematically identify those parcels of land involving a contaminating activity, assess whether a risk is posed, and what (if any) conditions are appropriate to make the land safe for its designated use. This 'duty of care' sequence applies to all parties but depends in particular on collaboration, coordination and integrated information management between regional and city / district councils. It requires councils to accord this work a priority until the required information systems, and decision-making procedures are in place and functioning effectively. The NES as proposed will make this area a priority by requiring the risk from contaminants in soil to be appraised, and if necessary to be further assessed, in respect of applications for a change in land use, and of land that is being developed or subdivided.

This discussion document, including the proposed national environmental standard (NES) and supporting soil guideline values (SGVs) deliver on two high-priority components of the Ministry for the Environment's contaminated land work programme:

- planning controls appropriate to district and city council plans for assessing contaminants in soil
- a set of chemical-specific soil contaminant thresholds that will define an adequate level of protection for human health for a range of differing land-uses in New Zealand.

These components are brought together in the proposal for an NES (as described in this document) developed to address significant gaps in how soil contamination is managed.

The problem addressed by this proposal?

The past use of chemicals (hazardous substances) in industry, agriculture and horticulture has left a legacy of soil contamination in New Zealand. It cannot be assumed that affected properties are safe for use unless they have been systematically identified, assessed and as necessary, contained or cleaned up.

This problem is not adequately addressed by many city and district councils at the critical stage, that is when land potentially affected by contaminants in soil is developed or subdivided for residential use.

Policy objective

The policy objective of the proposal is:

> To ensure that land affected by contaminants in soil is **appropriately identified** and **assessed** at the time of being **developed** and if necessary remediated, or the contaminants contained, to make the land **safe for human use**.

The proposed option

The proposed option for meeting the above objective is a national environmental standard for assessing health effects from exposure to contaminants in soil.

The proposed NES, applied within a framework for assessing contaminants in soil and including a national set of soil guideline values, will require local authorities to control the use of land affected by contaminants. The proposed NES will enable use to be made of affected land by ensuring that:

- district planning controls are appropriate and nationally consistent
- councils gather and apply the information needed for efficient decision making on contaminated or potentially contaminated land
- the soil guideline values are appropriate and applied consistently.

Costs and benefits

A preliminary assessment of the costs and benefits of the proposed national environmental standard has been prepared by independent consultants. The cost-benefit analysis shows that the nationwide impacts are expected to be positive. While the site-specific impacts are unable to be quantified, it is also likely that they will be positive.

Submissions

The Ministry for the Environment welcomes public feedback on the outlined proposal through public submissions. Anyone can make a submission on the proposed standard. **Submissions must be received by the Ministry for the Environment no later than 5.00 pm on 19 April 2010. Further details on making a submission are included in section 6.**

1 Introduction

1.1 Background

This discussion document, including the proposed national environmental standard (NES) and supporting soil guideline values (SGVs), deliver on two high-priority components of the Ministry for the Environment's contaminated land work programme.

The Ministry's contaminated land work programme is a product of extensive stakeholder consultation in 2006 and 2007. In November 2006, the Ministry published and consulted widely on a discussion paper (MfE, 2006c) that identified some of the gaps in the policy framework on contaminated land.

Using feedback from stakeholders, the Ministry developed a work programme that placed a high priority on:

- developing a nationally consistent method for deriving and applying soil contaminant levels, protective of human health, that trigger a defined management action
- developing nationally consistent land-use and subdivision rules
- continued advocacy of the contaminated sites remediation fund.

This consultation, and the development of the work programme, was documented in three reports[1] published by the Ministry for the Environment under the title *Working Towards a Comprehensive Policy Framework for Managing Contaminated Land in New Zealand*.

1.2 Purpose of this document

This discussion document has been prepared to:

- help you understand the proposal and its potential costs and benefits
- help you prepare questions and feedback
- guide you in making a submission.

The proposals in this document are especially important to territorial councils, as they are intended to support their respective functions under the Resource Management Act 1991 (RMA) relating to contaminated land, section 31(b)(iia).

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1 The three reports are the: *Discussion Document* (MfE, 2006c), *Report on Submissions* (MfE, 2007a), and the *Position Paper* (MfE, 2007b).

1.3 Structure of this document

This discussion document pulls together a number of different projects, some of which are highly technical in nature. To ensure the accessibility of this document to the widest possible audience, it has been presented in two parts.

Part 1: The proposed NES for assessing contaminants in soil

Part 1 provides a basic outline of the problem and the objective and options for addressing them, and why a national environmental standard is being proposed.

- Section 2 introduces the problem of contaminants in soil, describes the barriers to the adequate management of this land, and proposes a policy objective.
- Section 3 describes and assesses the available options for achieving the policy objective.
- Section 4 sets out the preferred option, being the proposed NES for assessing contaminants in soil.
- Section 5 provides a summary of the preliminary assessment of the costs and benefits of the proposed NES.
- Section 6 outlines the submissions process and a consolidated list of discussion questions.

Part 2: Implementing the proposed NES

Part 2 is more technical than Part 1. This part outlines how the national environmental standard is expected to be implemented, what soil guideline values are, and how they are to be applied.

- Section 7 outlines how the NES is expected to be implemented.
- Section 8 sets out the SGVs and describes their purpose.

Appendices

- Appendix 1 summarises the methodology used to derive soil guideline values protective of human health.
- Appendix 2 describes the method for the derivation of site-specific soil guideline values.
- Appendix 3 summarises the findings and recommendations of the review of toxicological intake values.
- Appendix 4 provides the Hazardous Activities and Industries List (HAIL).

Supporting reports not contained in this document

This discussion document is also supported by the following technical documents available on the Ministry for the Environment's website.

- *Draft Toxicological Intake Values for Priority Contaminants in Soil* (MfE, 2010a) – This technical report provides the recommended toxicological intake values used as the basis for deriving $SGVs_{(health)}$. A summary of its findings is contained in Appendix 3.
- *Draft Methodology for Deriving Soil Guideline Values Protective of Human Health* (MfE, 2010b) – This technical report outlines the method used to derive soil contaminant concentrations appropriate to generic land-use exposure scenarios. A summary of its findings is contained in Appendix 1.
- *Preliminary Cost-benefit Analysis of the Proposed NES for the Assessment of Soil Contaminants* (Covec, 2009) – This report, prepared by an independent consultant for the Ministry for the Environment, is the full preliminary cost-benefit analysis of the proposed NES for the assessment of contaminants in soil. A summary of its findings are contained in section 5 of this document.

1.4 What is a national environmental standard?

National environmental standards are regulations made under section 43 of the Resource Management Act 1991 (RMA) that prescribe technical standards, methods or requirements for environmental matters.

National environmental standards may cover, but are not limited to:

- contaminants
- water quality, level or flow
- air and soil quality
- noise
- standards, methods or requirements for monitoring.

National environmental standards may specify qualitative or quantitative standards, standards for discharges, classification methods, methods and processes to implement standards, as well as exemptions and transitional provisions. They can apply nationwide or only to specific areas.

The regulation-making power under the RMA is limited. Sometimes it is impossible to address all areas of concern in a standard because only those matters that could reasonably be considered under the RMA can be included in a national environmental standard.

In the present context, a national environmental standard can provide local government with the tools to help manage or prevent risks to human health and reduce risks to the environment. NESs can capture wider benefits than is possible from decision-making at a regional or local level. Such benefits include ensuring a nationally consistent approach, providing more certainty, and administrative efficiencies to the local plan development process.

Each local or regional council must enforce the same standard, although it may impose stricter rules or bylaws if the national environmental standard explicitly allows for this.

1.5 The process of developing national environmental standards

An outline of the process for developing a national environmental standard, including the informal and formal submission processes, is shown in figure 1. This discussion document forms part of the formal submission process.

The process of developing a national environmental standard differs from the statutory plan and resource consent processes in that there are no hearings, appeal provisions or First Schedule consultations. However, the RMA does require the Minister for the Environment to provide an opportunity for the public and iwi authorities to comment on the proposed subject matter of the standard before the NES is made. That opportunity is provided through submissions on this discussion document.

The submission period is your opportunity to make a formal submission on the proposed standard. A 10-week submission period is provided to enable any formal approval or ratification of submissions that is required by councils, committees or boards. Details on how to make a submission are given in section 6.

To help you formulate a submission, questions are posed throughout this document on aspects of the proposed standard for your consideration. These are listed at the end of each section and are brought together in section 6. However, you are welcome to provide feedback on any aspect of the proposed standard.

If the Government recommends a national environmental standard following consultation on this document, a regulatory impact assessment[2] will be required. This discussion document contains, and invites comment on, the substantive elements of a regulatory impact assessment.

At the end of the submissions process the Ministry for the Environment will prepare for the Minister for the Environment a report and recommendations on the comments and proposed subject matter of the standard and a formal evaluation of the alternatives, costs and benefits under section 32 of the RMA. The report and recommendations must be publicly notified. The Minister will then consider the report and recommendations and the section 32 evaluation before deciding whether to recommend to the Governor-General that the national environmental standard be made by order in council.

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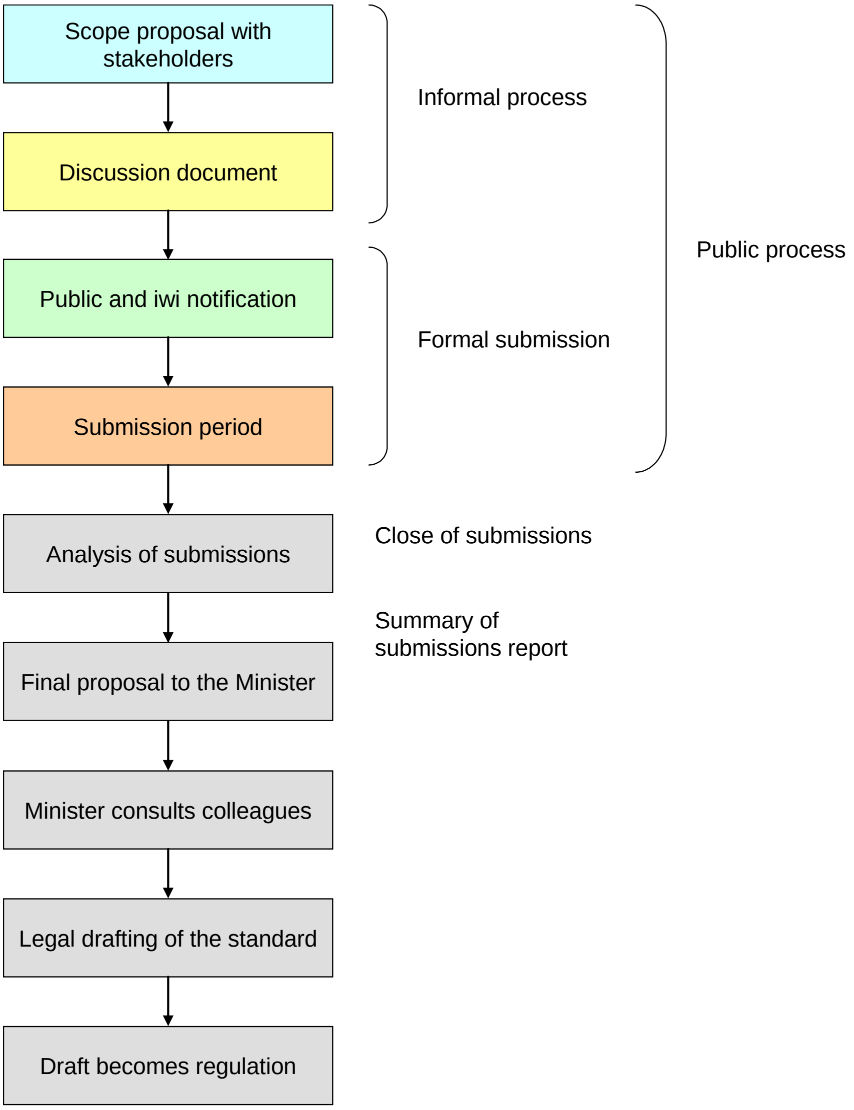
2 Regulatory impact assessment (RIA) is a policy tool widely used in OECD countries. RIA examines and measures the likely benefits, costs and effects of new or changed legislation and regulations. RIA is used to define problems and to ensure that government action is justified and appropriate.

Figure 1: Process for developing a national environmental standard



Part 1

The Proposed NES for Assessing Contaminants in Soil

2 What is the Problem?

The problem proposed to be addressed is best summed up as follows:

> New Zealand has a **legacy of soil contamination** that requires to be **identified and assessed**. To ensure this land is **safe for human use**, land affected by contaminants in soil should, if necessary, be **remediated or contained** at the time of being developed. However, the existing controls are either absent, inadequate or inconsistently or inappropriately applied.

This section presents evidence of the problem, specifically describing:

- *New Zealand's legacy of soil contamination* – why we have a legacy, why this affected land presents a problem, and who is responsible for controlling the adverse effects
- *the absent, inadequate and inconsistent controls on the land use, subdivision, and development of affected and potentially affected land*. Specifically including the inconsistent and inappropriate use of guideline values to assess the effects of affected and potentially affected land.

2.1 New Zealand's legacy of soil contamination

The past use of chemicals (hazardous substances) in industry, agriculture and horticulture has left a legacy of soil contamination in New Zealand. This contamination is mainly caused by past practices including storage and use of hazardous substances, and disposal of hazardous wastes.

The most common past activities that have led to the creation of contaminated sites in New Zealand are:

- *The manufacture and use of pesticides* – these activities have resulted in contamination at locations where pesticides were manufactured as well as the wider contamination associated with the use of the chemicals (eg, agrichemical sprays). Well-known examples of contamination from these activities include:
  - the Fruitgrowers' Chemical Company site at Mapua
  - disposal of waste chemicals from the Dow Agrichemical site in New Plymouth
  - horticultural land affected by the use of agrichemical sprays.
- *Production of gas and coal products* – includes many old gasworks sites located in most towns and cities. Well-known examples of contamination from these activities include:
  - disposal of waste products from former Auckland gasworks as fill beneath some parks and residential areas
  - the Rotowaro Carbonisation Plant near Huntly.
- *Production, storage and use of petroleum products* – contamination has occurred from leaking fuel storage facilities at tank farms and service stations. Well-known examples include the contamination of Auckland's Western Reclamation caused by leaking bulk storage tanks.
- *Historic mining* – usually associated with metals leaching from old tailings dams and mine shafts. The best-known example is the Tui Mine on Mount Te Aroha in the Waikato.

- *Timber treatment* – pentachlorophenol (PCP) was one of a number of chemical formulations used routinely at most sawmills and timber treatment plants from the 1950s until 1988, when its use ceased.
- *Sheep dipping* – use of DDT, arsenic and other chemicals to treat parasites on sheep in thousands of locations, usually on sheep farms but also known to be located in stockyards and railway sidings.

Many of these activities – for example, the use of DDT in sheep dips and to kill insects – were not known to be hazardous at the time.

2.1.1 When are soil contaminants a problem?

Contaminants are a problem when the hazardous substances are at a concentration and a place where they have, or are reasonably likely to have, an adverse effect on human health and the environment. Contaminants are a greater problem in environments where food is grown or in close proximity to buildings, people, water bodies and important habitats.

Contamination is not always limited to a specific site. Hazardous substances may seep through the soil into groundwater, or be carried to nearby land and waterways in rainwater and attached to dust. Hazardous gases can also pollute our air. The different pathways by which humans can be exposed to contaminants in soil are shown in figure 2.

2.1.2 Effects on human health

The effects to human health from exposure to contaminants can be categorised into short-term (acute) effects, and long-term (chronic) effects.

- *Acute toxic effects* – can result in immediate adverse health impacts. For example, acute arsenic poisoning has the potential to occur where children ingest soil contaminated with high levels of arsenic associated with old sheep dip or timber treatment sites.
- *Chronic effects* – are adverse health effects that can result from an ongoing but low-level chemical exposure over an extended period. Carcinogenic (ie, cancer-causing) or developmental effects (eg, affecting organ function) may not be expressed to the extent of being able to be diagnosed until many years later.

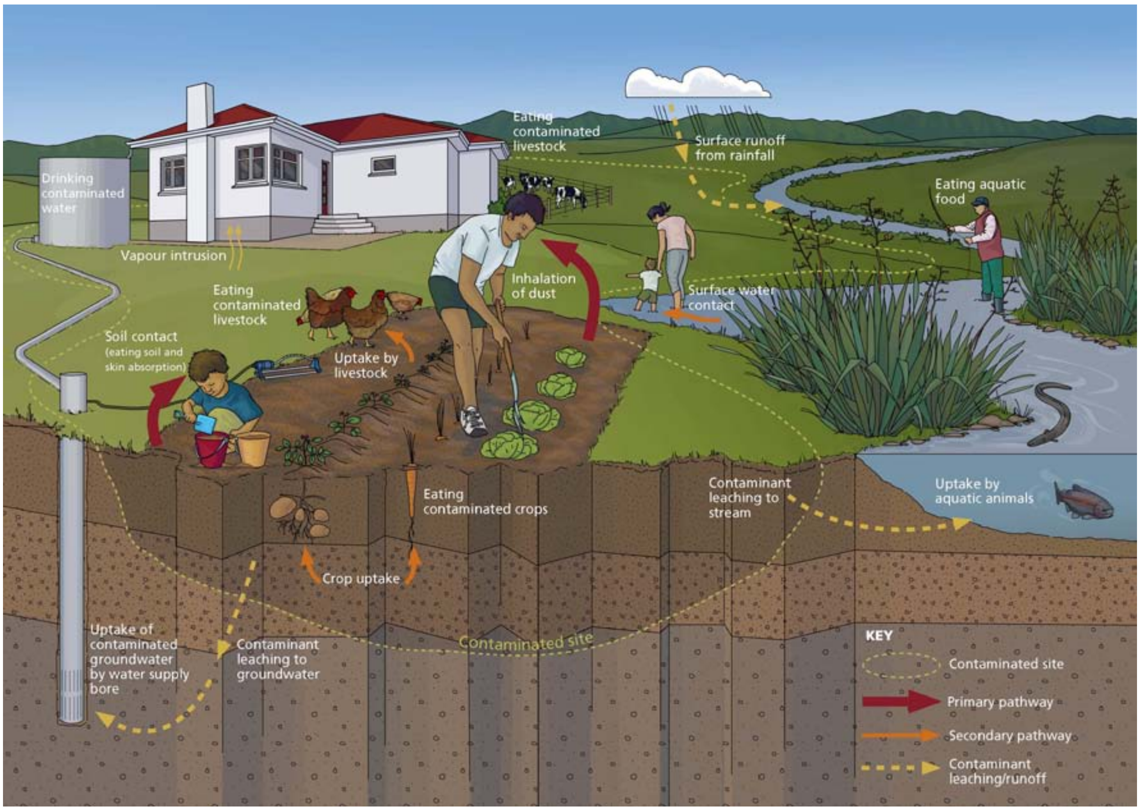
The study of this dose-response relationship (cause and effect) of chemical poisoning is at the core of the branch of science called toxicology. We are exposed to a myriad of chemicals daily, mostly at levels that do not prevent the ability of our bodies to function normally. Present-day assessments of safe exposure levels to chemicals are far more sophisticated than available, say, 50 years ago. Therefore, we have the advantage of being able to use this knowledge to estimate the safe levels of chemical residues that exist in soil as contaminants from past activity, and prevent or minimise exposure.

The specific human toxicological effects of some of the contaminants most commonly found in New Zealand are briefly described in Appendix 3.

As well as endangering human health and the well being of living organisms, the presence of contaminants can:

- limit the use of land
- cause corrosion that may be threaten building structures
- reduce land value.

Figure 2: Pathways by which contaminants in soil can affect human health



2.1.2 How much contaminated land is there in New Zealand?

It is widely accepted within the industry that there are still many contaminated sites that remain unidentified. Therefore it is uncertain exactly how many sites in New Zealand are affected or potentially affected by contaminants.

However, information collected by regional and unitary councils provides an indication of the number of sites identified so far. A recent survey (undertaken by Statistics New Zealand) of 11 regional councils identified:

- 472 sites confirmed[3] as contaminated land under the RMA
- 669 sites have been remediated
- 754 sites under management to ensure that the on-site contamination does not significantly affect the environment.

Due to the focus to date on activities on the Hazardous Activities and Industries List[4] (HAIL), most of these sites are likely to be industrial sites. As shown in figure 3, the number of reported sites is higher within the more populated regions. More populated areas generally have more industry as well as other activities that can lead to contaminated land.

However, the overall amount of contaminated land in New Zealand is uncertain. Further to the industry view that many sites remain unidentified, the Ministry estimates that councils have identified approximately 20,000 potentially affected sites. Of these, only a small proportion have been sufficiently investigated to determine whether the site has contaminants present.

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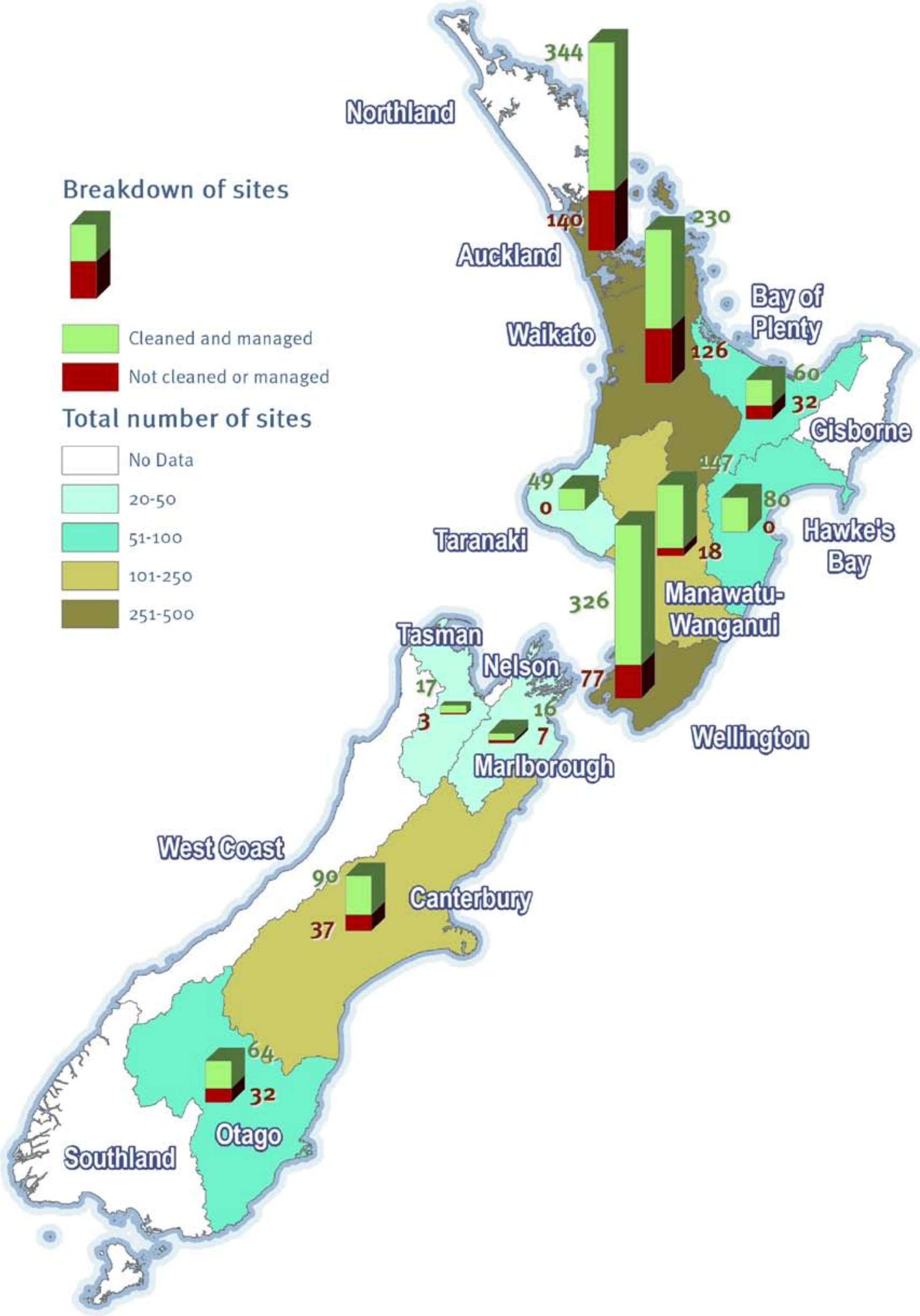
3 The total number of confirmed contaminated sites only includes sites which have not yet been cleaned up or managed, except for the Auckland value which includes some sites that have resource consents (and are therefore managed).

4 The Hazardous Activities and Industries List (HAIL) was published by the Ministry in 2003. It defines industries and activities which typically use or store hazardous substances that could cause contamination if those substances escaped from safe storage, were disposed of on the site, or were lost to the environment through their use. The full list is attached in Appendix 4.

Figure 3: Available information on contaminated sites in 11 regions (2008–2009)



Source: Data supplied by regional and unitary councils to Statistics New Zealand (2009) for the report titled: *Measuring New Zealand's Progress Using a Sustainable Development Approach: 2008*.

Note: The total number of confirmed contaminated sites only includes sites that have not yet been cleaned up or managed, except for the Auckland value which includes some sites that have resource consents (and are therefore managed).

2.1.3 How is soil contamination managed in New Zealand?

The current framework for managing land contamination includes a mix of laws and regulations, guidelines and funding arrangements. This mix of instruments is implemented by a range of central and local government agencies. This section focuses on the roles and responsibilities of local government and the Ministry for the Environment. These are the agencies most directly involved in managing soil contamination.

The full range of existing measures relating to contaminated land, and the roles and legislative responsibilities of all involved agencies, is described in the Ministry for the Environment discussion document: *Working Towards a Comprehensive Policy Framework for Managing Contaminated Land in New Zealand*.

Local government

Local government (regional councils, city and district councils) are responsible for the day-to-day management of contaminated land and have specific functions under the RMA. Local government is in charge of controlling the effects of contaminated land, and also for controlling activities that cause land to become contaminated. Sections 30 and 31 of the RMA give local government the following functions:

- **regional councils** – "the investigation of land for the purposes of identifying and monitoring contaminated land"
- **district and city councils** – "the prevention or mitigation of any adverse effects of the development, subdivision, or use of contaminated land".

These functions generally mean the following:

- Regional councils work to identify and monitor land that is contaminated within their region. Most regional councils also collate and manage information about contaminants on land in a specific land-use information register.
- District and city councils have the responsibility of ensuring, when decisions are made concerning land-use changes or the subdivision or development of land, that the potential for health effects are evaluated.

In addition to the RMA functions, district and city councils also have responsibilities under other Acts to, on request, report information about the presence of hazardous substances on land.

Regional councils

There are 16 regional councils in New Zealand, including four unitary authorities (which have dual territorial and regional council functions). Regional councils:

- are generally organised along major catchment boundaries
- prepare regional policy statements and regional plans
- regulate discharges to air, water and land
- have the contaminated land function of: "the investigation of land for the purposes of identifying and monitoring contaminated land".

Territorial authorities

There are 73 district and city councils. They:

- prepare district plans
- regulate land use, development, subdivision and building control
- have the contaminated land function of: “the prevention or mitigation of any adverse effects of the development, subdivision, or use of contaminated land”
- have a range of public health responsibilities under other legislation.

The Ministry for the Environment

The role of the Ministry for the Environment is to provide leadership on contaminated land issues across both central and local government. The Ministry for the Environment has been involved with a number of initiatives to support local government fulfil their functions. Most notably are the following:

- Ten contaminated land guidelines have been developed – these guidelines provide practical guidance on managing soil contamination and support local government functions under the RMA.
- The contaminated sites remediation fund has been established – allocating $1.78 million per year to high-risk sites where the landowners are unable to fund the management or clean up.
- Contaminated land functions for councils and a definition of contaminated land have been added to the RMA – to clarify the respective roles and responsibilities of local authorities.
- Voluntary targets for identifying, assessing and managing contaminated sites have been set for local authorities.

The guidelines are widely used by practitioners and are considered by them to be technically robust. The contaminated sites remediation fund has assisted in investigation and/or the remediation of 34 sites, including the remediation of New Zealand’s worst contaminated site, at Mapua.

2.2 The inadequate control of soil contamination

As described in the previous sections, the past use of chemicals (hazardous substances) in industry, agriculture and horticulture has left a legacy of soil contamination in New Zealand. Properties potentially affected by soil contamination cannot be assumed to be safe for use unless they have been subject to a process of:

1. **identifying** or confirming that the land is affected or potentially affected by contaminants in soil
2. **assessing** the risk of adverse effects posed by contaminants using appropriate soil contaminant thresholds
3. requiring the **clean up** or **containment** of soil contamination, if necessary, to minimise the risk of adverse effects occurring.

Planning controls that require this process would ensure that people's health is not placed at risk. However, many district and city councils do not yet have adequate controls that ensure this process is required at the critical stage, that is when land potentially affected by contaminants in soil is developed, subdivided or when its land use changes.

2.2.1 Inadequate development subdivision and land-use controls

Unless adequate checks and controls are in place, the use, subdivision and development of land affected by soil contamination can pose significant risks to human health and the environment. Development of land, especially earthworks and land-use change, can expose people and the environment to increased risk of exposure to contaminants. These controls are especially important when the use of the land is changing to a more sensitive land use.

District and city council land use and subdivision controls are the main way hazardous substances in or on land are identified and the risks are assessed, managed or remediated. Section 31 lists the functions of city and district councils under the RMA. Under section 31(b)(iia), territorial authorities are responsible for:

> "the prevention or mitigation of any adverse effects of the development, subdivision, or use of contaminated land".

However, a Ministry review of contaminated land provisions in district and city plans showed that the plans had widely variable controls and that most district plans do not yet reflect the important amendments made to the RMA in 2005. This review (MfE, unpublished) of 73 plans found that:

- although 46 (67 per cent) plans featured general objectives / policies, 23 (33 per cent) contained no provisions specific to contaminated land
- although 18 (25 per cent) featured specific rules, only 14 (19 per cent) of these featured rules specific to section 31 functions.

Table 1 shows the number of district plan sets that do not contain objectives and policies, rules, and rules specific to councils in relation to the contaminated land function of section 31 of the RMA.

Table 1: Number of district plans that have no contaminated land-specific provisions

Contaminated land-specific provisions	Number of district plan sets
No objectives / policies	27
No rules	55
No rules for section 31 functions	59

The lack of specificity in the controls of many district plans are likely to result in an ad hoc process of identifying, assessing and cleaning up or containing the contaminants. An ad hoc process has much greater risk of:

- affected sites not being identified at the time of development, and therefore any human health risk not being assessed
- identified sites being inadequately assessed because of the use of inappropriate methods for investigating and assessing soil contaminants
- remediation or containment being inadequately undertaken or controlled.

These outcomes may put people's health at risk, provoke community concern and outrage, initiate expensive post-development disputes, and require expensive post-development remediation or containment to correct.

Case study 1 – Liability claims against councils

Riskpool is the mutual fund that indemnifies councils against liability claims. Riskpool report that it handles on average two cases a year associated with a claim made against a council relating to instances where councils are alleged to have inappropriately allowed activities on affected sites.

Industry sources and Riskpool suggest that a typical claim may impose costs of around $20,000 to $60,000 to resolve. Some disputes involve legal process costs that are much higher. Other costs can also occur including: alternative accommodation for affected landowners, health treatment expenses (eg, blood testing), and relatively expensive post-development remediation. The total costs of these disputes can exceed $100,000.

Case study 2 – Identifying old sheep-dip sites

Old sheep-dip sites are locations where sheep were treated with an external insecticide for economic and welfare reasons.

The sites are typically contaminated due to the persistent and toxic nature of the chemicals used to control parasites. These chemicals included arsenic, dieldrin, DDT and lindane. Exposure to these chemicals is likely to be hazardous to human health and the environment.

Within a rural setting these sites pose little risk. However, if the land is developed and a more intensive or sensitive use is made of the land, the risk increases. At high risk are children playing in or around old sheep-dip sites, and site occupants who grow their own food on the contaminated area.

Across New Zealand it is estimated that thousands of former sheep-dip sites exist on both public and private land[5]. Their numbers and locations are largely unknown by councils because of the difficulties in identifying them. These difficulties include:

- the costs and resources required to actively identify and investigate these sites
- owners / occupiers are not under any legal duty to report soil contamination to councils, ie, there is no incentive for landowners to come forward, and the perceived effect on property value is a strong motive for landowners to avoid reporting sites, or even to actively hide sites
- critical information is being lost of the exact location of sites as the original owners / occupiers sell, retire or die.

2.2.2 Inconsistent and inappropriate use of guideline values

Numerical values for levels of hazardous substances that are protective of human health and the environment, and the methods used to derive them, are important tools in the assessment of contaminated land. Without these values and methods, practitioners are not able to consistently assess the effect of contaminants in soil on human health or on the environment.

Typically, New Zealand practitioners have relied on a mixture of national and international guidelines from which to select numerical values for decision making. However, these guidelines use different methods for deriving numerical values and not all are appropriate for use in the New Zealand context.

The Ministry for the Environment has produced guidance (MfE, 2003b) that helps practitioners select appropriate values from this mix, although it can remain unclear for some contaminants which guideline value to choose, or how a value should be applied. In addition, calculation errors and inconsistencies between guidelines have remained uncorrected and are often still used in assessments.

In addition, some district and city councils:

- *Reference old and outdated guidelines in their plans.* For example: of the 18 district plans that contain specific contaminated land rules, 13 still reference the *Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites* (ANZECC, 1992), which has been largely outdated for over six years (MfE, unpublished).
- *Derive their own guideline values for selected contaminants.* For example, at least two councils have engaged consultants to derive contaminant thresholds to help them assess the effects of developments. While the derivation of the values may be technically robust, this approach creates inconsistency between districts in determining what level of contaminants in soil is acceptable to protect human health.

These issues have contributed uncertainty for practitioners and local government when investigating, identifying, preventing or mitigating the adverse effects of the development, subdivision or use of land affected by contaminants.

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5 *Identifying, Investigating and Managing Risks Associated with Former Sheep-dip Sites: A Guide for Local Authorities* (MfE, 2006a).

Problems arising from the uncertainty include:

- an over-assessment of risk, resulting in un-required or more expensive clean up or containment of contaminants
- an under-assessment of risk, resulting in an unacceptable level of risk to human health
- expensive disputes over the most appropriate value to apply.

2.2.3 Issues not addressed by this proposal

The management problems described above are the problems the Ministry has identified as high priority, and needing to be addressed by the proposal.

They do not present a full picture of all the barriers to effectively managing soil contaminants. A full range of interrelated issues considered barriers by stakeholders is described in *Working Towards a Comprehensive Policy Framework for Managing Contaminated Land in New Zealand Report on Submissions* (MfE, 2007a) and *Position Paper* (MfE, 2007b).

2.3 The policy objective

The policy objective of the proposal is to address the problems identified in the proceeding section by:

> Ensuring that land affected by contaminants in soil is **appropriately identified** and **assessed** at the time of being **developed** and if necessary remediated, or the contaminants contained, to make the land **safe for human use**.

Note the following for the purpose of this objective:

- *Appropriately* **–** means to be consistent, efficient and adequate. A *consistent* and *adequate* process is desirable to ensure a minimum level of health protection for all New Zealanders. The process also needs to be *efficient* in ensuring that land made safe for human use is not un-necessarily constrained, can be implemented in a timely manner, and administration costs are minimised.
- *Assessed* – includes the appropriate use of soil contaminant thresholds protective of human health.
- *Developed* – includes development, subdivision, and land-use change.
- *Safe for human use* – Without diminishing the importance of other aspects of the environment, protecting human health is the primary concern when assessing land-use and exposure scenarios.

The policy objective is diagrammatically represented in figure 4.

Discussion – Why does the policy objective focus on *making the land safe for human use*?

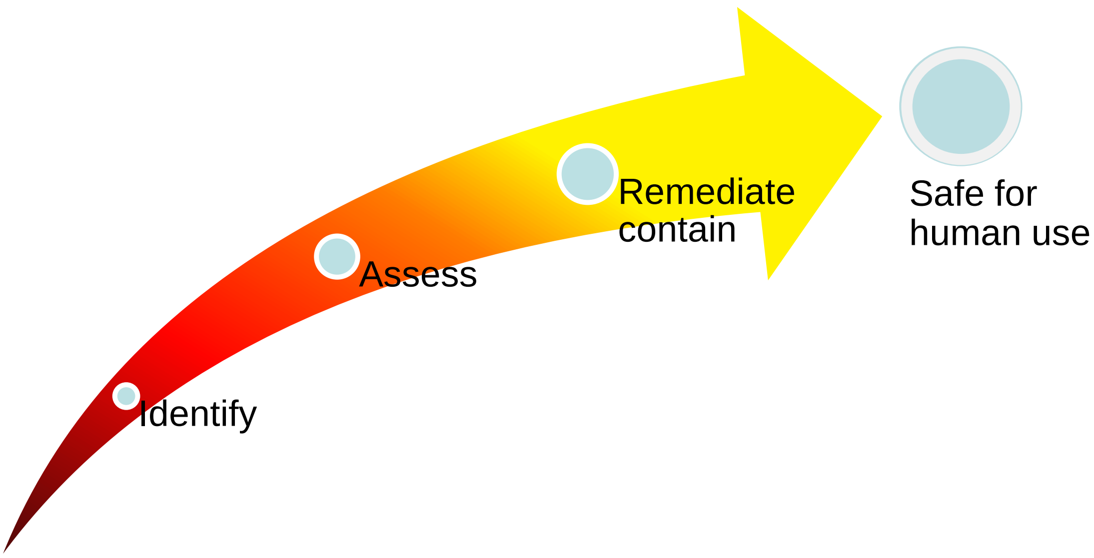
The quality of soil affected by hazardous substances has already been compromised.

The realistic and pragmatic response to this situation is to manage and/or remediate the land to **at least** ensure that human health is protected. This policy, incorporated into the objective of the national environmental standard, reflects the imperative of ensuring that land affected by soil contaminants is safe for human use.

The soil guideline values supporting this proposal have been derived in accordance with best international practice. The NES is achievable, practicable, and precisely targets the area of contaminated land policy that is presently weak.

A focus on addressing human health through a national instrument as a high priority was supported by stakeholders during consultation on the discussion document *Working Towards a Comprehensive Policy Framework for Managing Contaminated Land in New Zealand* (MfE, 2006c; 2007a; 2007b). This focus does not detract from the important and ongoing role of regional councils to assess ecological impacts on a site-by-site basis in accordance with their functions under the RMA.

Figure 4: Ensuring an appropriate process to identify, assess and remediate or contain contaminants in soil to make the land safe for human use



> **Questions**
>
> 1. Have the priority problems been defined correctly?
> 2. Are there other problems you can think of that need to be addressed as a priority?
> 3. Do you agree with the policy objective?
> 4. Should the objective be limited to ensuring that land is safe for human use? If not, why not?

3 What are the Options?

3.1 Options for achieving the objective

This section looks at a range of regulatory and non-regulatory options and assesses their appropriateness for addressing the problems defined in section 2, and for achieving the policy objective set out in section 2.3.

The options considered are to:

- amend the RMA
- develop a national policy statement under the RMA
- direct plan changes under the RMA
- provide non-regulatory national guidance
- develop a national environmental standard under the RMA.

Each option is assessed against a set of criteria that are derived from the policy objective. These criteria are as follows:

Does the option ensures that contaminants in soil are:

- *adequately* and *consistently* identified, assessed, remediated and contained
- *efficiently* identified, assessed, remediated and contained
- assessed using soil contaminant thresholds protective of human health that are *appropriate*.

3.1.1 Amend the Resource Management Act

There are two main ways the RMA could be amended to address the identified issues.

Change contaminated land function to a duty

The RMA already has functions that broadly specify what the roles of regional councils and territorial authorities are in relation to contaminated land. However, these provisions have been criticised by stakeholders[6] for not being strong enough to compel councils to undertake these functions.

Elevating the function to a duty to compel councils to act on them is likely to result in improvement in how councils give effect to their current functions. The advantage of this approach is that a higher priority than that presently given to soil contamination is likely. A higher priority may improve the resourcing applied to addressing soil contamination, which may include the initiation of plan changes to introduce appropriate provisions.

6 *Report on Submissions* (MfE, 2007a).

However, because of the broad nature of the RMA and the broad nature of the existing functions, these changes are open to interpretation. They would still leave the exact form, content and choice of rules and supporting technical methods to give effect to the duties to the discretion of individual councils. Therefore these changes would still lead to regulatory inconsistency between councils as they individually interpret and incorporate the RMA duties into plans and consent decisions.

Change to be more specific on the requirements for assessing contaminants in soil

In theory the RMA functions or duties could also be amended to be more specific on assessing contaminants in soil, such as defining contaminant values, technical methods and requiring that district plan controls ensure the appropriate identification, assessment and if necessary clean up or containment.

The advantage of amending the RMA is that it would provide a clear, unambiguous, legal obligation. However, this option would be contrary to the existing RMA framework, which generally sets out broad processes and principles rather than prescribing matters of technical detail. It would also require significant amendments to be made to the RMA and amendments each time a soil guideline value was revised.

These options implemented either together or by themselves are not considered to be the most appropriate means of achieving the policy objective because of their inability to ensure an adequate or consistent process.

3.1.2 Develop a national policy statement

A national policy statement (NPS) with specific objectives and policies on soil contamination has the potential to provide considerable improvements to how soil contamination is addressed by councils.

An NPS contains objectives and policies on matters of national significance that must be "given effect to" in RMA planning documents and given "particular regard to" in resource consent decision making. An NPS provides a potentially useful means by which national policy can be implemented through local and regional decision making.

An NPS may be prepared on any matter where the Minister considers it useful to state matters of national significance that are relevant to achieving the purpose of the RMA. The RMA sets out a range of matters the Minister may have regard to when deciding whether it is desirable to prepare an NPS. These matters are broad, and the proposed objective would fit within the broad criteria for an NPS.

The preparation of an NPS is, however, generally a lengthy and complex process. In addition, an NPS would leave the exact form content and choice of technical methods to achieve the policy outcome at the discretion of individual councils. An NPS, by itself, would likely lead to regulatory inconsistency between councils as they individually interpret and incorporate the NPS considerations into plans.

An NPS may, over time, achieve the objective. However, it is not the most appropriate way of achieving the objective because of the high-level nature and uncertainty of interpretation and implementation of such a policy statement.

3.1.3 Minister to direct plan changes

Under section 25A of the RMA, the Minister may direct a territorial authority to prepare a change to its plan that addresses council controls on the development, subdivision and use of contaminated land.

Section 25A of the RMA enables the Minister to direct a territorial authority to prepare a change to its district plan or proposed district plan that addresses a resource management issue relating to its function in section 31. The control of the actual or potential effect of soil contaminants is clearly a resource management issue relating to the council's section 31 functions.

This option would have the advantage of requiring district and city councils to specifically address how they control the effects of contaminated land. The outcome of these plan changes are likely to result in considerable improvements to how soil contamination is addressed by councils.

However, this option has the disadvantages of:

- *Not ensuring appropriate or consistent controls* – it is likely that the Minister would need to direct more than 60 plans due to the current state of plans. All directed plans would still be required to go through the schedule 1 process.[7] Even if the Minister was very specific about the issues to be addressed, the directions may be interpreted and drafted differently by each council. In addition, the process of consulting, hearing and addressing appeals may significantly vary what was originally proposed.
- *Being administratively inefficient* – more than 60 plan changes being required to go through the schedule 1 process at the same time is likely to be expensive and demanding on the already limited capacity of soil contamination experts and those stakeholders with a national interest in this issue (eg, oil industry and agricultural sectors).

For the above reasons this approach is not considered the most appropriate way of achieving the objective.

3.1.4 Non-regulatory national guideline approach

National guidelines have been the main mechanism used by the Ministry for the Environment to guide and support contaminated land practitioners in industry and local government. An overarching guideline for contaminated land that consolidates other guidelines is likely in itself, to improve contaminated land management. A national guideline is easily updatable and would help improve practice by:

- providing a one-stop reference on the derivation, appropriate selection and use of health-based numerical values
- explaining how numerical values can be tailored to New Zealand land-use settings (eg, a lifestyle block)
- increasing national consistency in how contaminants in soil are assessed and managed.

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7 Schedule 1, Part 1 of the RMA sets out the requirements relating to preparing and changing policy statements and plans including consultation, notification, disputes resolution, hearings and appeals.

Although credible guidelines are generally widely followed among local government and practitioners, their non-statutory status ultimately limits their ability to ensure a consistent, adequate and efficient approach because:

- *Guidelines are voluntary* and councils are not required to implement them.
- *Councils may vary from the prescribed approach* – some councils are likely to choose to adopt alternative approaches to those prescribed.
- *The transition to a guideline approach may be lengthy* – for example, because of the district planning cycle there may be a lengthy transition time between the publishing and the uptake of the guideline. The situation is further complicated by the fact that plans that reference previous guidelines would need to be changed for guidelines to have full effect in those areas.
- *The transition to a guideline approach is administratively inefficient* – under the guideline approach, each council would need to change its plan. This approach is likely to result in duplication of effort by councils and submitters and provide the opportunity for the serial re-litigation of proposed plan changes.

For the above reasons a non-regulatory guideline approach is not the most appropriate method of achieving the objective.

3.1.5 Develop a national environmental standard under the RMA

Essentially, a national environmental standard is a regulation that can *control activities directly* and independently of regional or district rules. An NES may also prescribe the way local authorities must manage activities and resources, including classifying activities, prescribing methods or monitoring requirements, and similar matters of *regulatory practice*.

An NES therefore generally has three advantages over other options, in that it can:

- take effect instantly (rather than having to be applied through plan changes – a process that can take some years)
- more directly remove decision-making discretion from local authorities and provide for greater certainty of objectives (especially in terms of matters relating to resource consents)
- prescribe the level of detail necessary to ensure an adequate and consistent approach.

3.2 The preferred option

Having considered the available options, a national environmental standard is considered the most appropriate way of achieving the policy objective. The basis for this view is summarised in table 2. The criteria for the assessment presented in the table are derived from the objective sought (as described in section 2.3).

Table 2: Comparison of the different options in terms of their effectiveness in achieving the policy objective and other critical factors

Criteria	Alternative options that did not satisfy the selection criteria					Preferred option
Ensures affected land is:	**Status quo**	**Non-regulatory guidance**	**Legislative change**	**National policy statement**	**Minister directed plan change**	**NES**
– adequately identified, assessed, remediated and contained	✓	✓✓	✓✓	✓✓	✓✓	✓✓✓
– consistently identified, assessed, remediated and contained	✓	✓✓	✓	✓	✓✓	✓✓✓
– efficiently identified, assessed, remediated and contained	✗	✓✓	✓	✓	✗	✓✓✓
– assessed using an **appropriate** soil contaminant thresholds protective of human health	✓	✓✓	✓	✓	✓	✓✓✓

The options considered most suitable to achieve the stated objective are national guidelines and national environmental standards. However, the proposed NES provides important additional benefits over all of the other options. An NES:

- mandates immediate and consistent use by overwriting conflicting guidelines and local government plans (consistency and efficiency)
- avoids the sometimes lengthy and uncertain transition normally associated with the implementation of the other approaches (efficiency)
- creates administrative efficiencies by preventing serial re-litigation of plans and resource consents (efficiency)
- ensures that its requirements are implemented because any requirements are legally binding on local government (adequacy).

These additional benefits over a guideline approach and the other options are considered particularly desirable for setting human-health thresholds, where consistency and certainty are very important.

Questions

5. Do you agree with the preferred option?
6. Is there an alternative option that has not been considered?
7. Are you aware of any other costs or benefits of the alternative options?

4 The Proposed NES for Assessing and Managing Contaminants in Soil

4.1 The proposed NES planning framework

The national environmental standard will achieve the main policy objective through a mix of allowing (permitting) and controlling (requiring resource consents) certain activities on land affected or potentially affected by soil contaminants. The proposed NES for assessing and managing soil contaminants includes:

a) permitted activity status (no resource consent required) for subsurface investigations of land to determine the presence, extent and nature of any contamination

b) soil guideline values (SGVs) that define the concentrations at which the risk to human health is considered acceptable (see section 8 for details)

c) permitted activity status (no resource consent required) for the use, development or subdivision of land where the risk to human health from soil contaminants is assessed as being acceptable for the intended land use

d) a restricted discretionary activity status (resource consent required) for any use, development or subdivision of land where the risk to human health from soil contaminants is assessed as not being acceptable for the intended land use

e) a restricted discretionary activity status (resource consent required) for any use, development or subdivision of land where there is insufficient information to confirm whether the risk to human health from soil contaminants is acceptable or not.

The standard would require all 73 territorial authorities (district and city councils) to give effect to and enforce its requirements. The standard will only impact on new decisions and resource consents.

An explanation of the activity types

Permitted: the activity does not require a resource consent provided the standards, terms or conditions specified are complied with.

Controlled: a resource consent is required. The consent authority must grant the consent, unless it has insufficient information, and can only impose conditions on the consent on matters over which it has reserved control.

Restricted discretionary: a resource consent is required. The consent authority may decline the consent, or grant it subject to conditions, but only on matters to which it has restricted its discretion.

4.1.1 Scope of the NES

The national environmental standard proposal applies to assessing and managing the actual or potential adverse effects of contaminants in soil on human health from the following activities:

- subsurface investigations
- the use, development and subdivision of land.

The NES proposal does not apply to assessing and managing the actual or potential adverse effects on other receptors including:

- the on-site and off-site ecology
- the on-site and off-site effects on surface water
- groundwater – including human drinking-water sources.
- amenity values.

Councils may pose additional controls to address any potential or actual effects on these receptors.

Why is the scope restricted to human health?

The focus of the policy objective is on making the land safe for human use. Therefore, the scope of the national environmental standard is restricted to protecting human health. For further discussion on this see Section 2.3 Discussion – Why does the policy objective focus on *making the land safe for human use*?

This restricting of the scope to human health does not detract from the important and ongoing role of regional councils to assess ecological impacts on a site-by-site basis in accordance with their functions under the RMA.

4.1.2 Permitted activity – subsurface investigations

The permitted activity allows:

- the taking of soil samples to determine the presence, extent and nature of any contamination
- small-scale and temporary activities necessary to obtain samples, including trenching, drilling and removal of underground tanks.

The permitted activity also requires a report on the findings of the investigation to be provided to the district or city council.

This permitted activity would allow the taking of soil samples to establish the presence, extent and nature of contaminants in soil. It is proposed that this provision would also permit small scale and temporary activities necessary to obtain samples. For example, drilling, trenching and removal of underground tanks.

Information requirements

The permitted activity would be subject to a report on the findings of the investigation being provided to the council within 60 days from the receipt of laboratory results. If a report is not provided the activity would default to a discretionary activity and therefore resource consent would be required.

No resource consent will be required to be applied for these activities under the proposed national environmental standard. However, sampling and associated activities may be subject to other controls as provided for under the relevant district and regional plans. For example, district and regional controls on noise, earthworks and groundwater monitoring wells.

Explanation

The purpose of this permitted activity is to:

- *enable subsurface investigations by not requiring resource consents* – the generally small-scale, short-duration and nature of subsurface investigations and associated activities are such that any adverse effects are considered likely to be minor
- *encourage subsurface investigations* – investigations are generally beneficial because they collect information on the land's actual or potential contamination and enable a more accurate assessment of risk.

Discussion – Is the requirement to provide information appropriate?

The purpose of the information requirements is to: *assist councils to identify land affected by soil contamination*. Allowing subsurface investigations of land to determine the presence, extent and nature of any contamination will provide information that will help councils to identify land affected by soil contamination.

However, we note that there are some potential negative effects and seek feedback on these to help decide whether this requirement is appropriate. Specifically:

- will the requirement actually provide a disincentive for some landowners to investigate land?
- are there concerns this requirement may compel those investigating spills to incriminate themselves ie, have the information used against them in enforcement action?
- will the requirement be difficult to monitor and enforce, as councils will not necessarily know that the activity is being undertaken?

4.1.3 Permitted activity – use, development or subdivision

> The permitted activity allows land-use change, development or subdivision of land where there is no evidence of soil contamination, or the proven levels are acceptable for the intended land use as defined by the relevant soil guideline value.

It is proposed to allow as a permitted activity: the use, development or subdivision of land that is proven as being acceptable for use.

Information requirements

This permitted activity is proposed to be subject to one or more site investigation reports, provided to the council before the change of use or development begins or before subdivision is effected. The report must confirm that there is no evidence of soil contamination or that the proven levels of soil contamination are *acceptable for the intended land use* as assessed under the relevant soil guideline value. How to determine whether soil contamination levels are *acceptable for the intended land use* is outlined in section 4.2.

The intention is that, provided the above condition is met, no resource consent will be required for these activities under the proposed national environmental standard in terms of the impact of soil contaminants on human health. Councils will not be able to impose more stringent controls in respect of the effects of change of use, development or subdivision on human health relating to soil contamination. However, the use, development or subdivision may be subject to additional controls as provided for by the relevant district and regional plans to address other adverse effects.

If a report is not provided, the activity would default to a restricted discretionary activity, therefore resource consent would be required (see section 4.1.4).

Explanation

The purpose of this permitted activity is to:

- *enable use, development or subdivision where contaminants are not present, or at acceptable levels* – it is considered unreasonable to require resource consent for land where contaminants are not present or are shown to be at a level acceptable for the intended land use
- *encourage site investigation and remediation* – allowing the use, development or subdivision of land subject to a site investigation report provides an incentive for sites to be investigated and, if necessary, remediated. The information can be held by the council for future reference.

The purpose of the information requirements is to provide:

- a record of any investigation to the council so that they can add this information to property files and amend any land-use registers
- the council with an opportunity to assess the adequacy of the investigation and whether the land meets the permitted activity criteria.

Discussion – How do we ensure that not *all land* is required to go through a site investigation?

Requiring all land to be assessed for potential soil contamination and impact on human health before any change of use, development or subdivision to be subject to this permitted activity would impose an unjustified administrative burden on councils, landowners and developers. This burden may be unjustified due to lack of evidence for most land that previous industries or activities could have resulted in soil contamination.

To avoid unnecessarily applying controls to land we propose limiting the type of land subject to this permitted activity to land on all or part of a site(s) that may be affected by contaminants due to its known historical use and the types of activities previously undertaken on it. It includes land:

- with a known history of land uses and activities identified in the Ministry for the Environment's Hazardous Activities and Industries List (HAIL, see Appendix 4)
- that is indicated on the district or regional council land-use information registers as being potentially affected or affected by contaminants in soil (or an equivalent classification).

The use, development or subdivision activities on land not covered by the above is proposed to be a permitted activity under the national environmental standard without conditions in terms of the impact of soil contaminants on human health. However, the proposed activities may be subject to other controls as provided for by the relevant district and regional plans in relation to other adverse effects.

Have we adequately defined the land that should be subject to a condition requiring site investigation?

- Is the approach too precautionary?
- Is the approach not precautionary enough?
- Is the category of land certain enough to be meaningful?
- Is the category of land adequately described so as to provide an objective basis for assessing compliance and enforcement?

Discussion – How do we ensure that *not all* activities will require a site investigation?

Similarly, requiring a site investigation before any change of use, development or subdivision of land would be unjustified due to the minor and small-scale effects of many activities. Likewise, subjecting activities to a requirement for a site investigation is considered unjustified if the activity is already appropriately controlled under other legislation and regulations.

To avoid unnecessarily applying a requirement for a site investigation, we propose permitting, in terms of the impact of soil contaminants on human health, the following activities without conditions:[8]

1. any ongoing activities or occupation of the land for the same activity of an existing use
2. subdivision which is not associated with a change in use or a disturbance of the ground

[8] The proposed activities may be subject to other controls as provided for by the relevant district and regional plans.

3. landscaping, fencing (but not retaining walls), and other minor actions which involves a minimum level of soil disturbance
4. internal and external additions and alterations to existing buildings that occur above ground level and do not disturb the ground
5. any activities on agricultural land used for the bulk production of food that are not associated with a change of use to a non-agricultural land use (for example, agricultural to residential).

Agricultural land is proposed to be excluded from the permitted activity requirements as produce from agricultural land is subject to the joint New Zealand Australian Food Standards: testing under this jurisdiction is a more direct measure of determining whether this land is safe for human use. Farm worker's exposure is subject to the provisions of the Health Safety and Employment Act 1992. The requirements of the national environmental standard may be properly applied to the residential vicinity of a farm house to assess whether human health is protected.

Have we adequately provided for activities that should not be caught by the requirements of this permitted activity?

- Do you think it is appropriate for the national environmental standard to permit the above activities without requiring site investigation reports?
- Are there additional activities that should be permitted without requiring site investigation reports?

Discussion – How do we ensure that site investigations are adequate?

Consistent and adequate investigations and assessment are critical to protecting human health and achieving land that is safe for human use.

The permitted activity requires the provision of a site investigation report. However, just providing a site investigation report provides no assurance that the land is safe for its intended use. The report needs to contain sufficient information to determine whether the land is acceptable for its intended use (ie, meets the soil guideline value).

A report must:

- confirm that that there is no evidence of soil contamination or provide evidence that soil contamination that exists is at a level that is *acceptable for the intended land use*
- be prepared by an *appropriately experienced and qualified practitioner*
- be prepared in accordance with *Contaminated Land Management Guideline No. 1 – Reporting on Contaminated Land in New Zealand* (MfE, 2003a) – This guideline provides minimum information requirements for preliminary and detailed site investigation reports.

If insufficient information is provided, or the report confirms that soil contamination is present at levels that are not acceptable for the intended land use, the activity would default to the restricted discretionary activity and resource consent would be required (see section 4.1.4).

To provide some level of assurance that site investigations are adequate we propose that the local authority have the opportunity before the activity proceeds to audit whether the activity meets the permitted activity condition. Therefore, the report must be provided to the local authority before the change of use or development begins or before subdivision is effected. The local authority will then audit the report against the above criteria.

Who is an appropriately qualified and experienced practitioner?

The purpose of requiring reports to be prepared by *appropriately qualified and experienced practitioners* is mainly to flag to landowners and developers to engage appropriate expertise at the outset. This is a step that may also save the landowner and developer significant time and money.

It is envisaged that developers who had concerns whether a particular practitioner meets the description would be ascertained through discussions with the council. However, the lack of certainty provided on who is appropriately experienced or qualified may create variable interpretation and potential disputes to arise between developers / landowners and councils and their respective advisers.

Ideally we would clearly define an appropriate level of qualifications and experience through reference to an accreditation scheme for practitioners. However, at this stage there is no scheme in New Zealand that is considered suitable for this purpose.

How do you think the national environmental standard should ensure the adequacy of site investigation?

- Do you think it is appropriate under a permitted activity for the NES to require site investigation reports for activities on affected land and land with a known history of land uses and activities?
- Do you think that the requirements for site investigation reports provide sufficient certainty for a person to know whether they comply or not?
- Do you think the requirements for site investigation reports provide sufficient certainty for councils to audit and confirm whether the activity meets the conditions of the permitted activity?
- Are the benefits of requiring an *appropriately qualified and experienced practitioner* to prepare the site investigation report outweighed by the potential negative effects associated with the lack of certainty?
- Are there enough *appropriately qualified and experienced practitioners* in your region or district to meet the demand for investigations?

Discussion – A permitted or a controlled activity?

This proposed permitted activity would work well for those sites that have previously been adequately investigated and assessed in consultation with a local authority. The intention is that such sites should be able to have a change in land use, be developed or subdivided without further control, unless a change of use to a more sensitive land use is proposed.

However, for sites that have not previously been assessed by councils, there are more risks that the process for assessing the acceptability of the site will not be robust; and that a permitted activity status does not provide for sufficient certainty for the developer or control for the council. In addition, under a permitted activity the costs of assessing whether an activity meets the criteria would fall on the council (unless the developer / landowner is applying for a certificate of compliance).

For these reasons this provision may be more appropriate as a *controlled activity*. Under a controlled activity resource consent is required. However, providing sufficient information is provided, consent must be granted. Councils are also able to more formally assess whether applications meet the criteria and recover their costs.

How do you think the national environmental standard should provide for these activities?

- As a permitted activity?
- As a controlled activity?
- Through an alternative way? (For example, requiring information on soil contamination where resource consent is required by other council controls on use, development or subdivision).

4.1.4 Restricted discretionary activity – use, development or subdivision

> A restricted discretionary activity status means a resource consent is required for any land-use change, development or subdivision of land where:
>
> - the risk to human health from soil contaminants is assessed as being unacceptable for the intended land use
> - there is insufficient information to confirm whether the risk to human health from soil contaminants is acceptable or not.
>
> Grounds for councils refusing the consent or granting consent subject to conditions is restricted to the:
>
> - nature and extent of contamination
> - methods to address the risk posed by contaminants to public health and safety
> - approach to the remediation and/or ongoing management of the contaminated land and the mitigation measures.

The restricted discretionary activity will apply to the land-use change, development or subdivision of land where:

- the risk to human health from soil contaminants is assessed as being unacceptable for the intended land use. Determining whether soil contamination levels are *unacceptable for the intended land use* is outlined in section 4.2
- there is insufficient information to confirm whether the risk to human health from soil contaminants is acceptable or not – because no report has been submitted or because the report is inadequate or inconclusive.

What activities are not covered?

The activities not covered are the same as described in the Discussion – How do we ensure that *not all* activities will require a site investigation? (section 4.1.3).

Information requirements

The following information is required to be submitted with an application:

1. site investigation report(s) (*preliminary and detailed site investigations*)
2. where remediation is proposed – *a site remedial action plan*
3. where containment or behavioural modification is proposed – a *monitoring and management plan*.

All reports must be prepared in accordance with *Contaminated Land Management Guidelines No. 1* (MfE 2003a) and by *appropriately experienced and qualified practitioners.* To read the discussion on the requirements in relation to experienced and qualified practitioners and *Contaminated Land Management Guidelines No. 1* see Discussion – How do we ensure that site investigations are adequate? (section 4.1.3).

The purpose of the information requirements is to provide:

- a record of any investigation to the council so that it can add this information to property files and amend any land-use registers
- the local authority with sufficient information to assess the adequacy of the investigation and remediation and/or management proposals.

Grounds for councils refusing the consent or granting consent subject to conditions

Councils must not grant consent unless satisfied that the:

- *nature and extent of contamination* has been sufficiently characterised and the *risk posed by contaminants to health and safety* has been adequately assessed
- *methods proposed to address the risk* (eg, remediation, containment) are adequate to ensure that land is safe for its intended use
- proposed *approach to the remediation, and/or ongoing management* avoids the potential for adverse effects on human health, and ensures that containment structures are adequately constructed, monitored and maintained.

To ensure this, the national environmental standard will note that grounds for refusing consent or reasons for granting consent and imposing conditions are restricted to:

1. the nature and extent of contamination
2. the risk posed by contaminants to public health and safety
3. the methods to address the risk posed by contaminants to public health and safety
4. the approach to the remediation, containment and/or ongoing management of the contaminated land and the mitigation measures.

Consent conditions

Resource consents shall include, but not be limited to, the following conditions:

1. Where the contaminants are proposed to be remediated – condition of consent shall incorporate the requirements of the *site remedial action plan.*
2. Where the land is proposed to be remediated – condition of consent shall include requiring the submission of a *site validation report* prepared in accordance with *Contaminated Land Management Guidelines No. 1*.
3. Where the contaminants are proposed to be contained – condition of consent shall incorporate the requirements of the *monitoring and management plan.*
4. Where contaminated soil and waste are proposed to be disposed off-site – condition of consent shall include requiring the use of an appropriate *waste tracking system* and disposal to land that is authorised and/or consented to take this material.

The purpose of the consent conditions are to ensure:

- the standard of remediation, containment and the management of these works is adequate
- that any adverse effects of the remediation and containment are appropriately controlled and ongoing maintenance and monitoring requirements are undertaken
- the transport of contaminated materials off-site is to be tracked by a delivery and receipting system to ensure contaminated materials are delivered to an appropriate facility.

Explanation

The purpose of allowing resource consent to be granted as a restricted discretionary activity is to allow activities on affected land, provided that controls are in place to:

- prevent on-site and off-site effects on human health from the remediation or development of the land
- ensure that land is cleaned up to the extent suitable for its current or proposed use
- ensure that any containment structures are monitored and maintained and any site management plans are given legal effect.

The use, development or subdivision of land that is unacceptable for human use are restricted discretionary activities because of the potential for them to give rise to adverse effects on human health. However, it is recognised that these activities are the main drivers and mechanisms by which affected land is remediated or managed so that it is safe for human use. Therefore, allowing the grant of consent, restricted to specific grounds, provides incentive for investigation, remediation, containment as well as mechanism to ensure that these processes are appropriately carried out, managed and monitored.

4.2 How is acceptable and unacceptable for use determined?

Soil guideline values ($SGVs_{(health)}$) have been developed for 12 priority contaminants to determine the acceptability of contamination, and therefore whether or not resource consent is required.

$SGVs_{(health)}$ are soil contaminant concentration levels at or below which the exposure is judged to be acceptable because any adverse effects on human health for most people are likely to be acceptable for the intended land use. The $SGVs_{(health)}$ for selected contaminants and generic land-use scenarios are provided in section 8. That section contains a more detailed description of what $SGVs_{(health)}$ are and how they are to be applied.

To determine whether land is acceptable for use, measured concentrations of contaminants are required to be compared against $SGVs_{(health)}$ applicable to the categories described in table 3.

Table 3: How to determine which $SGVs_{(health)}$ are applicable

Category	Applicable $SGVs_{(health)}$
Land use or intended land use **fits within** the generic land-use scenarios described in Appendix 1.	$SGVs_{(health)}$ contained in Section 8.
Land use or intended land use results in **greater human exposure** than for any of the generic land-use scenarios.	Site-specific $SGVs_{(health)}$ **must** be derived using the risk assessment methodology described in Appendix 2, **except** for land-use scenarios where produce consumption is greater than for the 10 per cent home grown produce consumption exposure scenarios (see discussion below).
Land use or intended land use results in **lesser human exposure** than for any of the generic land-use scenarios.	Site-specific $SGVs_{(health)}$ **may** be derived using the risk assessment methodology described in Appendix 2.
There is **no $SGVs_{(health)}$** for the contaminant of concern.	Soil contaminant values protective of human health and selected and justified in accordance with *Contaminated Land Management Guidelines No. 2 Hierarchy and Application in New Zealand of Environmental Guideline Values* (MfE, 2003b).

If the soil contaminants exceed $SGVs_{(health)}$ (ie, is unacceptable for use), the activity is a restricted discretionary activity (resource consent is required). If the soil contaminants meet or are under $SGVs_{(health)}$ (ie, acceptable for use), the activity is permitted and no resource consent is required.

Discussion – Why is site-specific assessment for produce consumption greater than 10 per cent not required by the NES?

The residential / rural lifestyle-block SGVs are based on an assumption that inhabitants consume 10 per cent of their fruit and vegetables from their home gardens. Site-specific SGVs should be derived if inhabitants are known to consume more than 10 per cent of their fruit and vegetables from their home gardens.

However, we propose that site-specific SGVs derived using produce consumption scenarios of greater than 10 per cent shall not be used as regulatory thresholds (ie, for the purpose of this national environmental standard); non-regulatory advice is appropriate if such site-specific SGVs are exceeded.

Ten per cent produce consumption is considered to be appropriate for most rural-residential situations. If landowners plan a more self-sufficient life style, they may want to refer to a more applicable scenario (ie, greater than 10 per cent) on a site-specific basis (possibly also factoring in animal produce). However, the SGVs derived for scenarios with greater than 10 per cent are non-regulatory, ie, subject to advisory and other non-regulatory methods.

Presently there is insufficient information to justify a regulation for an $SGV_{(health)}$ based on a 50 per cent produce consumption exposure scenario. Data is lacking on whether the inhabitants of a lifestyle block are any more likely to grow and consume 50 per cent of their produce than on a residential lot.

In addition for some contaminants, SGVs derived for consumption greater than 10 per cent may extend into the background ranges of naturally occurring elements in soil (eg, arsenic and cadmium).

How should the NES address site-specific assessment for produce consumption?

- Should the NES compel site-specific assessment?
- For reference purposes only, SGVs are provided in Appendix 2 for 50 per cent home grown produce consumption – Is it appropriate that this remain outside the scope of the NES?

Discussion – What about a naturally occurring element in soil that exceed the SGV?

The treatment of naturally occurring elements in soil in the context of this national environmental standard poses a dilemma. A naturally occurring element in soil does have the potential to cause human health effects if an $SGVs_{(health)}$ is exceeded. Where a naturally occurring element in soil is at concentrations above an $SGVs_{(health)}$, this would be considered to be a *natural hazard*.

For the current suite of $SGVs_{(health)}$, only the elements arsenic and cadmium occur naturally in soil at levels likely to exceed the $SGVs_{(health)}$ derived for the most sensitive exposure scenarios.

To be consistent with our objective of ensuring safe human use, our current position is that these *natural hazards* should be controlled as if they were a contaminant under this NES.

How should the NES address naturally occurring elements in soil?

1. Should controls on these *natural hazards* be left to the discretion of the council?
2 Should these *natural hazards* be controlled as if they were a contaminant under this NES?
3. Should these *natural hazards* not be subject to any control?

4.3 Who will be responsible for implementing the NES?

Territorial authorities will be responsible for giving effect to, and enforcing the requirements of the national environmental standard. The proposed NES has been developed to give effect to the function of territorial authorities under section 31(1)(b)(iia) of the RMA. This section lists the following function for the purpose of giving effect to the Act:

> The control of any actual or potential effects from the use, development or protection of land, including for the purpose of –
>
> ... the prevention or mitigation of any adverse effects of the development, subdivision, or use of contaminated land.

4.4 How will the NES affect existing plans?

In general, an national environmental standard overrides a rule in a plan. A rule in a plan:

- cannot be more lenient than an NES
- can specify that an activity (which is permitted by the standard) is permitted, subject to terms and conditions to regulate effects not covered by the standard
- can be more stringent if the NES specifically allows a rule in a plan to be more stringent.

It is not intended that the NES will require councils to immediately change their plans to reflect the NES. The NES is intended to override any rules in plans that relate to the effects of soil contamination on human health.

For the proposed NES, rules in plans that relate to the effects of soil contamination on human health will also not be able to be more stringent than the NES.

It is anticipated that any inconsistency between plans and the NES can be removed during the course of plan reviews that would occur in the normal course of events.

4.5 How will the proposed NES affect existing and new resource consents?

The proposed national environmental standard will not directly affect existing resource consents, unless a consent authority chooses to apply section 128 of the RMA to review consent conditions. If that is the case, depending on the context it may be relevant to consider the NES.

The intention is that the NES will apply to any new designation or application for resource consents that is lodged after the NES comes into effect. Where an application for resource consent has been made before the NES comes into effect, the intention is that the application does not have to comply with the requirements of the NES if the decision on whether to notify it has been made before the date on which the standard is notified in the gazette.

Questions

8. Do you see any problems complying with the proposed NES or with enforcing it?
9. Are the thresholds for determining whether resource consent is required clear and appropriate?

Questions 10–16 are supported by discussion and more specific questions in the text of section 4.

10. Is the *permitted activity – subsurface investigation* requirement to provide a site investigation report appropriate?
11. Have we adequately defined the land that should be subject to a condition requiring site investigation?
12. Have we adequately provided for activities that should not be caught by the requirements of this NES?
13. How do you think the NES should ensure the adequacy of site investigation?
14. Is the *permitted activity – use, development and subdivision* better provided as a *controlled activity* or another alternative?
15. How should the NES address site-specific assessment for produce consumption?
16. How should the NES address naturally occurring elements in soil?

5 Costs and Benefits of the Proposed NES

A preliminary assessment of the costs and benefits of the proposed national environmental standard has been prepared by independent consultants. The preliminary cost-benefit analysis shows that the nationwide impacts are expected to be positive. While the site-specific impacts are unable to be quantified, it is likely that they will be positive.

The complete analysis will be reported in two parts: an initial scoping assessment, presented in summary here, followed by a fuller quantification, after analysis of the consultation responses and formulation of a final position on the proposed national environmental standard.

A summary of the potential costs and benefits of the NES are shown in table 4 and a description of these impacts is described below. The complete cost-benefit report is available on the Ministry for the Environment's website.

Table 4: Potential costs and benefits of the proposed standard[1]

	Costs	Benefits
Nationwide impacts	• Administering additional information **$500,000** (public)	• Avoided plan changes **$700,000–$1.4 million** (public) • Avoided plan change submission costs **$1 million–$1.5 million** (private) • Reduced disputes and post-development remediation **$500,000–$1 million** (public and private)
Nationwide total	**$500,000**	**$2.2 million–$3.9 million**
Potential site-specific impacts[2]	• Additional investigation and remediation costs **$0–$200,000** (private) or • Reduced property value **un-quantified** (private)	• Reduced resource consent costs **$0–$100,000** (public and private) • Improved public health **un-quantified** (public and private) • Improved environmental outcomes **un-quantified** (public)

1 Nature of impacts indicated in brackets: private impacts accrue typically to landowners; public impacts accrue to the wider community.

2 To the extent that these impacts would occur in the future, estimates should be discounted accordingly.

5.1 Benefits

The introduction of the proposed standard would generate several benefits to society (notably via improved administrative efficiency), including:

1. *avoided plan changes*
2. *avoided submission costs*
3. *reduced resource consent costs*

4. *improved controls* – the standard would eliminate the risk of allowing inappropriate development of contaminated land leading to:
   a. *improved public health*
   b. avoidance of *post-development disputes and/or remediation*
   c. potential *improved environmental outcomes*.

A summary description of each of these benefits is provided below.

5.1.1 Avoided plan changes

The proposed national environmental standard would reduce administrative costs by avoiding the need for councils to make plan changes and introduce their own contaminated land rules and standards.

If the NES were not introduced, 40 to 50 councils are likely to implement their own contaminated land rules. Over 50 of the 73 district councils do not have specific rules relating to contaminated land in their district plans. Many of these are likely to establish their own rules in the absence of the NES due to increased awareness of this issue, and the specific RMA function. Up to three councils[9] may also develop specific soil contamination standards in response to development pressures and to provide additional certainty to landowners and developers.

The administrative costs that are avoided are the costs associated with engaging technical expertise, internal staff time, facilitating and reviewing public consultation (including advertising public notices), and engaging commissioners for hearings. Preliminary discussions with industry participants and councils who have implemented specific contaminated land rules, indicate that these costs could be in the vicinity of $15,000–$20,000 per council, and up to $100,000 if the plan change was appealed and resolved in the Environment Court.

Where councils develop their own soil contaminant standards, additional costs associated with technical expertise and staff costs could be in the order of $150,000. However, only a small numbers of councils are likely to develop soil contaminant standards.

The total administrative costs that would be avoided could be in the order of $700,000 to $1.4 million. This is based on an estimate of around 40 to 50 councils initiating plan changes over the next 5 to 10 years, three councils implementing their own soil contaminant standards, and five councils having their proposed changes appealed to the Environment Court.

9 Estimate based on the number of councils that have already developed local soil contaminant values over the past five years.

5.1.2 Avoided submission costs

The proposed national environmental standard would avoid submission costs that would otherwise be incurred by those who would submit on councils' proposed plan changes.

The process of establishing rules or amending district plans would result in interested parties making submissions and becoming involved in the consultation process within each district. A number of private parties would be likely to be involved in these consultation processes, ranging from local individuals to large, national organisations.

The introduction of the NES would eliminate the need for consultation and submissions across the country in each district that alters or introduces contaminated land rules in its district plans. This would reduce the time and expense faced by these parties as they would only incur a one-off submission costs in relation to the NES consultation process.

The costs that would be avoided range across the different parties. For instance, some organisations may be heavily involved in plan changes for reasons other than soil contamination. For such organisations the NES may only save relatively small amounts, eg, $1,000–$2,000 per plan change. For other, larger, organisations the costs avoided for each plan change may be much higher. Preliminary discussions with an industry group estimates that submission costs may range from as low as $5,000 to as high as $80,000–$100,000 if the NES prevents a dispute that would otherwise be resolved in the Environment Court.

The total cost of private submissions that would be avoided if the NES were introduced could be in the vicinity of $1 million to $1.5 million. This estimate is based on an assumption that, without the NES, around 40 to 50 councils would amend the contaminated land provisions over the next 5 to 10 years and that each proposed change attracts an average of 10 'small' (local) submitters and four 'large' (national) submitters, with up to five proposed changes appealed to the Environment Court.

5.1.3 Reduced resource consent costs

The proposed national environmental standard would result in fewer administrative, compliance and dispute costs associated with obtaining resource consent to subdivide, develop or change the land use of affected land.

In the absence of the NES, landowners and other interested parties can sometimes incur significant costs in the process of obtaining resource consents required to develop affected land. In some cases, disagreement may arise regarding the application of contamination guidelines and the appropriate levels of contamination that should be allowed at a given site.

Introduction of the NES could reduce these disputes and costs by:

- reducing uncertainty regarding the appropriate use of the different guidelines that would otherwise be available
- reducing the time and expense required interpreting and ascertaining various district plans for landowners and consultants that operate across different areas.

The costs incurred in disputes can include the purchase of legal advice and technical experts, as well as the time and expense of attending hearings. Based on discussions with selected councils and engineering and planning consultants these costs can range around $10,000–$20,000 but may be as high as $80,000–$100,000 if a dispute is taken to the Environment or High Court.

5.1.4 Improved public health

Introducing the proposed national environmental standard would be likely to lead to some affected land being subject to more effective remediation or, alternatively, it may prevent some affected land from being inappropriately developed for residential use. Such outcomes could lead to fewer people being exposed to harmful contamination.

The effects to human health from exposure to contaminants can be categorised into short-term (acute) effects, and long-term (chronic) effects.

- *Acute toxic effects* – can result in immediate adverse health impacts. For example, acute arsenic poisoning has the potential to occur where children ingest soil contaminated with high levels of arsenic associated with old sheep dip or timber treatment sites.
- *Chronic effects* – are adverse health effects that can result from an ongoing but low-level chemical exposure over an extended period. Carcinogenic (ie, cancer-causing) or developmental effects (eg, affecting organ function) may not be expressed to the extent of being able to be diagnosed until many years later.

Acute effects

While there are no New Zealand studies of the costs of contamination, the costs of dealing with acute toxic contamination may be similar in magnitude to those reported in other New Zealand studies on the costs of deaths and injuries.

According to the Ministry of Transport, the value of a loss of life or permanent disability that includes pain and suffering (eg, of victims and their families) as well as lost economic output, is estimated at $3.35 million (MoT, 2008).[10] Similar losses from serious injuries are estimated at $335,000. As well as the direct cost of pain and suffering to victims and victims' families, and the loss of wages (ie, economic output), severe toxic impacts would also generate medical costs involved in the treatment of victims. The average cost of medical treatment for serious injuries from vehicle accidents is in the order of $10,000 to $15,000 (MoT, 2008).

Chronic effects

Estimation of the adverse health impacts from chronic effects are typically carried out using values for quality adjusted life years (QALY). A QALY is a measure of the impacts of a disease, ie, the reduction in both the quantity and quality of life. Every QALY that the national environmental standard were to generate would represent the equivalent of one additional year of life in perfect health for one individual who might otherwise suffer from exposure to contaminants. Regarding the potential value of a QALY, of note is that the Pharmaceutical Management Agency of New Zealand funds drugs up to a value of at least $20,000 per QALY, and in some cases much higher.[11]

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[10] Note that to the extent that any potential fatality would be prevented from occurring in a future time period, this estimate should be discounted to reflect its value in current dollars.

[11] Note that to the extent that the NES would avoid incidents of in future time periods, any estimate of QALYs added, or public health costs avoided, should be discounted to reflect the value of these impacts in current dollars.

The NES could also avoid public health costs for cancer treatment. These costs can vary considerably, from relatively low-cost, inexpensive treatments to upwards of $20,000 for more expensive chemotherapy and radiotherapy. Similarly, the treatment of other illness that may be contracted because of contamination can range from an insignificant amount for minor irritation to up to $50,000 per year for dialysis. The cost of residential care for an adult with severe intellectual and/or physical impairment can be as high as $50,000 per year (Milne, 2005).

Although estimating the extent to which the NES could lead to a decrease in the incidence of cancer and other long-term impacts is beyond the scope of this assessment, analyses of soil contamination done elsewhere, or analyses of other forms of contamination, may provide an approximate indication of the potential magnitude of such impacts.[12]

There is a significant body of literature regarding attempts to estimate the value of reduced exposure to soil contamination in the United States (US EPA, 2005a). Although the results of these studies are site-specific and not directly comparable, these studies typically indicate positive and significant public health benefits from improved remediation of contaminated sites.

Also of interest is the analysis carried out by the US Environmental Protection Agency regarding the proposed alteration of regulations concerning permitted levels of arsenic in drinking water. This analysis indicated that moderately reducing the allowable level of arsenic in drinking water could provide public health benefits in the order of US$70 million annually.[13] The benefits included in this estimate were: avoided pain and suffering from fewer cases of cancer; earnings of victims and/or caregivers that would have otherwise been lost; and, avoided medical costs. Adjusting for population, exchange rates, and GDP per capita, this value is equivalent to around NZ$900,000 per year. Although this value is not directly comparable to the potential benefits of the proposed NES, it provides a rough indication of the potential magnitude of public health benefits from these types of policies.

5.1.5 Post-development disputes and/or remediation

The proposed national environmental standard would result in fewer post-development disputes and/or remediation through councils and landowners better identifying sites of potential concern and better addressing potential contamination issues before sites are developed.

Claims are occasionally made by landowners against councils on the basis that councils' rules and practices for assessing and dealing with contaminated land have been insufficient and, as a result, landowners have suffered losses. These losses may reflect reductions in property values caused by the discovery of contamination, compensation for physical harm or compensation for the costs incurred in carrying out necessary remediation after such sites have already been developed.

Although remediation of sites may have been necessary regardless of whether contamination was identified pre- or post-development, remediation costs may be considerably higher if contamination is not identified until after a site has been developed.

[12] For example, see Annex B of Covec Ltd *Enabling Biofuels: Biofuel Economics* June 2006 for an analysis of potential long-term public health impacts from reducing particulate emissions.

[13] Note that stricter regulations were estimated to generate much higher benefits, ie, up to US$490 million. However, implementing these regulations would also have imposed costs that were much higher.

These 'excess' remediation costs and the costs of resolving disputes could be reduced if the NES were introduced. Based on the current rate of contaminated land claims made against councils, the NES has potential to eliminate around one or two disputes over liability per year. Although costs vary according to the specifics of each claim, discussions with various councils, industry participants and Riskpool suggest that a typical claim may impose costs of around $20,000 to $60,000 to resolve, eg, legal and experts' fees, council and landowner time. Some disputes could impose legal process costs that are much higher. Other costs may also be incurred, such as alternative accommodation for affected landowners or health treatment expenses, along with relatively expensive post-development remediation costs. The total costs to society of such a dispute can exceed $100,000.

A reduction in inappropriate development could also reduce the costs associated with responding to unexpected contamination incidents. Addressing these incidents and dealing with outraged individuals or groups can use a significant amount of councils' time and resources. For example, an incident similar to the recent discovery of potentially dangerous contamination at Marfell Park in New Plymouth could generate up to $100,000 in council related costs, much of them communications and media-related. These costs are in addition to direct site investigation costs.

Consequently, if the NES eradicated two disputes per year, the value of the dispute costs that could be avoided over the next 20 years would be in the order of $500,000 to $1 million.[14]

5.1.6 Improved environmental outcomes

The proposed national environmental standard is intended to make the land safe for human use, and is not focused on obtaining improved environmental impacts. Therefore, any improvement in environmental impacts would be an unintended consequence of the NES, although such benefits may arise nevertheless.

5.2 Costs

The proposed national environmental standard would impose some costs, or negative effects, on various members of the wider society. These costs (that apply to situations where current practice might not adequately protect human health) include:

1. *administering additional information* – any additional administrative costs imposed on councils in implementing the new rules and standards
2. *additional investigation and remediation costs* – compliance costs incurred by landowners who would need to comply with new rules and standards, eg, higher investigation and remediation costs
3. *reduced property values* – reductions in value of affected land suffered by landowners for sites that are not subsequently developed because of a potential increase in remediation costs.

[14] This assumes the average cost of a dispute or contamination incident is around $50,000.

5.2.1 Administering additional information

The proposed national environmental standard would impose additional administrative costs on district councils in implementing the new rules and standards.

If the proposed NES was introduced, councils that do not currently address contaminated land issues would need to carry out activities additional to those they carry out now. Such activities would require additional resources, such as additional employees and external consultants.

Costs passed on to landowners

Most of the costs of considering resource consent applications (eg, reviewing assessments, consultation costs, and deciding on resource consent applications), would be passed on to landowners applying for resource consent, in the form of council fees.

Because these costs are ultimately borne by landowners who must comply with the rules and standards, they are compliance (private) costs, not administrative (public) costs. Consequently, these costs are considered in more detail in the compliance cost section, see section 5.2.2 below.

Costs borne by councils

Although the majority of costs incurred by councils would be passed on to landowners, some costs would be borne by councils, and ultimately ratepayers. These costs are categorised as ‘administrative costs’. This is because they are a cost to the wider society in the process of administering the new regulatory policy (ie, the national environmental standard). Hence resources are used up that could otherwise be put to other uses, ie, these resources have an opportunity cost.

These costs are likely to be a result of councils being required to handle a greater amount of information regarding potentially contaminated sites. For example, district councils may need to allocate additional resources to linking information to property files, carrying out data entry and copying information for regional councils.

This task would constitute a relatively small, one-off cost for a number of councils who currently do not address contaminated land issues and would be unlikely to without the NES. Consequently, the magnitude of this cost would be expected to be relatively small, eg, less than $500,000 worth of internal staff time.[15]

5.2.2 Compliance costs

In areas that would not otherwise have rules or standards similar to those in the proposed national environmental standard, its implementation has potential to result in new, additional costs being imposed on landowners who seek to develop affected sites. These costs can be categorised as:

- investigation costs – the costs of investigating sites for contamination to determine if resource consents are required
- application costs – the costs of obtaining resource consent to develop affected land
- remediation costs – the costs of treating contaminated land.

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15 This is based on internal staff costs of $10,000–$20,000 per council for around 30 councils.

Of note is that the NES may not affect the cost of some options for dealing with certain types of contaminated land, for example, carrying out a 'cap and contain' approach, along with an associated Tier 2 human health risk assessment to derive site-specific acceptance criteria. The costs of this approach to a re-development of a former industrial site may be identical either with or without the NES. Consequently, whether remediation costs would be affected by the NES depend on a number of site-specific characteristics.

Investigation costs

When seeking to obtain resource consent to develop land identified as potentially contaminated, landowners' applications will need to be supported by soil contamination assessments. Such assessments are undertaken at landowners' expense. In areas where soil assessments are already required, the national environmental standard would not lead to an increase in assessment costs. This is because the methodology by which a contaminated site is assessed will not change, ie, it will still be undertaken in accordance with *Contaminated Land Management Guidelines No. 5* (MfE, 2004b). The only change would relate to the benchmark against which site contamination levels are evaluated. Hence this would not result in higher assessment costs, but could result in higher potential remediation costs (see remediation costs section below).

On a per-site basis, the proposed NES could increase soil assessment costs in those areas where such assessments would not otherwise be required, ie, where there are no current rules regarding contamination. This increase in assessment costs could be minor if a preliminary 'desk-based' investigation is all that is required or if a simple site visit is sufficient – if a former sheep dip location has been identified some distance away from the location of the proposed building site. If more sophisticated soil assessments are required, these may cost around $10,000 for relatively straightforward assessments. In rare cases these costs may be as high as $100,000 for more complex assessments.

Application costs

If the proposed national environmental standard would result in soil assessments being carried out where they otherwise would not, this activity would also require councils to undertake reviews of these assessments. The costs of these council reviews, as distinct from the costs of assessments themselves, include council staff time and/or hiring external consultants.

Although these costs would be incurred by councils in the first instance, they would be passed on to landowners in the form of higher council fees for consent applications. These additional costs may be in the range of $5,000 to $20,000 per site (ie, per application), depending on the nature and extent of contamination, and the complexity of the site.

Remediation costs

The implementation of the national environmental standard would not be expected to have any material impact on remediation costs for a large number of sites. Note that the extent of remediation that is carried out for many sites would be the same whether or not the NES were formally introduced. This is because the soil guideline values contained in the proposed NES would become widely used as public guidelines.

However, the NES would be likely to have an impact on remediation costs for some sites, particularly those in areas where there are no specific contaminated land rules. In these areas, the NES is most likely to increase remediation costs. In contrast, in a small proportion of instances the NES may lead to smaller remediation costs, eg, where the standards it contains are less conservative than current guidelines.

The approximate scale of these remediation costs on the relevant site types under different possible scenarios are summarised in table 5. The different scenarios include:

1. no NES and no specific contaminated land rules
2. no NES and new guideline values from proposed NES are not adopted (ie, old guidelines continue to apply)
3. no NES and new guideline values from proposed NES are adopted
4. NES is implemented.

Because the same guideline values would apply under scenarios 3 and 4, the expected remediation costs for these two scenarios are the same.

Table 5: Potential per site remediation cost estimates under different scenarios, selected sites

	Scenarios			
Site type	**1. No NES, no rules**	**2. No NES, old guidelines**	**3. No NES, new guidelines**	**4. NES**
Timber treatment	$0	$115,000	$200,000	$200,000
Horticultural land	$0	$95,000	$170,000	$170,000
Sheep dip	$0	$7,500	$15,000	$15,000

Note: Assumes arsenic is the contaminant of concern.

If the national environmental standard were not introduced, but instead its soil guideline values were published as guidance, the proportion of councils that would be expected to continue with no specific contaminated rules (scenario 1 above) is around 10–20 per cent. The proportion of councils that would be expected to continue to use existing guidelines (scenario 2) is around 20–40 per cent, with the proportion of councils that would be expected to adopt the new guidelines (scenario 3) ranging from around 40–70 per cent.[16] In contrast, it would be expected that most, if not all, councils would comply with the NES if it were introduced.

The potential changes in remediation costs across the different scenarios are summarised in table 6. Note the expected change in remediation costs because the NES depends on which of the first three scenarios above would apply to a given site if the NES were not introduced.

[16] These outcomes are based on a survey of 16 regional councils by the Ministry in 2006 (MfE, Unpublished) regarding the level of compliance with current contaminated land guidelines. This survey indicated that a significant proportion of these councils did not follow all of the guidelines. Given that many territorial authorities tend to have fewer resources in this area, the level of non-compliance with any new guidelines (if the NES were not introduced) would be higher. This analysis assumes that 30–60 per cent of territorial authorities would not immediately comply with new guideline values without the NES.

Table 6: Potential change to remediation costs because of NES, per site

Site developed	Change in costs because of NES
Timber treatment site	Increase per site of between $0 to $200,000
Horticultural land	Increase per site of between $0 to $170,000
Service station	No change
Sheep dip	Increase per site of between $0 to $15,000 For DDT, potential minor decrease
Industrial site	No change
Gasworks	No change For benzo(a)pyrene equivalent (BaPeq), potential minor decrease

5.2.3 Reduced property values

As described above, implementing the national environmental standard could lead to an increase in compliance costs for those seeking to develop land in some areas. Although in many cases this cost increase would not prevent the development of contaminated land, in other cases it could have an effect. This is because the increased assessment, application and remediation costs could eliminate the commercial viability of developing a site.

Because of population growth, the nationwide stock of dwellings would need to increase to provide sufficient housing over time. If some contaminated sites would no longer be commercially viable for development because of the impact of the NES, other sites would need to be developed instead.

To the extent that development of certain non-contaminated sites would be preferred over contaminated sites the undeveloped contaminated sites would be expected to lose value because of differences in profitability. So, because the NES would lead to reduction in some property values, these falls would constitute costs to the wider society as overall wealth has declined, although this decline may be offset by gains to other, non-contaminated sites.

In general, the market value of a property should reflect the expected future returns from that site. Consequently, any increase in costs of developing a site would decrease the expected return from that site. The magnitude of such a fall in a property’s value should broadly reflect the increase in remediation costs. Thus, the estimates of potential increases in remediation costs for affected sites provide approximate estimates of any reductions in the value of sites that could be adversely affected by the NES.

Questions

17. Have we accurately reflected the range of costs and benefits arising from the proposals for an NES, and who might bear the costs or receive the benefits?
18. Are there any costs and benefits we have overlooked?
19. Do you have information that you would like to see included in the cost-benefit analysis that will be carried out after the submissions are received and analysed?

6 What Happens Next?

6.1 Making a submission

Any person can make a submission on the subject matter of the proposed standard. The questions at the end of each section have been gathered below to help you organise your responses.

Please include the following information with your submission:

1. your name and postal address, phone number, and email address (where applicable)
2. the title of the proposed standard you are making the submission about
3. whether you support or oppose the standard
4. your submission, with reasons for your views
5. any changes you would like made to the standard
6. the decision you wish the Minister for the Environment to make.

You must forward your submission to the Ministry for the Environment, PO Box 10362, Wellington 6143, or by email to standards@mfe.govt.nz, in time to be received no later than:

5.00pm on 19 April 2010.

Note: your submission is public information and will be subject to release under the Official Information Act 1982.

6.2 What happens to submissions?

All submissions will be made publicly available through the Ministry's website. Once submissions have been compiled, they will be considered during the development of the proposed standard. The Ministry will prepare a report with recommendations on the comments and subject matter of the standard for the Minister for the Environment, including a section 32 (cost-benefit) analysis. The report and recommendations will be publicly notified. If the Minister's approval is given to continue developing the proposed standard, the final wording will be drafted and the proposed standard made into regulations.

6.3 Discussion questions

Your submission may address any aspect of the proposed subject matter of the standard. However, the Ministry for the Environment would also greatly appreciate any specific comment you may have on the following questions.

What is the problem?

1. Have the priority problems been defined correctly?
2. Are there other problems you can think of that need to be addressed as a priority?
3. Do you agree with the policy objective?
4. Should the objective be limited to ensuring that land is safe for human use? If not, why not?

What are the options?

5. Do you agree with the preferred option?
6. Is there an alternative option that has not been considered?
7. Are you aware of any other costs or benefits of the alternative options?

The proposed NES

8. Do you see any problems complying with the proposed NES or with enforcing it?
9. Are the thresholds for determining whether resource consent is required clear and appropriate?

Questions 10–16 are supported by discussion and more specific questions in the text of section 4.

10. Is the *permitted activity – subsurface investigation* requirement to provide a site investigation report appropriate?
11. Have we adequately defined the land that should be subject to a condition requiring site investigation?
12. Have we adequately provided for activities that should not be caught by the requirements of this NES?
13. How do you think the NES should ensure the adequacy of site investigation?
14. Is the *permitted activity – use, development and subdivision* better provided as a controlled activity or another alternative?
15. How should the NES address site-specific assessment for produce consumption?
16. How should the NES address naturally occurring elements in soil?

Costs and benefits

17. Have we accurately reflected the range of costs and benefits arising from the proposals for an NES, and who might bear the costs or receive the benefits?
18. Are there any costs and benefits we have overlooked?
19. Do you have information that you would like to see included in the cost-benefit analysis that will be carried out after the submissions are received and analysed?

Part 2

Implementing the Proposed NES

7 Implementing the Proposed Standard

This section describes how the national environmental standard is envisaged to be implemented from the perspective of councils implementing and enforcing the requirements of the NES and developers / landowners complying with its requirements. If this proposal is approved, a modified and expanded version of this section is likely to form part of a user's guide.

7.1 Subsurface investigations – permitted activity

When undertaking any *subsurface investigations* (defined in section 4.1.2) the person undertaking the subsurface investigation will be required to report the findings of the investigation to the district council with 60 days of receiving laboratory reports.

The district council receiving this report will then attach the information to its property file. The district council should copy reports received to the regional council.

It is recognised that compliance with the condition may be variable because many councils do not monitor permitted activities. This permitted activity status, however, gives the council an additional avenue for collecting information on contaminants it may not otherwise receive. It also provides a legal mechanism for obtaining a report if the council finds that a subsurface investigation has been undertaken without satisfying the condition.

7.2 Use, development or subdivision – permitted activity

Where a developer proposes a change of *use, development or subdivision of land that is affected or potentially affected by soil contaminants*, the developer is required to provide a report to councils to confirm that the site is acceptable for use.

The report is required to:

- be prepared by a suitably experienced and qualified person
- report the level of soil contaminants against the applicable soil guideline value (see section 8).

The council will audit the report for compliance with the requirements of the permitted activity. Like the *permitted activity for subsurface activities*, this control assists councils to require and collect information on contaminants on land. In addition, it provides an opportunity for:

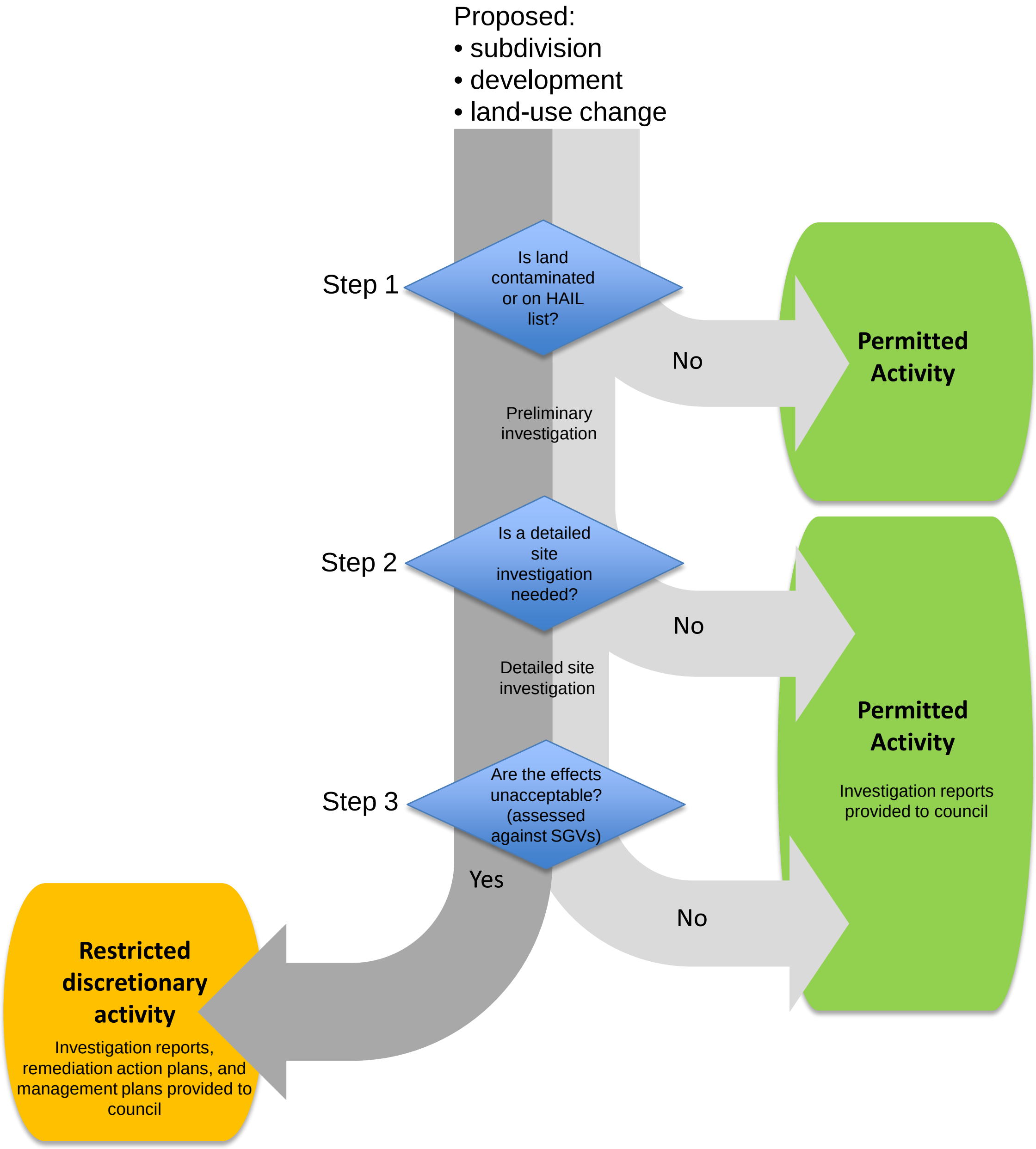
- the council to review the report to audit compliance with the permitted activity conditions
- the developer to apply for a certificate of compliance.

The district council receiving this report will then attach the information to its property file.

7.3 Use, development or subdivision – restricted discretionary activity

A flowchart showing the decision process for determining whether resource consent is required under the national environmental standard is set out in figure 5. This flowchart sets out three steps in determining whether an activity requires consent and the information required from the applicant to support those decisions.

Figure 5: Flowchart for determining resource consent requirements under the NES



7.3.1 Step 1: Determine whether the land is potentially affected by soil contaminants

Where land may be affected by soil contaminants, councils should ensure that applications for land-use change, development or subdivision contain an assessment of the land's potential to be affected by soil contaminants. If this information is not provided by the applicant, councils should request further information from the applicant under section 92 of the RMA.

Before submitting a consent application, developers and landowners should appraise the need for an assessment. They are guided by the criteria that land is considered to be potentially affected if it:

- is listed on the district or regional council land-use information register as being potentially affected or affected by soil contaminants
- is known to be associated with a current or historic industry or activity listed on the Hazardous Activities and Industries List (HAIL)
- exhibits any other evidence of the land being affected by contaminants.

Preliminary site investigations

If land is identified as being potentially affected by soil contaminants, a *preliminary inspection* should be required from the applicant.

The preliminary inspection assesses the need for further investigation at the site, specifically with reference to the current and/or proposed land uses and/or the potential environmental impact. The preliminary assessment draws together all the information available on the land and should be undertaken by a suitably qualified and experienced person.

If the preliminary inspection finds that no further investigation is required, then no resource consent is required. For example, historical photos may show that the location of a sheep dip is remote from the land being developed. Council has the discretion to determine if the land is acceptable for use and the activity qualifies as a permitted activity.

7.3.2 Step 2: Determine whether a detailed site investigation is necessary

If land is considered (as a result of the assessment undertaken in Step 1) as being likely to have contaminants in the soil as a result of previous or current hazardous substance use, storage or disposal the site would need to be further investigated and the effects (if any) assessed. The investigation should be carried out by an experienced and qualified practitioner.

Detailed site investigations

If the preliminary assessment recommends further investigation, a detailed site investigation should be commissioned by the developer. The detailed site investigation and the assessment and analysis must be undertaken by a qualified and experienced practitioner in accordance with *Contaminated Land Management Guidelines No. 5* (MfE, 2004b).

7.3.3 Step 3: Does the site exceed $SGVs_{(health)}$?

To determine whether the land is acceptable for use, the detailed site investigation should compare the measured concentrations of contaminants as follows:

1. *for land use or intended land use that fits within the generic land-use scenarios of Appendix 1* – against $SGVs_{(health)}$ contained in Section 8
2. *for land use or intended land use, that results in* ***greater or lesser human exposure*** *than for any of the generic land-use scenarios* – against site-specific $SGVs_{(health)}$ derived using the risk assessment methodology described in Appendix 2
3. *where there is* ***no*** $\boldsymbol{SGVs_{(health)}}$ *for the contaminant of concern* – against soil contaminant values protective of human health and selected and justified in accordance with *Contaminated Land Management Guidelines No. 2* (MfE, 2003b).

If the soil contaminants exceed $SGVs_{(health)}$ (ie, is unacceptable for use), the activity is a restricted discretionary activity (resource consent is required).

If the soil contaminants meet or are under $SGVs_{(health)}$ (ie, acceptable for use), the activity is permitted and no resource consent is required.

7.4 What happens if the activity is a restricted discretionary activity?

If the activity is a restricted discretionary activity, a resource consent is required. In considering the consent, the council will follow the same decision pathway as it does when considering any other activity that is a restricted discretionary activity.

The following provides a brief description of the specific information required by councils in considering requests, as well as notes on the important decision points.

7.4.1 Site investigation reports, remedial action plans, and management and monitoring plans

Where soil contaminants exceed SGVs, the council will require the applicant to prepare and provide:

- site investigation report(s) *(preliminary and detailed site investigations)*
- remedial action plan – where the applicant proposes to remove or reduce the contaminant mass to below SGVs
- management and monitoring plan – where the applicant proposes to cap, contain or manage the contamination to prevent or minimise exposure.

The development of *remedial action plans* and *management and monitoring plans* should be undertaken by a qualified and experienced practitioner and prepared in accordance with *Contaminated Land Management Guidelines No. 1* (MfE, 2003a).

7.4.2 Determine whether the effects can be adequately mitigated

The council needs to assess the information provided by the applicant to determine if the site has been adequately investigated and assessed, and the proposals outlined in the *remedial action plan* and/or the *management and monitoring plan* adequately mitigate the adverse effects of the activity.

The grounds for councils refusing the consent, or granting consent subject to conditions, are restricted to the:

- nature and extent of contamination
- methods to address the risk posed by contaminants to public health and safety
- approach to the remediation and/or ongoing management of the contaminated land and the mitigation measures.

The information provided in the required reports / plans will provide the basis for decision-making and setting appropriate consent conditions.

7.4.3 Decide whether the application should be publicly notified

The national environmental standard proposal does not include any specific notification requirements. Councils should consider the need for publicly notifying applications as they do for any other restricted discretionary activity.

7.4.4 Determining the adequacy of the applicant's reports

Identifying, investigating, remediating and managing land affected by contaminants requires specialist expertise. The national environmental standard therefore requires that assessments prepared in support of resource consent application are prepared by an appropriately experienced and qualified practitioner.

To determine the adequacy of submitted reports, councils may have any reports prepared in support of the resource consent applications reviewed against the requirements of the NES and the contaminated land management guideline series (especially *Contaminated Land Management Guidelines No. 1* and *Contaminated Land Management Guidelines No. 5*: MfE, 2003a and 2004b). Where appropriate expertise is not available in-house, councils may contract this expertise from an appropriately experienced and qualified third party.

Where the reports do not meet the requirements of the NES and *Contaminated Land Management Guidelines No. 1*, further information should be requested from the applicant under section 92 of the RMA.

7.4.5 Conditions for consent

The resource consent shall require activities on the site to be undertaken in accordance with the requirements of the *remedial action plan* and/or *management and monitoring plan*.

For remediation, consent conditions shall also require the submission of a *site validation report* that confirms whether the remediation has met the remediation goals.

For activities that involve the removal of contaminated soil and waste off-site, consent conditions shall include:

- the use of an appropriate *waste tracking system*
- disposal to land that is authorised and/or consented to take this material.

Ideally the term of the consent should be related to the duration of the activity. This may be short term for sites where remediation is planned, and indefinite where contaminants are proposed to remain on site and are needed to be managed and monitored.

8 Soil Guideline Values

This section describes what $SGVs_{(health)}$ are, how they have been derived, and how they are to be applied. It is expected that if the national environmental standard is implemented, the $SGVs_{(health)}$ provided in tables 6–8, and the method for deriving site-specific $SGVs_{(health)}$, will be incorporated into the NES.

8.1 What are $SGVs_{(health)}$?

$SGVs_{(health)}$ are threshold concentrations for 12 contaminants in soil, calculated for five generic land-use exposure scenarios at which the exposure is judged to be acceptable because any adverse effects on human health for most people are likely to be no more than minor.

The generic exposure scenarios are described in Appendix 1.

8.1.1 The function of $SGVs_{(health)}$

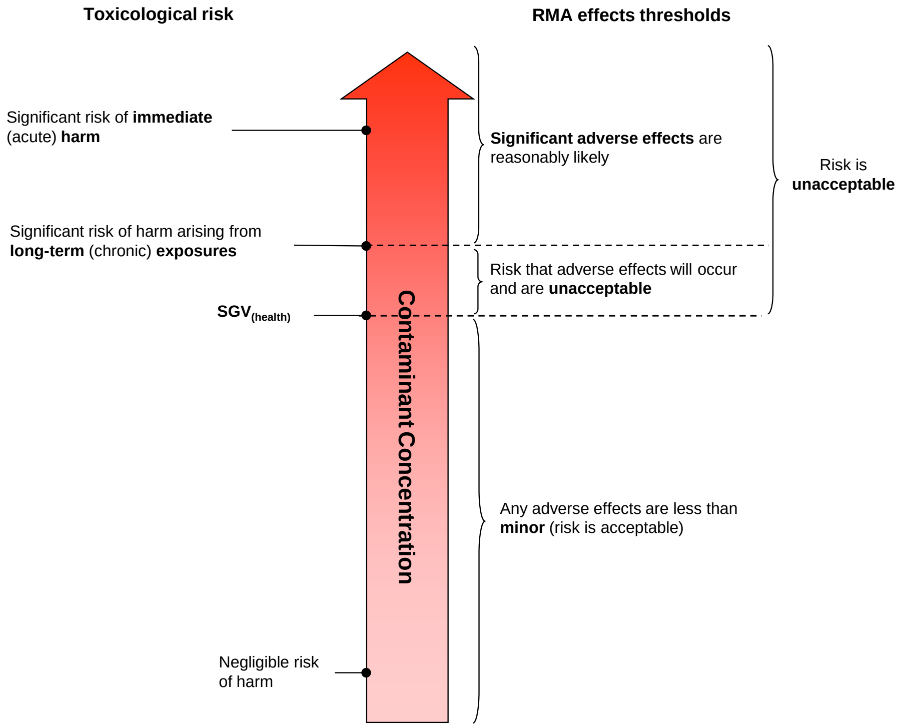
$SGVs_{(health)}$ perform two functions:

1. *Health-based trigger values* – $SGVs_{(health)}$ represent a human health risk threshold above which:
   - the effects on human health may be unacceptable over time
   - further assessment of a site is required to be undertaken.
2. *Remediation targets* – $SGVs_{(health)}$ represent the maximum concentrations of contaminants at or beneath which land is considered "safe for human use" and the risk to people is considered to be acceptable**.**

$SGVs_{(health)}$ **do not** necessarily provide protection for the natural environment (eg, soil invertebrates and plants) whose $SGVs_{(health)}$ may be significantly lower.

The relationship between human health risk thresholds ($SGVs_{(health)}$) and effect thresholds (as defined under the RMA) is shown in figure 6.

Figure 6: Relationship between human health risk, $SGVs_{(health)}$ and the RMA effects thresholds



8.2 Soil guideline values – $SGVs_{(health)}$

SGVs for 12 metals and semi-volatile organic compounds are presented in tables 7, 8 and 9. The values have been rounded to two significant digits.

The values are purely for the protection of human health. The $SGVs_{(health)}$ contained in the proposal are not to be promoted as desirable soil quality criterion nor as levels up to which contamination may be allowed to occur.

The $SGVs_{(health)}$ for chromium III and copper range to in excess of a hundred thousand milligrams per kilogram soil ($>10^5$ mg/kg), indicating a minimal threat to human health from the presence of these contaminants. These levels are well in excess of concentrations that are phytotoxic, ie, affecting plant health. Although phytotoxicity is beyond the scope of this proposal, if these contaminants are present at excessive concentrations it is questionable whether the land is fit for the intended purpose. This would need to be considered on a site-specific basis.

The $SGVs_{(health)}$ for cadmium shown in table 9 is the proposed value (at a pH of 5) derived using Joint Expert Committee on Food Additives (JECFA) tolerable daily intake, as recommended in the *Draft Toxicological Intake Values for Priority Contaminants in Soil* (MfE, 2010a).

The $SGVs_{(health)}$ proposed for cadmium would be reviewed if a future meeting of the JECFA of the Food and Agriculture Organization and the World Health Organization recommends a more conservative tolerable daily intake, in line with that adopted by the European Food Safety Authority.

The SGVs$_{(health)}$ for cadmium in table 8 show cadmium SGVs$_{(health)}$ for soil pH values 5–8 in a residential or rural residential scenario. Where the pH of the soil is measured, SGVs$_{(health)}$ can be determined using this table. Where soil pH is not measured, the default is the SGVs$_{(health)}$ at a pH value of 5.

Figure 7 shows the dependence of cadmium SGVs$_{(health)}$ on pH. The 50 per cent produce curve is shown for reference purposes only.

Table 7: Summary of soil guideline values for inorganic substances (mg/kg)

	Arsenic	Boron	Cadmium (pH 5)[1,2]	Chromium		Copper	Inorganic lead	Inorganic mercury
				III[3]	VI			
Rural residential / lifestyle block 10% produce	20	34,000	5	280,000	560	32,000	730	380
Residential 10% produce	24	34,000	5	280,000	560	32,000	730	380
High-density residential	50	75,000	370	890,000	1,800	60,000	1,600	1,200
Recreation	100	220,000	1,100	NL	5,200	170,000	4,700	3,500
Commercial / industrial outdoor worker	70	400,000	1,600	NL	6,300	290,000	7,000	4,200

1 Default value is for pH 5. See table 8 for SGVs at other soil pH values.

2 Values for Joint Expert Committee on Food Additives tolerable daily intake of 2 µg/kg bw/day.

3 The SGVs$_{(health)}$ for boron, chromium III, and copper represent levels well in excess of concentrations that would affect the health of plants.

NL = No limit.

Table 8: Summary of soil guideline values for organic compounds (mg/kg unless shown otherwise)

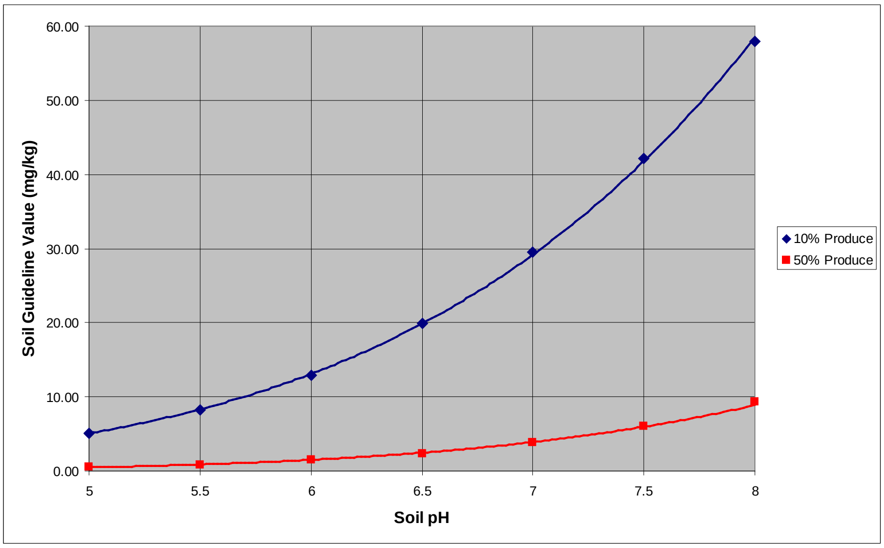
Scenario	BaP	DDT	Dieldrin	PCP	Dioxin (µg/kg TEQ)	
					TCDD	Dioxin-like PCBs
Rural residential / lifestyle block 10% produce	85	90	3.1	70	0.19	0.15
Residential 10% produce	100	90	3.1	70	0.19	0.15
High-density residential	240	270	50	130	0.41	0.38
Recreation	440	750	110	230	1.1	0.9
Commercial / industrial outdoor worker	300	1,000	160	360	1.4	1.2

Table 9: Cadmium soil guideline values for soil pH values 5–8 (mg/kg)

pH	Scenario	
	Rural residential / lifestyle block 10% produce	Residential 10% produce
5	5	5
5.5	8	8
6	13	13
6.5	20	20
7	30	30
7.5	40	40
8	60	60

Notes: Where pH is not measured, the SGVs$_{(health)}$ at a pH value of 5 should be used.

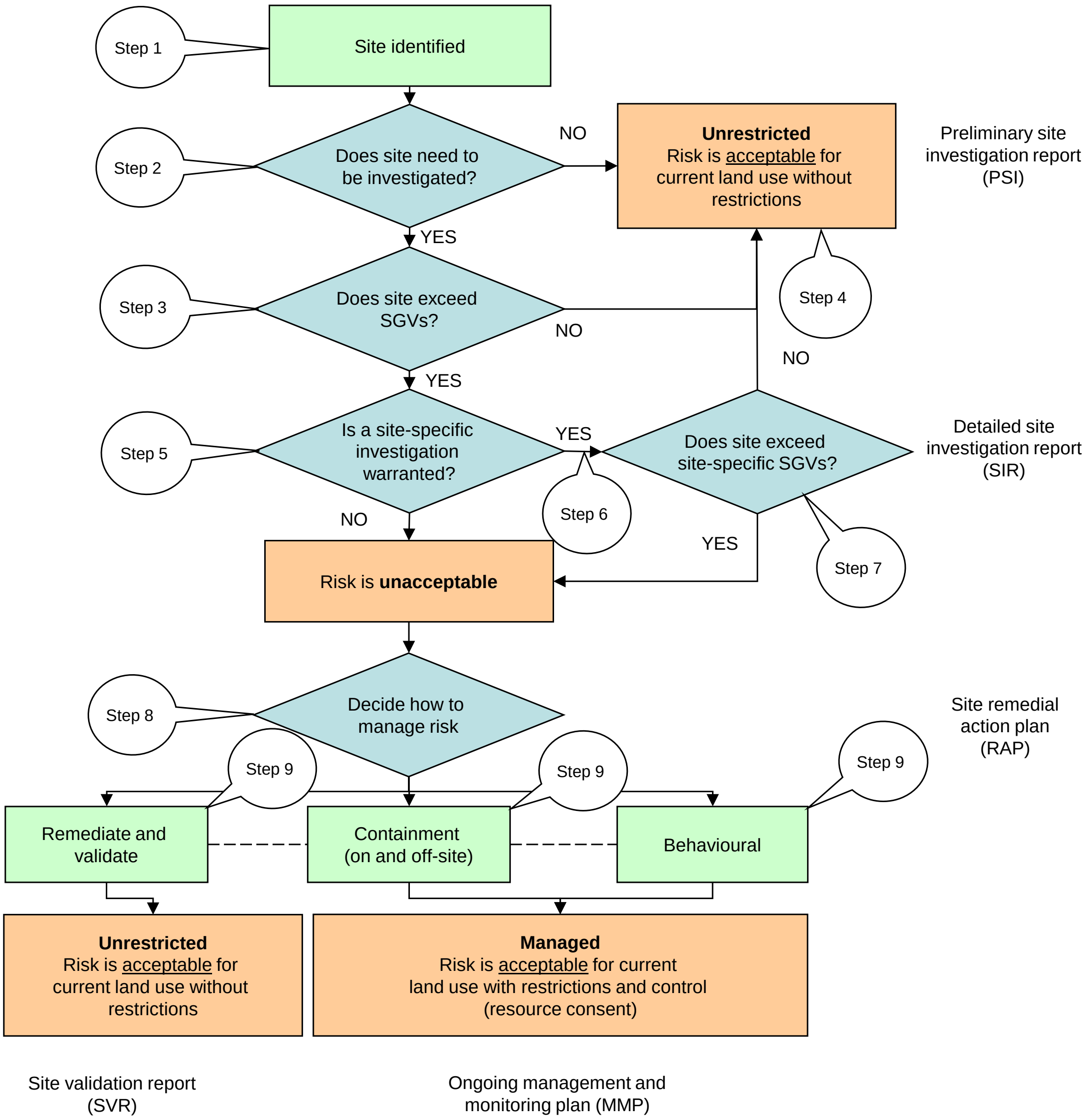
Figure 7: Dependence of cadmium soil guideline value on pH (50% produce is shown for reference purposes only)



8.3 The SGV application framework

A decision tree that guides applying SGVs$_{(health)}$ is set out in figure 8. This flowchart sets out nine steps in determining whether the risk from soil contaminants is unacceptable and if so, the further steps to manage the risk from that contamination. If this proposal is approved, a modified and expanded version of this section is likely to form part of the user's guide.

Figure 8: Decision tree for applying SGVs$_{(health)}$: basic steps



The process is typically iterative, with more information gained at each review step which might send the process back to an earlier step. However, it is also possible to short-circuit the process at an early stage by simply choosing to go directly to the management or remediation stages, if site-specific risk assessment is considered unwarranted.

Step 1 – Site identified

A site is identified as possibly having hazardous substances on or in it. Land may be identified through a variety of ways including: regional councils HAIL survey; information provided in resource consent applications for subdivision, development or land-use change; enquiries to councils from landowners and/or neighbours, complaints, and through council responses to unauthorised discharge events.

For guidance on identifying and prioritising sites refer to:

- *Identifying, Investigating and Managing the Risks Associated with Former Sheep-dip Sites: A Guide for Local Authorities* (MfE, 2006a)
- *Contaminated Land Management Guideline No. 3: Risk Screening Systems* (MfE, 2004a)
- The Hazardous Activities and Industries List (Appendix 4).

Step 2 – Does land need to be investigated?

Sufficient information is gathered to determine whether further investigation is warranted, via a preliminary study as defined in *Contaminated Land Management Guideline No. 1* (MfE, 2003a). An essential part of the preliminary study is to develop a conceptual site model as set out in *Contaminated Land Management Guideline No. 5* (MfE, 2004b). The conceptual site model should set out receptors and exposure pathways for the particular land use or proposed land use.

For further guidance on determining whether further investigation is required and on developing a conceptual site model refer to:

- *Contaminated Land Management Guideline No. 1*: *Reporting on Contaminated Sites in New Zealand*
- *Contaminated Land Management Guideline No. 5: Site Investigation and Analysis of Soils*.

Step 3 – Does site exceed $SGVs_{(health)}$?

Carry out a further investigation involving sampling. The results are compared against $SGVs_{(health)}$ and the conceptual site model should be updated as required, based on additional information from the investigation. Sampling should be carried out in accordance with CLMG5. For further guidance on sampling and analysis and determining whether land exceeds $SGVs_{(health)}$ refer to:

- *Contaminated Land Management Guideline No. 5: Site Investigation and Analysis of Soils*.

Step 4 – Risk is acceptable

If the site complies with the $SGVs_{(health)}$ for the particular land use (and conceptual site model), then the risk from hazardous substances in or on the site is considered acceptable for the current land use without restrictions. Compliance with $SGVs_{(health)}$ is deemed as sufficient proof that land does not have, or is not reasonably likely to have, hazardous substances on or in it, at levels that would lead to unacceptable adverse effects on human health under that particular land use.

Step 5 – Is a site-specific investigation warranted?

If the site does not comply with the $SGVs_{(health)}$, then decision options include:

1. carrying out a site-specific exposure assessment to better quantify the actual risk – go to Step 6
2. remediating the site to reduce the hazard (ie, reduce the concentration of the contaminants) – go to Step 8

3. managing the site to prevent access to or exposure to the hazard (ie, interrupt the exposure mechanism(s) or pathway(s)) – go to Step 8.

The factors to consider in making this decision are contained in Appendix 2.

Step 6 – Assess site-specific exposure

A site-specific analysis will quantify the risk, taking into account the actual site parameters and whether the generic exposure parameters used to derive the $SGVs_{(health)}$ are too conservative for the site or not conservative enough. If carried out numerically, site-specific $SGVs_{(health)}$ will be derived using the methodology in Appendix 2 with varied exposure parameters. There are limits, however, as to what can be varied.

For further guidance on assessing site-specific exposure, refer to Appendix 2.

Step 7 – Determine whether land exceeds site-specific SGVs(health)

If the site complies with the site-specific $SGVs_{(health)}$, then the risk from hazardous substances in or on the site is considered acceptable for the current land use without restrictions as in Step 4. However, if the site does not comply, the risk is considered unacceptable and the risk must be managed as in Step 8.

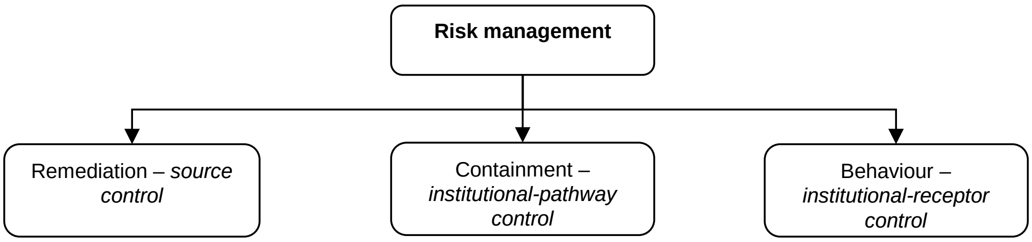
For further guidance on determining whether land exceeds $SGVs_{(health)}$ refer to:

- *Contaminated Land Management Guideline No. 5: Site Investigation and Analysis of Soils*.

Step 8 – Decide how to manage risk

It may be decided that some form of management is the best approach (because the additional expense of a site-specific assessment is not worth it, or the site is clearly contaminated and will require management regardless of a further site-specific assessment or it has failed a site-specific assessment). In that case the next step is to weigh up the available management options. These options could be remediation of the soil, containing the soil in some way to prevent or limit access, or (if appropriate to the circumstances) by restricting behaviour to ensure that people are not at an unacceptable level of risk (see figure 9). These and other options are discussed further in *Contaminated Land Management Guideline No. 5*; see also the sheep-dip guide (MfE, 2006a).

Figure 9: Methods for managing the risks from contaminants in soil



Step 9 – Manage the risk

If the site is remediated, and validated to demonstrate it complies with generic or site-specific $SGVs_{(health)}$, it is deemed that the risk is acceptable for current land use without restrictions. The remediation of a site should be subject to controls to protect off-site and on-site receptors; these controls should be formalised through resource consents held for the duration of the remediation.

If the land remains un-remediated and exceeds $SGVs_{(health)}$, other management action (eg, containment, behavioural modification) is to be put into effect to ensure the risk to human health is acceptable for current land uses. Any maintenance or restrictions to land use need to be made legally binding through conditions of resource consent, or non-regulatory advice.

Reporting

The process of identifying, investigating and managing risks associated with contaminants in soil should result in the land investigator preparing a report that documents their work for their client and/or intended audience. *Contaminated Land Management Guideline No. 1* identifies five reporting stages:

- preliminary site investigation report
- detailed site investigation report
- site remedial action plan
- site validation report
- ongoing monitoring and management plan.

These stages may be reported together or separately, and not all sites will need to report all stages.

For further guidance on reporting on contaminated sites including checklists for each stage of reporting refer to:

- *Contaminated Land Management Guideline No. 1: Reporting on Contaminated Sites in New Zealand*.

Information management

Where reports on soil contaminants are submitted to regulatory authorities (regional councils and territorial authorities), this information should be held on the property file. The land to which the information applies should be classified and information on the site reported and made available to the public in general accordance with *Contaminated Land Management Guideline No. 4*.

For further guidance on local government recording and reporting:

- *Contaminated Land Management Guideline No. 4: Classification and Information Management Protocols* (MfE, 2006b).

Table 10: Application of existing guidelines within the application framework

Guideline	What	Application within the assessment framework
Draft Methodology for Deriving Soil Guideline Values Protective of Human Health (MfE, 2010b)	Provides a national method for deriving soil guideline values; provides a list of derived $SGVs_{(health)}$ for common land-use scenarios	Source of $SGVs_{(health)}$ against which to assess sites (used in decision points 3, 7 and 8)
Contaminated Land Management Guideline series (CLMG)		
1 *Reporting on Contaminated Sites in New Zealand* (MfE, 2003a)	Provides guideline reporting forms and checklists	(Used in decision points 2 and 8)
2 *Hierarchy and Application in New Zealand of Environmental Guideline Values* (MfE, 2003b)	Provides guidance on selecting guideline values from domestic and international guidelines	Source of soil guideline values against which to assess sites, where $SGVs_{(health)}$ are not derived in the draft methodology (used in decision points 3, 7, and 8)
3 *Risk Screening Systems* (MfE, 2004a)	Provides a system for doing a desktop risk screening of contaminated land.	The HAIL list contained in Appendix 4 can be used as a trigger for investigating a site, and identifying possible contaminants (used in decision point 1)
4 *Classification and Information Management Protocols* (MfE, 2006b)	Provides a consistent method for local government registers and the release of information through relevant legislation (eg, land information memoranda through the Local Government Official Information and Meetings Act 1987 and project information memoranda through the Building Act)	Guides the recording and reporting on the land status throughout the assessment process (used to record and report the outcomes of the assessment process)
5 *Site Investigation, Analysis of Soils* (MfE, 2004b)	Provides best practice for the sampling and analysis of soils on sites where hazardous substances are present or suspected in soils, and guidance on the principles governing the interpretation of the data obtained. Revised guideline also contains best practice for site remediation and management	Guides all aspects of site investigation including sampling, analysis, and interpreting of data, as well as site remediation and management (used in decision points 2 and 3, as well as Step 8)
Industry-specific guidelines		
Health and Environmental Guidelines for Selected Timber Treatment Chemicals (MfE and MoH, 1997)	Provides guidance on the assessment and management of timber treatment sites, including numerical values for selected timber treatment chemicals	Used to assist the assessment and management of timber treatment sites Numerical criteria are superseded by $SGVs_{(health)}$ (used in decision points 1, 2, 8 and 9)
Guidelines for Assessing and Managing Contaminated Gasworks Sites in New Zealand (MfE, 1997)	Includes numerical values for hazardous substances associated with gasworks sites	Used to assist the assessment and management of timber treatment sites Numerical criteria are superseded by $SGVs_{(health)}$ (used in decision points 1, 2, 8 and 9)
Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand (MfE, 1999)	Includes numerical values for hazardous substances associated with petroleum hydrocarbon sites	Used to assist the assessment and management of timber treatment sites Numerical criteria are superseded by $SGVs_{(health)}$ (used in decision points 1, 2, 8 and 9)
Identifying, Investigating and Managing Risks Associated with Former Sheep-dip Sites: A Guide for Local Authorities (MfE, 2006a)	Provides guidance to help local authorities address the potential risks arising from contaminated sheep-dip sites	Numerical criteria are superseded by $SGVs_{(health)}$ used in decision points 1, 2, 8 and 9)

Appendix 1: Soil Guideline Values and Exposure Scenarios

How have the SGVs$_{(health)}$ been derived?

The SGVs have been derived through a risk-based process involving two main steps. Figure 10 visually represents the process of deriving SGVs$_{(health)}$.

Step 1: Toxicological intake values for priority contaminants in soil

The first step involved the review of applicable toxicological literature and the selection of toxicological intake criteria appropriate to New Zealand. The selected toxicological intake values are used as the basis for deriving SGVs$_{(health)}$.

The selected toxicological intake criteria have been reviewed by an interdepartmental group of toxicologists and a practitioners group that includes local government and industry representatives. The work has also been subject to scientific peer review by New Zealand and Australian experts.

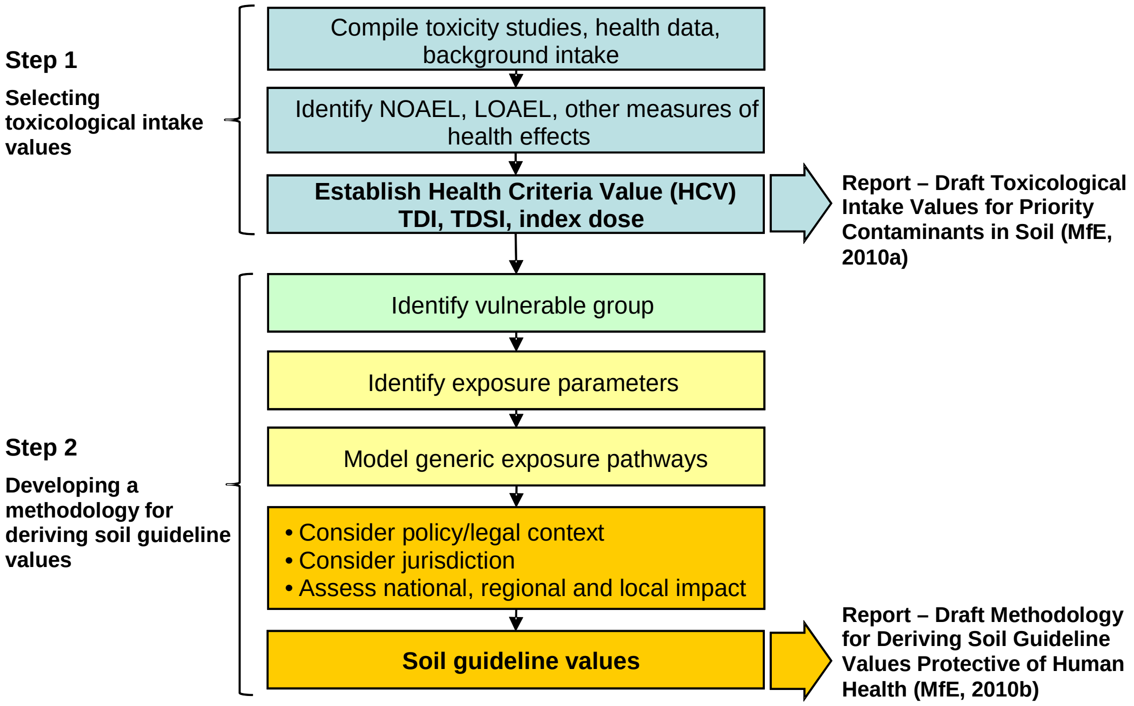
The findings of the literature review and the rationale for the recommended intake values are reported in the *Draft Toxicological Intake Values for Priority Contaminants in Soil* (MfE, 2010a). This report is available on the Ministry's website and is summarised in Appendix 3.

Step 2: A methodology for deriving soil guideline values protective of human health

The second step involved a review of how other applicable jurisdictions derive contamination concentrations in soil protective of human health.

The findings of this review and a description of the methods used to derive soil contaminant concentrations appropriate to generic land-use exposure scenarios are reported in the *Draft Methodology for Deriving Soil Guideline Values Protective of Human Health* (MfE, 2010b). This report is available on the Ministry's website and is summarised in Appendix 1.

Figure 10: The multi-step process of deriving $SGVs_{(health)}$



Source: adapted from Defra, 2006.

NOAEL = no observable adverse effects level; LOAEL = lowest observable effects level; TDI = tolerable daily intake; TDSI = tolerable daily soil intake.

Relationship between $SGVs_{(health)}$ and the RMA definition of contaminated land

An $SGV_{(health)}$ does not set a threshold for determining whether or not land is *contaminated* under the RMA definition. Contaminated land is defined under section 2 of the RMA as follows:

> **contaminated land** means land that has a hazardous substance in or on it that –
>
> (a) has significant adverse effects on the environment; or
>
> (b) is reasonably likely to have significant adverse effects on the environment.

Importantly, the focus of the $SGVs_{(health)}$ is human health, while the RMA definition of environment, in section 2, is wider than human health and includes:

> (a) Ecosystems and their constituent parts, including people and communities; and
>
> (b) All natural and physical resources; and
>
> (c) Amenity values; and
>
> (d) The social, economic, aesthetic, and cultural conditions which affect the matters stated in paragraphs (a) to (c) of this definition or which are affected by those matters.

$SGVs_{(health)}$ are therefore unlikely to meet the RMA definition of contaminated land as in most instances, an $SGV_{(environment)}$ would be more precautionary than its $SGVs_{(health)}$.

Generic exposure scenarios

Soil guideline values have been derived for five standard scenarios. With one exception, these are similar to the exposure scenarios of the existing industry-based guidelines (eg, the *Health and Environment Guidelines for Selected Timber Treatment Chemicals*, MfE and MoH, 1997). One additional exposure scenario is defined, and the rural / lifestyle block scenario is offered for reference but not for regulatory purposes.

The generic scenarios are as follows:

Scenario	Description
Rural / lifestyle block	Rural residential land use, including home-grown produce consumption (10 per cent). Applicable to the residential vicinity of farm houses for protection of farming families, but not the productive parts of agricultural land. (Not for regulatory use.)
Residential	Standard residential lot, for single dwelling sites with gardens, including home-grown produce consumption (10 per cent).
High-density residential	Urban residential with limited soil contact, including small ornamental gardens but no vegetable garden (no home-grown produce consumption); applicable to urban townhouses, flats and ground-floor apartments with small ornamental gardens, but not high-rise apartments.
Parks / recreational	Public and private green areas and reserves that are used for active sports and recreation. This scenario is intended to cover playing fields and suburban reserves where children play frequently. It can also reasonably cover secondary school playing fields but not primary school playing fields. Check exposure for park maintenance staff using commercial / industrial unpaved.
Commercial / industrial outdoor worker (unpaved)	Commercial / industrial site with varying degrees of exposed soil. Exposure of outdoor workers to near-surface soil during routine maintenance and gardening activities with occasional excavation as part of maintaining sub-surface utilities (ie, a caretaker or site maintenance personnel). Also conservatively applicable to outdoor workers on a largely unpaved site.

The generic scenarios and $SGVs_{(health)}$ are not intended to cover land uses and activities that deviate markedly from the exposure rates assumed in the $SGVs_{(health)}$ derivation. It may be that the generic scenarios can be used as a conservative first screening for activities or land uses that clearly involve less exposure than the chosen generic scenario; otherwise, site-specific assessment may be necessary (or may be best if the generic scenario is excessively conservative).

On some sites, one or more generic scenarios may be applicable to some parts of the site, while other parts of the site may require a site-specific assessment.

The rationale for these exposure scenarios and other non-regulatory scenarios is set out in more detail in the *Draft Methodology for Deriving Soil Guideline Values Protective of Human Health* (MfE, 2010b).

Appendix 2: Site-specific Assessment

1 Purpose

The methods and guidance provided in this section have been prepared to support practitioners deriving, or contemplating deriving, site-specific soil guideline values (site-specific SGVs) as provided for in the proposed National Environmental Standard for Assessing and Managing Contaminants in Soil.

2 Introduction

Site-specific or 'Tier 2' assessment in contaminated site practice is using site-specific information to modify the generic assumptions used for the SGV derivation; this will more accurately estimate a person's exposure and therefore the risk to human health for the particular situation. Site-specific soil guideline values (SSGV) are then derived using the same basic methodology used to derive the generic guidelines, *Draft Methodology for Deriving Soil Guideline Values Protective of Human Health* (MfE, 2010b).

Site-specific assessment considers each element in the hazard (source)-pathway-receptor model of risk assessment, and theoretically could involve modifying one or more of:

- the toxicity of the chemical of concern, particularly in relation to chemical speciation (overlaps with bioavailability issues)
- the default assumptions about the receptors considered to be at risk in the generic derivations, including the physical characteristics of those receptors (eg, weight, skin areas) and their behaviour (frequency and duration on the site, lifestyle)
- the exposure (intake) estimates, such as whether all the exposure pathways assumed to exist actually exist, or exist to the degree assumed; and whether the generic exposure rates (eg, soil ingestion, soil adherence, produce consumption) and other exposure factors are realistic for the particular situation.

As a fundamental starting point, any site-specific assessment needs a well-developed conceptual site model with all contaminants of concern, exposure pathways (and any barriers) and receptors identified and quantified.[17] A good understanding of the soil concentrations and distribution of concentrations is required. Only then can consideration be given to modifying the generic scenarios and associated factors.

Site-specific assessment is a task for an appropriately qualified and experienced contaminated-land professional. Expert professional judgement and an intimate knowledge of the derivation methodology is required to vary factors used in the derivation of the guideline values. In considering site-specific assessments, local authorities may need to obtain independent expert review.

[17] Refer to *Contaminated Land Management Guidelines No. 5* (MfE, 2004b) for a discussion on the conceptual site model and sampling requirements.

3 When a site-specific assessment should not be carried out

One could argue that a site-specific assessment should be carried out on any site because not one will exactly fit the generic exposure assumptions. Also, the SGVs are deliberately conservative so that many sites fitting a generic scenario would still be safe at concentrations in excess of the SGV. However, the intention is that, for sites that generally fit within a particular generic exposure scenarios set out in Appendix 1, **and** there is no resource consent providing for site-specific management of exposure, then site-specific assessment is not allowed. This is because without the enforcement mechanism provided by the resource consent, there is no guarantee that any current site-specific circumstances creating lower exposure will remain into the future.

For example, all urban housing with a typical section will fit within the standard residential scenario, even if there is no vegetable garden; they should be assessed as such unless a resource consent that allows variation of the standard exposure is to be applied for.

Site-specific principle 1:

Site-specific assessment is not permitted for sites that fit within the generic scenarios of Appendix 1 above unless a resource consent is granted that ensures the exposure assumed in the site-specific assessment will continue into the future.

It may not be economic to go to the expense of a site-specific assessment for some sites, particularly small or low-value sites, where a small amount of remedial work would cost less than the cost of the site-specific assessment and applying for a resource consent to manage the site. In that case, site-specific assessment should not be carried out.

Site-specific assessment should also not be carried out if the owners decide that remediation best suits their intentions for the site. Some owners prefer to know their site is fit for any purpose.

4 When a site-specific assessment must be carried out

Site-specific assessment must be carried out if it is clear the current site use, or intended site use, does not fit within any of the generic exposure scenarios such that the selection of the most relevant generic SGV would under-estimate actual human exposure. In this situation the derivation of a site-specific SGV would be indicated. Note, however, that the assessor is free to use a more conservative generic scenario so long as it is sufficiently protective. For example, if the actual use of a park was more intensive than the generic parkland scenarios envisaged, then use of the residential SGV would be sufficiently protective without the need to go to a site-specific assessment.

Site-specific assessment is not triggered or required, however, for reassessing the proportion of home-grown produce consumed. The two generic land-use scenarios included within the scope of the national environmental standard (rural residential / lifestyle block, residential) are based on an assumption that up to 10 per cent of fruit and vegetables consumed are grown on the property. Where owners consume more than 10 per cent of their produce from a home garden, guidance is provided (for non-regulatory purposes) in tables A2.1 and A2.2. Any site-specific assessment and adjustment of the SGV is a voluntary step and cannot be required. If the SGV (10 per cent) is exceeded, non-regulatory advice is appropriate and it would be good practice to record the circumstances on the property file, and inform the owner of the exposure risk and the range of measures that could be adopted to mitigate this risk. Although not a NES requirement, a site-specific assessment is strongly advised if the owners consume home-produced eggs, poultry or dairy products **and** the contaminants of concern are highly toxic lipophilic compounds (eg, dioxins).

The 50 per cent SGVs will be conservative for any situation where it is estimated that home-grown produce is 50 per cent or less of the produce consumed. However, if the owners have adopted a 'self-sufficiency' lifestyle, then an estimate may need to be made of their home-grown produce consumption and SGVs calculated accordingly.

Site-specific principle 2:

Site-specific assessment must be carried out if the current site use, or intended site use, results in greater human exposure than for any of the generic exposure scenarios.

5 When a site-specific assessment may be carried out

Site-specific assessment and derivation of site-specific SGVs is appropriate if both of the following apply:

- a site has been sampled and the results exceed one or more relevant SGVs
- the generic land-use scenarios for which SGVs are available do not fit the actual site use or configuration with sufficient accuracy. In this case the generic SGVs for the contaminants of concern are too protective, resulting in an unjustified restriction on site use or unnecessary remediation with associated financial burden.

As noted in *Contaminated Land Management Guidelines No. 5* (MfE, 2004b), it is not envisaged that occasional SGV exceedances would necessarily trigger a site-specific assessment (or management action or remediation), rather the site should be assessed on the basis of average exposure over appropriate exposure (averaging) areas, taking into account any hotspot contamination, as necessary.

There is no compulsion to carry out site-specific assessment, unless it is to support a resource consent application. An owner may be prepared to tolerate, or require, a more conservative assessment than the site use would suggest, and would then carry out remediation as appropriate to any SGV exceedances.

Particular situations where site-specific assessment **could** be carried out fall into two situations:

1. SGVs are exceeded for a site that fits squarely with one of the generic definitions, but the site has current or proposed circumstances that limit exposure, and the owner is to apply for a resource consent to permit limited remediation or management.
2. The site falls outside the generic exposure scenarios, or between two of the generic scenarios, and is of a type that the use is not likely to change for the foreseeable future, eg, there is a long history of the particular use, or the land is designated for particular purposes (eg, education), or there are district plan restrictions on the type of use for the particular site. A resource consent would not be required in these cases, as a change to some more sensitive use is likely to come to the attention of the territorial local authority and a reassessment would be required.

Examples of the former situation include:

- A conventional residential property where there is no vegetable garden and no likelihood of a garden (eg, the backyard is too small or is paved) and this situation will be preserved by restrictions imposed by a resource consent.
- A conventional residential property where there is, or intended to be, a vegetable garden, but the owner has installed (or will install) a raised-bed garden with clean soil. The owner would need a resource consent that restricted vegetable gardens to raised-bed gardens. In this case the site-specific assessment may be to simply recalculate the SGV without the produce pathway.

Examples of the second situation include:

- A childcare centre – a residential scenario could be used as a conservative screening but site-specific assessment will probably result in higher (less conservative) SGVs. This would only be appropriate where the site has been, or is likely to be, a childcare centre for a long time. A childcare centre in a converted house that may revert to residential at any time should be assessed as residential.
- Primary or secondary schools – a residential scenario is too conservative. A parkland scenario might be appropriate for parts of the site, but a site-specific assessment taking into account different sub-uses of the school grounds is more appropriate.
- Rural land not used for residential accommodation, or reserve land used for occasional or passive recreation where the generic human-health scenarios provided are probably too conservative.

Table A2.1: Summary of soil guideline values for inorganic substances (mg/kg)

	Arsenic	Boron	Cadmium (pH 5)[1,2]	Chromium		Copper	Inorganic lead	Inorganic mercury
				III	VI			
Rural residential / lifestyle block no produce	25	42,000	200	500,000	1,000	33,000	900	660
Rural residential / lifestyle block 10% produce	20	34,000	5	280,000	560	32,000	730	380
Rural residential / lifestyle block 50% produce	10	5,200	0.5	100,000	210	29,000	400	140
Residential no produce	29	42,000	200	500,000	1,000	33,000	900	660
Residential 10% produce	24	34,000	5	280,000	560	32,000	730	380
Residential 50% produce	14	5,200	0.5	100,000	210	29,000	400	140
High-density residential	50	75,000	370	890,000	1,800	60,000	1,600	1,200
Recreation	100	220,000	1,100	NL	5,200	170,000	4,700	3,500
Commercial / industrial outdoor worker	70	400,000	1,600	NL	6,300	290,000	7,000	4,200

1 Default value is for pH 5. See table 8 for SGVs at other soil pH values.

2 Values for Joint Expert Committee on Food Additives tolerable daily intake of 2 µg/kg bw/day

NL = no limit.

Note: Shading indicates SGV used for the purpose of this NES.

Table A2.2: Summary of soil guideline values for organic compounds (mg/kg unless shown otherwise)

Scenario	BaP	DDT	Dieldrin	PCP	Dioxin (µg/kg TEQ)	
					TCDD	Dioxin-like PCBs
Rural residential / lifestyle block no produce	110	150	28	70	0.23	0.21
Rural residential / lifestyle block 10% produce	85	90	3.1	70	0.19	0.15
Rural residential / lifestyle block 50% produce	40	35	0.67	70	0.11	0.07
Residential no produce	130	150	28	70	0.23	0.21
Residential 10% produce	100	90	3.1	70	0.19	0.15
Residential 50% produce	55	35	0.67	70	0.11	0.07
High-density residential	240	270	50	130	0.41	0.38
Recreation	440	750	110	230	1.1	0.90
Commercial / industrial outdoor worker	300	1,000	160	360	1.4	1.2

Note: Shading indicates SGV used for the purpose of this NES.

6 What factors may be changed?

Any factors may be changed **except**:

- the contaminant toxicity values
- the dermal absorption factors
- the averaging time for non-threshold substances (MfE, 2010a)
- the use of 100 per cent contaminant oral bioavailability.

The *toxicity values* and *dermal absorption factors* have been considered and approved by a panel of government experts and should not be changed without going through the same process. Where toxicity values do not exist, then a similarly rigorous process to that described in *Draft Toxicological Intake Values for Priority Contaminants in Soil* (MfE 2010a) in developing values for the current priority contaminants for which SGVs have been derived, should be followed. However, if it is clear that people on a site have a higher background intake than has been assumed in the SGV calculation, then the residual tolerable daily intake assigned to soil must be reduced.

The *averaging time for non-threshold contaminants* is, by definition, a lifetime. Again, the duration of a lifetime has been approved by a panel of government experts on the basis of population statistics. Until such time as average life expectancy changes the value must remain fixed.

Contaminant bioavailability has been subject to much debate internationally. The consensus is that, currently, the test methods available in New Zealand for estimating site-specific bioavailability are not yet good enough and the use of generic bioavailability values from the literature is not appropriate. Bioavailability considerations are discussed in greater detail in the Technical note at the end of this section.

Some factors are less likely (or less appropriate) to be changed than others. Factors that are less likely to be changed, or require greater justification to change, include: body weights, inhalation rates, and skin areas for given body parts for the standard receptors (ie, adults and young children). As skin areas are proportional to body weight, fixing body weights will fix total skin areas (but not skin area exposed if fewer or more body parts are likely to be exposed than the generic scenario).

Any varying of exposure factors should be fully justified in the assessment report, either on the basis of professional judgement or by citing scientific studies. The calculations should be presented.

Typical situations that would enable the generic factors to be changed are described in table A2.3.

Table A2.3: Modifiable exposure factors, typical situations and examples

Factor	Situations	Examples[1]
Background intake (increase only)	Where a non-soil exposure results in greater than the assumed background intake used for the generic SGV derivation	Groundwater used on-site has natural or anthropogenic contamination
Exposure duration	Non-residential situations where duration of occupancy is likely to be at variance from the standard situations	Childcare centre Secondary school Construction site
Exposure frequency	Occupancy for a typical person is discontinuous throughout the year, or for less than five or seven days per week	Some childcare facilities Schools Short-tem construction Some parks, public gardens and reserve land
Body weight	Situations where the critical occupant is at variance from the standard child (toddler) or adult weights	Primary school – choose body weight for 5-year-old female Secondary school – 12-year-old
Skin area	As for body weight	As for body weight
Soil ingestion rate	Where enforceable management controls create permanent or semi-permanent barriers to soil Partial remediation reduces area of soil above SGV[2] Where the typical activities increase or reduce likelihood of soil ingestion	Installation of paving, decking, soil cap with marker layer, gravel with geotextile (reduced exposure) Parks and gardens for passive recreation (reduced exposure) Construction sites where excavation is carried out (increased exposure)[3]
Dermal adherence factor	Activities that result in increased or decreased likelihood of getting dirty	Parks and gardens intended for passive recreation (little soil adherence) Excavation activities (increased soil adherence)[3] Lakes or beaches with contaminated sediments where children play
Percentage home-grown produce (in the extreme, eliminating this pathway)	Where site-circumstances or enforceable management controls eliminate or reduce risk of produce uptake Lifestyle of owners indicates substantial home-grown produce	Raised-bed vegetable garden allows dispensing with produce pathway Remediation of backyard allows dispensing with produce pathway Rural property with substantial vegetable garden and favourable climate for year-round growing
Produce uptake factors	Applicable only to residential gardens	Deriving site-specific bio-concentration factors - using soil and produce concentrations from the particular site[4, 5]
Additional pathways	Situations where the soil ingestion, dermal absorption and produce consumption pathways do not account for a significant part of the contaminant exposure	Extremely dusty sites such as mines and construction sites[3] Consumption of home-grown eggs, poultry or dairy where the contaminant is highly toxic and lipophilic On-site abstraction and use of groundwater impacted by contaminants

1 This is an indicative list. There are many other situations where adjustment of factors may be appropriate. The services of an experienced contaminated-site professional should be used to decide whether site-specific assessment is appropriate and, if so, the modified factors to be used.

2 Arguably, this does not need site-specific adjustment of the ingestion rate as the partial remediation enables the average site concentration to be redefined.

3 It is probable that such a situation would be controlled by a requirement for appropriate personal protective equipment and site occupational health and safety controls (a health and safety plan), rather than modifying allowable SGVs.

4 Deriving site-specific bio-concentration factors (BCFs) will require measurement of soil concentrations and concentrations within appropriate plant species grown in the site soil (with sufficient testing to be statistically significant). If suitable plants species are not available, growing trials would be necessary. Field-scale studies are likely to be more realistic of the home gardener, but are difficult to control. Pot experiments are often seen as a compromise between control and realism. However, pot experiments also have known problems resulting in over-prediction of plant uptake (EA, 2006).

5 In theory, soil properties could be modified to reduce produce uptake, eg, liming to reduce pH or cause reduction of metal solubility. However, there is a question of the long-term effectiveness of such treatment where the intention is to meet regulatory requirements (eg, make a residential site suitable for growing up to 10 per cent of produce consumption). It is unlikely that such an approach would be acceptable to regulators unless it is conclusively demonstrated that the treatment would be effective, long-lived and/or irreversible for the particular site. Evidence required might include bench trials, field trials or full-scale remediation, with appropriate and sufficient (statistically significant) chemical testing. Testing could include such things as soil pH, soil mineralogy, soil organic carbon, soil clay content, and sequential extraction tests. However, there may be non-regulatory circumstances where such treatment may be appropriate and require a lower standard of evidence. For example, an owner is seeking to grow more than 10 per cent of vegetable consumption and the site complies with SGVs for 10 per cent produce but would fail a non-regulatory SGV for that greater percentage.

7 The site-specific assessment process

The need for a site-specific assessment will tend to be an exception; before embarking on this path its relevance should be determined. For most sites it will not be economic or useful to carry out a site-specific assessment, since remediation or site management can be achieved simply or more readily.

The site-specific assessment process is set out in diagrammatic form in figure A2.1: Site-specific assessment steps. This figure expands on Steps 5 and 6 of the flow chart for applying SGVs given in figure 9, section 8.3. Carrying out a site-specific assessment presupposes the site is well understood and sufficient work has been carried out to properly characterise the soil conditions. If the site has not been properly characterised, or the site conceptual model is poorly developed, it is important that these be remedied before embarking on site-specific assessment. Further site characterisation may reveal, for example, that average site concentrations are actually below SGV values; and/or, the contaminant-pathway-receptor relationships are not as first thought and require better defining.

The steps shown in figure A2.1 should be carried out at a level of detail consistent with the size and complexity of the site. A small or simple site would warrant no more than a brief consideration of the various steps, while a complex site undergoing extensive investigation or a site undergoing a high-cost redevelopment could warrant detailed analysis at each step.

Step 1 involves reconsideration of the receptors at risk, the mechanisms by which those receptors might be exposed by contaminants, and whether the conditions exist on the site for that exposure to occur. Not all contaminants will behave in the same way, with the result that the exposure mechanism can be different for different contaminants, eg, the critical exposure pathway for a volatile organic compound may be different from a heavy metal. Setting out a matrix of contaminants (and associated characteristics), receptors and exposure pathways is a good way of assessing the linkages.

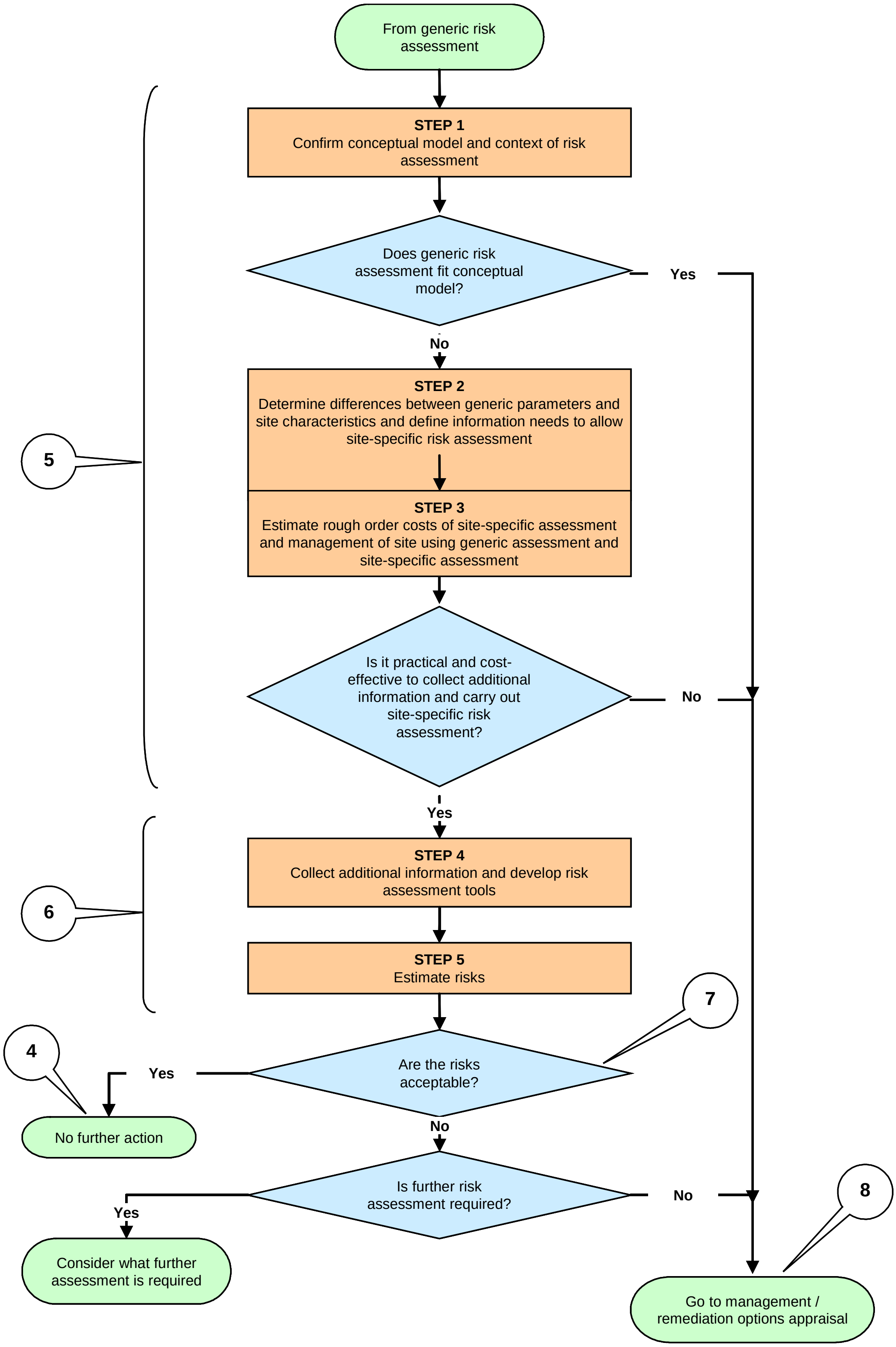
Step 2, in determining how actual exposure differs from the generic exposure, should consider for each receptor in turn (and for each exposure area relevant to that receptor):

- whether the standard parameters adequately describe the receptors' physical characteristics and exposure
- whether all of the standard pathways are relevant and, if not, which can be eliminated
- whether additional pathways are relevant.

If the answer is ‘no’ to either of the first two questions or ‘yes’ to the last, then it is necessary at **Step 3** to assemble sufficient information to decide whether it is practical and economic to proceed to a site-specific assessment. This could be very simply exercising professional judgement for a small site or a formal assembling of options and carrying out a cost-benefit analysis for a large complex site. This will tend to be interactive with Step 4, for complex sites.

Step 4 involves deciding on what factors can be changed (as set out in table A2.3), and what values these factors should take. This may involve carrying out soil and plant testing if produce bio-concentration factors are to be changed, researching receptor body weights and skin areas, researching occupancy, and carrying out literature searches to justify modifying soil ingestion rates or dermal adherence factors. Inevitably, professional judgement will be involved. At this point, a site-specific assessment would be abandoned if it is obvious that the site-specific SGVs (SSGVs) will not be sufficiently different from the SGVs to warrant going further. Otherwise, the next step is to proceed to derive the SSGVs at **Step 5**, developing additional exposure equations if necessary for any additional exposure pathways that need to be considered. Fate and transport modelling may be appropriate for the inhalation and groundwater pathways.

Figure A2.1: Site-specific assessment steps



Note: Numbers in circles refer to steps in figure 8, SGV application framework, section 8.3.

Site-specific assessment examples

Example 1: Step 1 – Confirming the site conceptual model

The site (about 5000 m^2) is currently occupied by an engineering workshop, with underground storage tanks holding degreasing solvents and old machinery stored in one corner of the site. It is being considered for conventional residential redevelopment. The proposed residential lots will be of a sufficient size to have gardens, in keeping with the surrounding residential use. The site is generally level. The site geology is mixed fill overlying sandy gravels, with the water table at 2 m. A stream is on one boundary of the site.

Possible contaminant-pathway-receptor linkages

Contaminant	Pathway(s)	Receptor
Metals A, B, C	Ingestion, direct contact Consumption of contaminated vegetables	Future residents, site workers Future residents
Semi-volatile, non-halogenated hydrocarbons D, E, F	Ingestion, inhalation, direct contact Consumption of contaminated vegetables Dermal contact Migration through fill Migration through gravels	Future residents, site workers Future residents Future residents Groundwater in gravel River
Volatile halogenated hydrocarbons X, Y, Z	Inhalation through migration into buildings Ingestion, direct contact Consumption of contaminated vegetables Migration through fill Migration through gravels	Future residents, neighbours (possibly) Future residents Future residents Groundwater in gravel River

Example 2: Step 2 – Determining differences from the generic model

A secondary school has been built on an old landfill. The site has been investigated and found to contain elevated concentrations of lead, zinc, copper and arsenic. Landfill gas was not being produced. As an initial conservative screening, the results were compared with residential guidelines. It was found that zinc and copper were well below the residential SGVs but that lead in surface soil was up to three times the residential SGV of 750 mg/kg and arsenic up to four times the SGV of 24 mg/kg.

The assessor considered the conceptual model and decided that the site should be broken into two areas, based on likely exposure – the area around the buildings which was entirely grassed or paved, and the playing fields where an individual pupil might practise and play contact sports on up to four occasions a week.

The assessor also decided receptors that needed considering were the pupils and the school caretaker. Teaching staff were considered less at risk than the caretaker and therefore not the critical adult. Twelve-year-olds were considered to be the youngest (and lightest) likely group at school and were therefore used as the critical child receptor. An average 12-year-old weighs about 40 kg. This weight is also about the 25th percentile for a 13-year-old.

For the building area, it was assumed the 12-year-old pupil was at school five days a week for 38 weeks of the year and the school caretaker was carrying out maintenance and gardening activities five days a week for 48 weeks of the year.

For the playing field area, it was conservatively assumed a 12-year-old pupil would be practising and playing contact sport on four occasions a week during term time (38 weeks per year) and the school caretaker would be mowing the fields and carrying out miscellaneous activities two days per week on average.

It was decided that the residential guideline for lead was too conservative as it was based on a 15 kg two-year-old child with 350 day exposure to bare soil. Instead, SSGVs were calculated for each of the two areas using the 40 kg body weight typical of a 12-year-old child, and soil ingestion rates for high-density residential and recreational, as being an approximation for the activities for the two areas. As contaminant intake for the two areas is additive, part of the lead tolerable daily intake was assigned to each area in proportion to expected intake. The reduced exposure frequencies for the two areas were used. Produce consumption was dispensed with as not a valid exposure pathway.

After further examination of the exposure parameters, it was decided for the caretaker that the standard commercial / industrial outdoor worker scenario was sufficiently accurate, with calculation of a site-specific guideline not warranted. The measured concentrations did not exceed these guidelines. As such, the caretaker was not considered further.

For arsenic, a similar approach was taken for the 12-year-old child, but as arsenic is non-threshold and exposure is averaged over a lifetime, the exposure duration becomes important. The exposure duration for the child was reduced from the standard 14 years residential exposure for an adult to the five years a typical child would spend at high school.

The calculated site-specific SGVs were in excess of the measured concentrations and no remediation was required. The school implemented a management plan to control off-site disposal of soil in the event of redevelopment.

Example 3: Steps 3–5 – Revision of site conceptual model and site-specific assessment

A rural subdivision was proposed on a former timber treatment site. The subdivision was being promoted as a sustainable development for families who wanted to get away from the city. The show-home was to be of packed-earth construction, double glazed and with solar heating. The advertising brochures showed houses with large vegetable gardens. There was to be an on-site communal water supply using groundwater.

The site had been used for chromated copper arsenate (CCA) and boron treatment, but the site had been tested and remediated to residential guidelines. The site had also been tested for pentachlorophenol (PCP) as a precaution, although there was no known history of pentachlorophenol PCP use on the site. PCP was below the detection limit in the tested locations.

During the development, a bore was sunk and tested and found to only marginally comply with the arsenic drinking-water guideline. In addition, a former site worker informed the developer that PCP had definitely been used in the boron dip for a few years in the early 1980s. The developer consulted an environmental consultant who advised the following:

(a) The additional exposure to arsenic through drinking water meant that residents would be subject to a greater risk of cancer. The consultant further advised that it was not appropriate to calculate a SSGV as arsenic was a non-threshold substance and background intake did not figure in the calculation. Instead, the consultant calculated the increased risk of cancer using the measured soil concentrations and the additional exposure from water.

(b) Despite PCP being below the detection limit, it was possible that dioxin was present. Dioxin was a known contaminant of PCP and very resistant to degradation. Testing of dioxin was recommended at the boron dip, the diffusion shed location, and locations in between.

The site-specific calculation of the risk from arsenic found that the risk from soil and drinking water was less than 1 in 100,000, however the developer decided to include arsenic removal in the water treatment process.

Dioxin at concentrations in excess of the residential guideline was found at the former boron dip location, but below the residential guideline elsewhere. However, the consultant, knowing how the development was being promoted, advised the developer that the concentrations measured in some locations would exceed an SSGV calculated for 30 per cent home-grown produce and was well in excess of a guideline that took home-produced eggs into account.

The proposed lot containing the former dip location became a community tennis court. Encumbrances were placed on property titles preventing the keeping of chickens and farm animals (also consistent with the desirability of a quiet neighbourhood). Topsoil in future backyards was replaced with imported topsoil.

Example 4: Steps 4 and 5 – Eliminate pathways and calculate SGV

A residential site was found to have arsenic contamination at twice the SGV over the complete site as a result of past orchard use. Associated lead contamination, while above the SGV in places, was not critical compared with arsenic. Elevated copper was not critical as it was well below the SGV.

The site was considered to fall squarely within the standard residential scenario. As such, 10 per cent produce home-grown produce was applicable.

The assessor determined that if the produce consumption pathway was eliminated then the modified SGV would be in excess of the measured concentrations. The assessor proposed to the owners that the site would comply if:

- the owner undertook to pave the backyard or replace the site soil with at least a half metre cap of clean soil (this could be in a raised-bed garden separated from the contaminated soil by a geotextile marker layer)
- applied to the council for a resource consent which would have as a condition restrictions on changing the new site configuration without obtaining permission from the council.

After consulting their architect, the owners decided to install a raised-bed garden over a third of the backyard, with the remainder landscaped with paving and a half metre of contoured soil capping. They applied for and were granted a resource consent.

The remainder of the site was left un-remediated.

Technical note: Bioavailability considerations in site-specific assessment

It is standard practice in contaminated site assessment to assume 100 per cent bioavailability in the first instance, with comparison of soil sampling results against generic soil guideline values for appropriate land-use scenarios. In theory, site-specific assessment may then include modifying the generic guidelines by considering reduced bioavailability of the contaminants of concern. This is mentioned in New Zealand guidance as a possibility in the *Sheep-dip Guidelines* (MfE, 2006a).

It is generally accepted that many contaminants in soil are less than 100 per cent bioavailable to humans when ingested, opening up the possibility of modifying the guideline for a specific site. However, bioavailability is not a fixed value, but depends on the contaminant, the soil organic content, the chemical form of the contaminant, contaminant concentrations, the mineralogy of the soil and may other factors. Textbook values cannot be relied on, with testing of the particular contaminated soil required. However, as noted in the *Sheep-dip Guidelines* there is no generally accepted method for determining the bioavailability of contaminants in New Zealand. This conclusion was reinforced by Gaw et al (2006) who reported that an approach using relative bioavailability or bioaccessibility factors has yet to be formulated.

Overseas, two basic methods for assessing oral bioavailability have been employed; tests using animals (in-vivo methods) and laboratory analysis that simulates extraction by the human gastrointestinal tract (in-vitro methods). In-vivo tests and, in particular, tests using juvenile swine, are generally considered the benchmark (Wragg and Cave, 2003). Authorities such as the US EPA will accept testing carried on animals, but such testing is very expensive and time-consuming. It can only be justified on the largest of sites and even in the United States has been carried out for only a few sites. It is unlikely to be available in New Zealand in the foreseeable future.

Most of the research has been carried out on lead in soil, with reasonably robust relationships developed between in-vivo and in-vitro testing. This gives some confidence that in-vitro testing works sufficiently well for lead contaminated soil. Much less work has been carried out on other metals and metalloids, with the consequence that the validation between in-vivo and in-vitro testing is much less certain and the test methods are still evolving (US EPA, 2005b; Wragg J, 2005). Much of the testing has been on mining waste, which has different characteristics to contaminated surface soil, and at much higher concentrations than might be encountered on typical contaminated sites in New Zealand.

The Environment Agency concluded the following (EA, 2007):

- bioavailability and bioaccessibility and their relationship is specific to method, site, chemical and chemical form being tested
- the applicability of an in-vitro method developed and validated for a particular contaminant is uncertain in predicting bioavailability for other contaminants
- no reference materials, either in the UK or overseas, associated with in-vivo bioavailability data, are available to assess the validity and reproducibility of in-vitro method
- geochemistry of soil is likely to play a major part in governing the dissolution and bioavailability of chemicals in biological receptor such as human. However, with the current limited knowledge, geochemistry-based prediction of bioaccessibility and bioavailability is unlikely to be appropriate.

As far as it is known, there have not been any in-vivo studies on New Zealand contaminated soil (few New Zealand sites could justify the expense). Very limited in-vitro testing has been carried out by Hill Laboratories (pers. comm., Peter Robinson, Hill Labs) as a research exercise and New Zealand samples have been sent to Australian laboratories on occasion.

At this stage, it is the Ministry for the Environment's position that, until the science is better developed for New Zealand soils and conditions, use of reduced bioavailability is not appropriate. Given the lack of confidence that much better resourced overseas jurisdictions have in the available testing methods, it does not seem appropriate to change this stance at this stage.

Appendix 3: Summary of the Toxicological Intake Criteria

The *Draft Toxicological Intake Values for Priority Contaminants in Soil* (MfE, 2010a) presents recommendations for toxicological intake values for 14 priority contaminants to be used in the derivation of human-health-based soil guideline values, $SGVs_{(health)}$, for New Zealand. Toxicological intake values describe a concentration at which substances might pose no appreciable risk or minimal risk to human health, depending on the substance being considered. Specifically:

- Threshold substances are those for which it is possible to identify a level of exposure at or below which they do not produce an adverse effect, and toxicological intake values typically prescribe a daily level of exposure over a lifetime at which there is no appreciable risk to human health.
- Non-threshold substances, which include most carcinogens, pose an inherent risk at any level of exposure. For these values the toxicological intake values describe a level of exposure for which there is considered to be minimal risk. This may be determined from quantitative risk modelling for risk levels of 1 in 100,000 or application of a default factor of 10,000 to estimates of $BMDL_{10}$ (benchmark-dose lower bound, 10 per cent).

These recommendations are based on a literature review of the toxicity of contaminants, and reference health standards developed by various international agencies. The term 'reference health standards' is used in this report to refer to any value, set by a regulatory or advisory body, that provides an estimated daily (sometimes weekly or monthly) amount of a substance that can be taken into the body either without any or with minimal additional risk of detrimental health effects occurring (based on available scientific information).

Additionally, estimates of the background exposure (primarily from food and water) of New Zealanders for the priority threshold contaminants are made based on the most recent New Zealand Total Diet Survey (Vannoort and Thomson, 2005) and information on the chemical quality of drinking water (Davies et al, 2001). Exposure to non-threshold contaminants is based on an agreed acceptable increase in risk, and therefore exposure from all sources should be limited as much is reasonably practicable. It is considered that exposure to each source is managed by this principle, therefore it is irrelevant in the context of developing SGVs.

Toxicological intake values for the inhalation route are considered for volatile contaminants only, as inhalation will be a negligible route of exposure for non-volatile or semi-volatile contaminants.

The recommended toxicological intake values are shown in tables A3.1 and A3.2, with a summary of the bases for the recommendations provided below.

Table A3.1: Summary of toxicological intake values for threshold priority contaminants

Contaminant	Oral (μg/kg bw/day) unless stated otherwise	Skin absorption factor	Background exposure (μg/kg bw/day) unless otherwise stated	
			Child	Adult
Cadmium – daily	1 7 μg/kg bw/week	0.001	0.41 2.87 μg/kg bw/week	0.26 1.82 μg/kg bw/week
Copper	150	NA	56	20
Chromium III	1500	NA	1.2[a]	0.53[a]
Chromium VI	3	NA	No data	No data
Lead	3.57 25 μg/kg bw/week	NA NA	0.97 6.7 μg/kg bw/week	0.41 2.85 μg/kg bw/week
Mercury	2	NA	0.05	0.065
Boron	200	NA	80	17
Dieldrin	0.05	0.1	0.0036	0.0014
∑DDT (complex)	0.5	0.018	0.051	0.019
Pentachlorophe nol	0.3	0.24	0.02	0.02
Dioxins and dioxin-like PCBs	30 pg TEQ/kg bw/month	0.02 (PCDDs) 0.05 (PCDFs) 0.07 (PBCs)	10 pg (I-TEQ)/kg bw/month	10 pg (I-TEQ)/kg bw/month

NA = not applicable, TEQ = toxic equivalents.

a Based on recommended nutritional intake for chromium.

Table A3.2: Summary of toxicological intake values for non-threshold priority contaminants

Contaminant	Oral risk-specific dose (μg/kg bw/day)	Inhalation risk-specific dose (μg/kg bw/day)	Skin absorption factor
Arsenic	0.0086	NA	0.05
Benzene	0.24	0.48	0.0005
Benzo(a)pyrene	0.043	NA	0.026

NA = not applicable.

Arsenic –Arsenic is considered to be a non-threshold contaminant, with internal cancers such as bladder and liver cancers the most sensitive endpoints. Estimates of carcinogenic potency are primarily derived from human epidemiological data from exposure through drinking water. A daily risk-specific dose of 0.0086 μg/kg bw, derived from the arsenic concentration in drinking water determined to represent 'negligible risk' by Canadian agencies (0.3 μg/L), is recommended. This value is based on the most current risk modelling data, and includes an external comparison population. Dermal absorption is considered to be negligible, although the skin absorption factor of 0.5 per cent (Lowney et al, 2007) could be used as a refinement in the development of soil guideline values.

Cadmium – Cadmium is considered to be a threshold contaminant, with kidney damage as a result of long-term exposure considered the most sensitive endpoint. Unlike for most other substances, toxicokinetic modelling has typically been used to estimate tolerable intakes. Given the long-term effects of cadmium, it is more appropriate to express intakes as weekly intakes. The Joint Expert Committee on Food Additives (JECFA) of the Food and Agriculture Organization and the World Health Organization recommend a provisional tolerable weekly intake of 7 μg/kg bw/week; the total daily intake derived from this has been the value most widely used by different international agencies, hence for consistency with those agencies this value could be used in New Zealand. However, there is recognition that this value may not be sufficiently protective of the general population and some other agencies have adopted different values. Dutch agencies have adopted a pragmatic approach and simply applied an additional safety factor of 2 to the JECFA value, while the European Food Safety Authority (EFSA) recently established a tolerable weekly intake of 2.5 μg/kg bw/week based on toxicokinetic modelling of a sensitive human population. As a result of the EFSA derivation, JECFA has indicated it will review cadmium again in 2010. It is recommended the current JECFA value is the primary toxicological intake value used in New Zealand until the JECFA review. Dermal absorption is expected to be negligible, although a dermal absorption factor of 0.0012 could be used. Dietary intake is the primary source of background exposure to cadmium and was estimated to be 2.87 μg/kg bw/week for a child (aged 1–3 years, 13 kg) and 1.82 μg/kg bw/week for an adult.

Copper – Copper is an essential element, and adverse effects can arise from both copper deficiency and excess copper intake. Liver damage is the critical endpoint for intake of high levels of copper in animal and human studies. The tolerable upper limit of 10 mg/day, based on liver function, derived by the US Institute of Medicine (2001) and converted using a 70-kg bodyweight, is used to derive a toxicological intake value of 0.15 mg Cu/kg bw/day. Dermal absorption and inhalation are expected to be negligible routes of exposure and are not considered relevant for soil contamination. Dietary intake is the primary source of background exposure to copper. Estimated dietary intake for a child aged 5–6 years was 0.06 mg/kg bw/day and for an adult (25–44 years) was 0.02 mg/kg bw/day, which is within the recommended dietary intake for copper.

Chromium – Chromium in its trivalent state is an essential element, but at high concentrations, and particularly in its hexavalent state, it is toxic. There are limited data on which to base tolerable daily intakes for chromium, and the US EPA-recommended toxicological intakes of 1500 μg/kg bw/day and 3 μg/kg bw/day for Cr(VI) are recommended for use in New Zealand. Dermal absorption of chromium (III) is expected to be a negligible route of exposure for soil contamination and is not considered relevant here. It is recommended that the adverse effects arising from dermal exposure to chromium (VI) are considered separately to those arising from oral exposure and that allergic contact dermatitis is the main effect of interest. A soil guideline value protective from allergic contact dermatitis could be established, but as these effects are likely to be elicited at higher concentrations than those arising from oral exposure, a soil guideline value protective against effects arising from oral exposure will also protect against allergic contact dermatitis. Estimates of dietary intake of chromium (III) are based on nutrient reference values for different age groups from the US Institute of Medicine as recommended by the Australian National Health and Medical Research Council.

Lead – The most significant critical effect of low concentrations of lead is considered to be reduced cognitive development and intellectual performance in children. JECFA is the only authoritative body that has derived a tolerable intake for lead and the provisional tolerable weekly intake of 25 μg/kg bw/week, and the tolerable daily intake derived from this, has been the value most widely used by different international agencies and is recommended for use in New Zealand. Inhalation exposure and dermal absorption are expected to be negligible, and could be ignored in the derivation of soil guideline values for contaminated land in New Zealand, as has been done by other jurisdictions (Baars et al, 2001). Dietary intake is the primary source of background exposure to lead and was estimated to be 6.7 μg/kg bw/week for a child and 3.75 μg/kg bw/week for an adult.

Inorganic mercury – Inorganic mercury is considered to be a threshold contaminant, with renal effects in rats considered the most sensitive endpoint. A tolerable daily intake of 2 μg/kg bw/day is recommended as this is the value most widely used by different international agencies. Inhalation exposure is expected to be negligible on contaminated sites due to limited volatility of the forms of mercury likely to be present (mercury II). Dermal absorption is also expected to be negligible. Dietary intake, in particular seafood, and dental amalgam are the primary sources of background exposure to mercury. Dietary intakes of inorganic mercury were estimated to be 0.05 μg/kg bw/day for a child and 0.025 μg/kg bw/day for adults. Intake from dental amalgam was considered to be negligible for children and 0.04 μg/kg bw/day for adults, giving rise to a total inorganic mercury intake of 0.065 μg/kg bw/day for adults.

Boron – Boron is considered to be a threshold contaminant, with foetal weight decrease in rats the most sensitive endpoint. A tolerable daily intake of 0.2 mg/kg bw/day, based on benchmark dose modelling in two studies by the US EPA, is recommended. Inhalation exposure and dermal absorption of boron are expected to be negligible and are not considered relevant here. Dietary intake is expected to be the primary source of background exposure to boron and, in the absence of information specific to New Zealand, it is recommended that tolerable daily intakes of 0.08 mg/kg bw/day for children and 0.017 mg/kg bw for adults are used, based on international data.

Benzo(a)pyrene – Benzo(a)pyrene (BaP) is considered to be a genotoxic carcinogen, and therefore is a non-threshold contaminant. An oral-risk-specific dose of 0.043 μg/kg bw/day (slope factor of 0.23 per mg/kg bw/day) is recommended for use. This value is the geometric mean of 14 $BMDL_{10}$ estimates from four studies divided by 10,000 and maximises the use of available data. No cross-species scaling is applied. A dermal absorption of 0.026 (2.6 per cent) is recommended for use. BaP is considered representative of a range of carcinogenic polycyclic aromatic hydrocarbons (PAHs), and potency equivalence factors (PEF) are used to estimate the potential carcinogenicity of environmental PAH mixtures. A consistent set of PEFs is recommended to enable assessment of potential carcinogenicity of PAH mixtures through comparison with a BaP-equivalent soil guideline value in New Zealand. Further, it is recommended that the range of PAHs routinely analysed is expanded to include additional PAHs considered carcinogenic by the Food and Agricultural Organization and the World Health Organization.

Dieldrin – Dieldrin is a threshold contaminant, with the liver being the critical target of chronic toxicity in several animal species. Most jurisdictions have adopted the Joint FAO/WHO Meeting on Pesticide Residues (FAO/WHO, 1977) acceptable daily intake of 0.1 μg/kg bw/day, based on hepatoxicity in rats, and this is recommended for use in New Zealand. No dermal absorption data are available for dieldrin; hence, it is recommended that an absorption factor of 0.1 is used. The dietary intake for a child aged 1–3 years was estimated to be 0.0036 μg/kg bw/day and for an adult, 0.0014 μg/kg bw/day, while intake from drinking water is negligible.

∑DDT – DDT and its derivatives are considered to be threshold contaminants, given the equivocal data on their genotoxicity. These substances enhance liver enzyme production, are weakly hormone disrupting, and act on the central nervous system. Ideally, toxicological criteria for DDT should be based on data regarding the effects of DDE, because it is the primary metabolite found in the environment. However, insufficient data are available to do so – other than to note that toxicologically the adverse effects of DDE and DDT are similar – hence criteria are set based on the effects of DDT. In line with a number of international agencies, an oral tolerable daily intake of 0.5 μg/kg bw/day, based on hepatotoxicity in rats, is recommended for use in New Zealand. A dermal absorption of 0.018 (1.8 per cent) is recommended for use. Dietary intake of DDT residues is considered to be the primary source of exposure. The dietary intakes of ∑DDT for a child aged 1–3 years and an average adult are 0.0511 μg/kg bw/day and 0.0193 μg/kg bw/day, respectively, while intake from drinking water is negligible.

Pentachlorophenol (PCP) – While there appears to be reasonable evidence of carcinogenic effects in humans arising from exposure to PCP, there is weak evidence of genotoxicity and it seems more plausible a non-genotoxic mechanism is responsible for carcinogenic effects. As such, it is recommended that PCP be considered a threshold contaminant, and a tolerable daily intake of 0.3 μg/kg bw/day is recommended. An additional uncertainty factor of 10 is applied to the tolerable daily intake (TDI) derived by Baars et al. (2001) to account for the observed carcinogenicity of PCP. This TDI is recommended, as it uses the most sensitive relevant toxicological endpoint from available data and appropriate uncertainty factors. Inhalation exposure is likely to be negligible on contaminated sites due to the low volatility of PCP. However, PCP is indicated to be readily absorbed dermally and an absorption factor of 0.24, based on Wester et al (1993), is recommended. No data are available on food intake of PCP, and no PCP was detected in drinking-water supplies. In circumstances where no data are available on background exposure, it has been agreed to allocate 5 per cent of TDI allocated to background exposure, as such, background exposure is 0.02 μg/kg bw/day. These criteria (table A3.1) are applicable to exposure to PCP only, and are not necessarily protective of effects associated with the contaminants of technical-grade PCP, such as the polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans, which should be considered separately.

Dioxins and dioxin-like PCBs – Dioxins and dioxin-like PCBs are considered to be threshold contaminants, with developmental effects on the reproductive system in male offspring of exposed pregnant females considered the most sensitive toxicity endpoint. These effects are also considered to be protective against carcinogenic effects of dioxins. The maximum monthly intake value of 30 pg TEQ/kg determined by the Ministry of Health is recommended, for consistency between New Zealand agencies. Further it is recommended that WHO (2005) toxic equivalency factors developed for individual dioxins and dioxin-like PCBs are used to calculate total toxic equivalent values, as these are based on the latest re-evaluation by WHO, and thus are likely to become the international standard. Inhalation exposure to dioxins and dioxin-like PCBs is likely to be negligible on contaminated sites, due to their low volatility. Dermal absorption of these compounds is dependent on the physico-chemical properties of the individual congeners. It is recommended that dermal factors of 0.02, 0.05 and 0.07 are used as conservative estimates of dermal absorption of PCDDs, PCDFs and dioxin-like PCBs, respectively. Dietary intake is the primary source of background exposure to dioxins and dioxin-like PCBs and was estimated to be 0.33 pg/kg bw/day or 10.0 pg I-TEQ/kg bw/month for an adult, and is extended to children.

Appendix 4: Hazardous Activities and Industries List

This Hazardous Activities and Industries List (HAIL) defines industries and activities which typically use or store hazardous substances that could cause contamination if these substances escaped from safe storage were disposed of on the site, or were lost to the environment through their use. The fact that an activity or industry appears on the list does not mean that hazardous substances were used or stored on all sites occupied by that activity or industry, nor that a site of this sort will have hazardous substances present in the land. The list merely indicates that such activities and industries are more likely to use or store hazardous substances and therefore there is a greater probability of site contamination occurring than other uses or activities. Conversely, an activity or industry that does not appear on the list does not guarantee such a site will not be contaminated. Each case must be considered on its merits, considering the information at hand.

In applying the list, it must be remembered that the activity may only have occupied a small part of the site, and therefore the possibility of contamination will also be for a small part of the site.

1. Abrasive blasting – carrying out abrasive blast cleaning (other than cleaning carried out in fully enclosed booths) or disposing of abrasive blasting material.
2. Acid / alkali plant, formulation and bulk storage.
3. Agrichemical spray contractor's premises used for filling and washing out tanks for commercial agrichemical application.
4. Airports – fuel storage, workshops, washdown areas, stormwater runoff from hardstanding.
5. Analysts – commercial analytical laboratory sites.
6. Asbestos products' production, use, and disposal. Also sites with buildings containing asbestos products known to be in a deteriorated condition.
7. Asphalt or bitumen manufacture or bulk storage – manufacturing asphalt or bitumen, or bulk storage of these products, other than at a single-use site used by a mobile asphalt plant.
8. Battery manufacture or recycling – assembling, disassembling, manufacturing or recycling batteries (other than storing batteries for retail sale).
9. Brake lining manufacturers, repairers and recyclers.
10. Cement or lime manufacturing – manufacturing cement or lime from limestone material using a kiln and storing wastes from the manufacturing process.
11. Cemeteries.
12. Chemical manufacture and formulation and bulk storage such that land-use consent is required.
13. Coal and coke yards.
14. Concrete manufacture and bulk cement storage.
15. Defence works and defence establishments, including ordinance storage and training areas where live firing is carried out.
16. Drum and tank reconditioning or recycling.

17. Dry cleaning plants – restricted to premises where dry cleaning is carried out and solvents are stored.
18. Electrical transformers – manufacturing, repairing or disposing of electrical transformers or other heavy electrical equipment.
19. Electronics – manufacturing and reconditioning.
20. Engine reconditioning – use of solvents and degreasers.
21. Explosive production or bulk storage.
22. Fertiliser manufacture – manufacturing or bulk storage of agriculture fertiliser.
23. Foundry operations – commercial production of metal products by injecting or pouring molten metal into moulds and associated activities.
24. Gasworks – manufacture of town gas from coal or oil feedstocks.
25. Gun, pistol or rifle ranges or areas with lead shot deposition.
26. Iron and steel works.
27. Landfill sites.
28. Livestock dip or spray race operations.
29. Market gardens, orchards, glass houses or other areas where the use of persistent agricultural chemicals occurred.
30. Metal treatment or coating – including polishing, anodising, galvanising, pickling, electroplating, heat treatment using cyanide compounds and finishing, curing works or commercially finishing leather.
31. Mining and extractive industries and mineral processing – including chemically or physically extracting metalliferous ores, exposure of faces or release of groundwater containing hazardous contaminants and storing hazardous wastes, including waste dumps and tailings dams, but not gravel extraction (just note that these areas can be included because of fuel storage).
32. Motor vehicle workshops.
33. Paint manufacture and formulation.
34. Pest control – commercially operating premises (or former pest destruction board, now regional council sites) where storage and preparation of pesticide occurs, including preparation of poisoned baits and filling or washing of tanks.
35. Pesticide manufacture (including animal poisons, insecticides, fungicides and herbicides) – commercially manufacturing, blending, mixing or formulating pesticides.
36. Petroleum or petrochemical industries or storage, including oil production and operating a petroleum depot, terminal, blending plant or refinery, retail or commercial refuelling facility, and facilities for recovery, reprocessing or recycling petroleum based materials and bulk storage above and below ground.
37. Pharmaceutical manufacture – commercially manufacturing, blending, mixing or formulating pharmaceuticals, including animal remedies and illicit drug manufacturing.
38. Port activities – including dry docks and ship and boat maintenance facilities.
39. Power stations and switchyards.
40. Printing – commercial printing, using metal type, inks and dyes, or solvents.

41. Railway yards – operating a railway yard including goods-handling yards, workshops, refuelling facilities and maintenance areas.
42. Sawmills – use of anti-sapstain chemicals during milling.
43. Scrap yards – operating a scrap yard including automotive dismantling or wrecking yard or scrap metal yard.
44. Service stations.
45. Smelting or refining – fusing or melting metalliferous ores or refining the metal.
46. Tannery, fellmongery or hide curing – operating a tannery or fellmongery or hide curing works or commercially finishing leather.
47. Transport depots.
48. Storage tanks and drum storage for fuel, chemicals and liquid waste.
49. Waste storage, treatment and/or disposal including land disposal of wastes, but not the use of biosolids as soil conditioners.
50. Wood treatment and preservation and bulk storage of treated timber.
51. Wool, hide and skin merchants (eg, drying, scouring).
52. Any site that has been, or could be, subject to the migration of hazardous substances from hazardous substances present in soil or water on adjacent sites.
53. Any other facility or activity that stores, uses or disposes of hazardous substances, in sufficient quantity that intentional or accidental discharge of the substance could be a risk to human health or the environment.

Abbreviations / Glossary

ADI	Acceptable daily intake. Estimated daily amount that can be taken into the body without any detrimental health effects occurring, based on available scientific information. May also be referred to as a reference dose (RfD). Applies to food additives and veterinary drug residues
Acceptable risk level	Regulatory-defined acceptable level of increased risk associated with exposure to contaminants
Background exposure	Exposure to contaminants from background sources including food, water and air
BaP	Benzo(a)pyrene
BCF	Bio-concentration factor
BMD_x	Benchmark dose – the lowest dose, as estimated from an appropriate model, at which a given (x) excess tumour incidence occurs; used for oral exposure data
$BMDL_x$	Benchmark-dose lower bound – the lower confidence limit of the estimated benchmark dose (BMD), provides an upper-bound estimate of the slope factor; used for oral exposure data
Carcinogenic potency	Estimates of the potency of non-threshold contaminants, may be expressed as a slope factor (risk/mg/kg bw day) or risk specific dose (mg/kg bw day) or similar
CCA	Chromated copper arsenate
CLMG	Contaminated land management guideline
EFSA	European Food Safety Authority
FAO	Food and Agriculture Organization
Genotoxic	Direct or indirect damage to the DNA molecule – may lead to mutations or cancer
HAIL	Hazardous Activities and Industries List. A list of industries and activities considered likely to manufactured, stored or used hazardous substances. List may be used as a trigger for investigating a site, and identifying possible contaminants. The full list is attached in Appendix 4.
Index dose	Estimated daily amount that can be taken into the body without exceeding an acceptable risk level for a non- threshold contaminant based on available scientific information. Also referred to as the risk-specific dose
JECFA	Joint FAO/WHO Expert Committee on Food Additives
JMPR	Joint FAO/WHO Meeting on Pesticide Residues
LOAEL	Lowest observable adverse effects level
MfE	Ministry for the Environment (NZ)
NES	National environmental standard – a regulation under the Resource Management Act 1991
NHMRC	National Health and Medical Research Council (Australia)
NOAEL	No observable adverse effect level
Non-threshold contaminant	Contaminant for which toxic effects are considered to occur at any level of exposure
PAH	Polycyclic aromatic hydrocarbon

PCP	Pentachlorophenol
PEFs	Potency equivalence factors
PHARMAC	Pharmaceutical Management Agency of New Zealand
PTWI	Provisional tolerable weekly intake
Permitted	The activity does not require resource consent under the RMA provided the standards, terms or conditions specified are complied with
Phytotoxic	Concentration at which contaminants are toxic to plants
PTWI	Provisional tolerable weekly intake
QALY	Quality adjusted life years
RfC	Reference concentration – an estimate (with uncertainty spanning perhaps an order of magnitude) of a continuous inhalation exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime. It can be derived from a NOAEL, LOAEL, or benchmark concentration, with uncertainty factors generally applied to reflect limitations of the data used. Generally used in the US EPA's non-cancer health assessments
RfD	Reference dose – an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily oral exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime. It can be derived from a NOAEL, LOAEL, or benchmark concentration, with uncertainty factors generally applied to reflect limitations of the data used. Generally used in US EPA's non-cancer health assessments – analogous to the tolerable daily intake
RHS	Reference health standard – any value set by a regulatory or advisory body that provides an estimated daily (sometimes weekly or monthly) amount of a substance that can be taken into the body without either any or an unacceptable additional risk of detrimental health effects occurring (based on available scientific information), eg, tolerable daily intake, reference dose, drinking water standard
Restricted discretionary	A resource consent is required under the RMA. The consent authority may decline the consent, or grant it subject to conditions, but only on matters to which it has restricted its discretion.
RIA	Regulatory impact assessment
Risk-specific dose	Estimated daily amount that can be taken into the body without exceeding an acceptable risk level for a non- threshold contaminant based on available scientific information – also referred to as an index dose
RMA	Resource Management Act 1991
$SGVs_{(health)}$	Soil guideline values for human health as defined in section 8 and table 3 of this document.
SSGV	Site-specific soil guideline value
Slope factor	Plausible upper-bound estimate of the probability of an individual developing cancer as a result of a lifetime of exposure to a particular level of a potential carcinogen
TDI	Tolerable daily intake. Estimated daily amount that can be taken into the body without any detrimental health effects occurring based on available scientific information. May also be referred to as a reference dose
TEFs	Toxicity equivalence factors

TEQ	Total toxic equivalent value
Threshold contaminant	Contaminant for which toxic effects are considered to occur if exposure exceeds a threshold concentration
WHO	World Health Organization

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