

# Cost-Benefit Analysis of the Proposed NES for Assessing and Managing Contaminants in Soil to Protect Human Health

Prepared for

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Ministry for the Environment

**Authorship**

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# Executive Summary

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This report provides a cost-benefit analysis of the proposed National Environmental Standard (NES) for assessing and managing contaminants in soil to protect human health. The proposed NES would introduce required planning controls for land affected by contaminants, including a set of soil contaminant thresholds that would define an acceptable level of protection for human health.

The expected impacts of the NES are compared with a counter-factual scenario in which the proposed NES is not formally implemented. In this counter-factual scenario, the contamination standards and planning controls contained within the proposed NES would be published by the MfE as guidelines only. An economic cost-benefit analysis framework is used to assess the net overall impact of the proposed NES in contrast to the outcomes that would arise under this counter-factual.

The impacts of the proposed NES would vary across the country. The NES would be expected to result in contamination rules and standards that are stricter in areas where councils currently have no such rules or standards and are unlikely to introduce any. In other areas, where councils have already implemented contaminated land rules and standards, the NES could result in standards that are comparable or more lenient for some contaminants. Thus the costs and benefits would vary across the country.

## Costs of NES

The proposed NES would impose several costs. The main administrative costs that would be generated by the NES would be the cost of upgrading information systems that would identify potentially contaminated sites. Such upgrades are not a requirement of the NES and councils already have an obligation under the Resource Management Act to address issues of potential contamination that could affect human health. While councils that fail to adequately identify at the time of issuing development are already exposed to an increased risk of litigation, some councils consider that the NES increases this risk. Consequently, the NES may cause these councils to improve the way they identify and manage the information relating to contaminants on land, for instance by consolidating relevant information across the council in one specific database.

The main potential costs for private landowners would arise in areas where the NES led to the introduction of stricter standards than would otherwise be the case. Here, the greater focus on identifying and dealing with potentially contaminated land could mean that landowners face higher investigation and remediation costs than if the NES were not implemented. This situation would be most likely to arise in areas where there are not, and are unlikely to be, any specific contaminated land rules in District Plans. This is because in the absence of the NES some potentially contaminated sites in these areas may be developed without consideration of possible contamination.

In the event that remediation costs for some sites are higher because of the NES, landowners may decide not to develop these sites. Although landowners would not

incur any additional expense in this situation, the value of the affected property may well be reduced. This is because the presence of un-remediated contamination may become public knowledge through council records.

### **Benefits of NES**

The introduction of the proposed NES would generate several benefits to society. For instance, if the NES were not introduced a large number of councils that do not currently have specific contaminated land rules in their District Plans are likely to implement their own rules. Some may also develop their own specific contamination standards. Doing so would incur time and expense, particularly as the technical nature of contaminated land issues means that many councils may decide to engage external consultants for this process. Introducing the proposed NES would avoid these costs.

Avoiding this Plan change process would also reduce the costs that would be incurred by interested parties that would otherwise make submissions. Such parties range from individual residents to large organisations and industries, such as Horticulture New Zealand and Federated Farmers.

The proposed NES is also likely to decrease resource consent costs for both councils and landowners. This is because the NES would reduce the scope for disagreements and disputes about the appropriate use of the different guideline values currently available. Improved certainty would be expected to reduce the frequency of costly legal disputes.

The proposed NES would also ensure that the removal of petroleum storage tanks ('tank pulls'), typically from former petrol station sites, would be a permitted activity. Currently, this activity is a controlled activity in a number of territories. This change would reduce resource consent applications costs for landowners in those areas that would otherwise require consent. This analysis assumes that this change would only occur as a result of the proposed NES.

Improvements in addressing the management of contaminated land brought about by the NES would also be expected to reduce the inappropriate development of contaminated sites. This would generate several positive impacts, including:

- reducing exposure to toxic contaminants;
- avoiding post-development disputes between landowners and councils;
- reducing the need for costly post-development remediation and public health responses by local and central government agencies; and
- potentially improving environmental outcomes.

By reducing the exposure to contaminants, the NES could generate public health benefits in the form of fewer illnesses and the associated loss of life (or quality of life for non-fatal illnesses), and avoid the costs of treatment.

Although exposure to extremely high doses of harmful contaminants may cause immediate, acute illness, the more commonly expected benefit from reduced exposure to soil contamination is likely to be fewer cases of chronic illnesses, eg cancer or liver

damage. Chronic illnesses such as these are most likely to occur after some latency period subsequent to initial exposure. Consequently, the majority of the public health benefits from the NES are not expected to arise until well into the future.

### **Uncertainty regarding the magnitude of costs and benefits**

Although the costs and benefits that would arise from the NES can be readily identified, there is a high degree of uncertainty about the magnitude of these impacts. This has severely constrained the ability of this analysis to generate quantitative estimates of some of these potential effects over the time period used for this analysis, 20 years. Consequently, the quantitative estimates produced by this analysis should be considered as indicative only.

In particular, little is known about a number of variables that could have a significant impact on the magnitude of additional remediation costs and public health benefits that may be generated by the NES over the next 20 years. The major areas of uncertainty relate to the amount of contaminated land that would be affected by the NES, how it would otherwise be dealt with and how the NES could alter the risks of illness to residents of such sites. Specifically, it is difficult to predict:

- the total area of land developed for residential use in the future that may potentially be contaminated because of previous use and where this land is located;
- the area of this potentially contaminated land that would be identified as such by councils and investigated for actual contamination in the absence of the NES;
- the proportion of land area with levels of contaminants that exceed the soil guideline values specified in the NES, as well as the specific contaminants and the actual levels at which they are present;
- whether any contamination would be addressed by remediation or some other, potentially less costly, approach (eg altering the location of buildings);
- the approach or method the landowner would choose to manage the risk on his land (clean up often more costly than containing the contaminants on-site);
- the level of risk that residents would face if they were exposed to the contamination currently present on this land; and
- the number of individuals that would subsequently develop illnesses because of exposure to this contamination, what these illnesses would be, when they would occur, and whether these illnesses would be fatal.

### **Estimates of costs and benefits**

Despite the high degree of uncertainty regarding these key aspects and the difficulties in obtaining useful data regarding these variables, this analysis nevertheless attempts to provide quantitative estimates of the potential magnitude of the costs and benefits outlined above. Where useful data are not available these estimates are largely based on discussions with selected stakeholders as well as anecdotal evidence acquired by MfE officials. Additionally, given the restricted timeframe for undertaking this analysis, the degree of consultation with stakeholders about the suitability of these assumptions has been limited. Nevertheless, the assumptions used in this analysis are considered by those consulted to represent the most likely scenario.

Based on these assumptions, this analysis suggests that, over the next 20 years, the proposed NES could generate total benefits for the wider community that are similar in magnitude to the total costs. This outcome is summarised in Table 1 below. This shows that, assuming the most likely scenario regarding the area of contaminated land affected by the NES (ie around 100 hectares), the total estimated costs of the NES could be in the order of \$6.5 million to \$7 million. The total estimated benefits could be in the vicinity of \$4.5 million to \$10 million.

However, of note is that these estimates are sensitive to the assumptions used in the analysis. In particular, these estimates vary depending on assumptions regarding: the amount of contaminated land affected by the NES; and the reduction in risk from reduced exposure to contaminants and the resulting number of fatal illnesses subsequently avoided.

Table 1: Estimated costs and benefits of NES compared with counter-factual (ie NES as guidance only)

<b>Certainty</b>	<b>Estimated Benefits</b>	<b>Estimated Costs</b>
High	Avoided Plan change costs for councils • \$1 million	Information systems upgrade • \$0.5 – 1 million
	Avoided Plan change submission costs • \$1.5 million	
	Reduced consent application costs (eg disputes regarding SGVs) • \$0.5 million	
	Avoided consent costs for tank pulls • \$1 - 2 million	
Low	Avoided contamination response costs for councils, Govt • \$0 – 2 million	Increased remediation costs • \$4.5 million
	Avoided public health costs • \$0 – 1.5 million	Increased consent application and investigation costs • \$1 million
	Avoided post-development remediation costs • \$0 – 0.5 million	Reduced property values • \$0 – 0.5 million
	Avoided post-development dispute costs • \$0.5 - 1 million	
	Potential environmental benefits • Unquantified	
<b>Totals</b>	<b>Benefits</b> • <b>\$4.5 – 10 million</b>	<b>Costs</b> • <b>\$6 – 7 million</b>

These costs and benefits are estimated over a 20 year period. Future impacts are discounted at 8%.

The estimates used in Table 1 are based on Statistics New Zealand’s medium population growth scenario. This assumes that the population will grow by around 16% by 2031, to

5.1 million people. The corresponding amount of contaminated land that would be affected by the NES would be around 100 hectares. By ensuring that this contaminated land was appropriately addressed, the NES could prevent an estimated 1,685 individuals from being exposed to harmful contamination over the next 20 years.

However, using the low growth scenario (4% growth to 4.5 million) only around 50 hectares may be affected. Consequently, the estimated total costs of the NES could range around \$4 million, with the estimated total benefits potentially being around \$4 million to \$8 million, see Table 2 below. In contrast, using the high growth scenario (29% growth to 5.8 million) around 250 hectares of contaminated land may be affected by the NES. This leads to estimated total costs of in the order of around \$15 million, with estimated total benefits ranging up to \$12 million.

These figures indicate how the estimates generated by this analysis are sensitive to the area of land that is affected by the NES over the next 20 years. Another factor that has a crucial influence on this analysis is the extent to which the risk of illness would be reduced by the NES and, as a result, the expected number of fatalities that would be avoided.

Table 2: Estimated costs and benefits, alternative population scenarios

Estimate	Population Growth Scenario		
	Low	Medium	High
Benefits	\$4.5m - \$9m	\$4.5m - \$10m	\$4.5m - \$12m
Costs	\$3.5m - \$4m	\$6.5m - \$7m	\$15.5m - 16m

The main factor which accounts for the proportionately larger differences in costs as opposed to benefits relates to the timing difference of when the major costs (ie remediation costs) are incurred as opposed to when some of the major benefits (ie public health benefits) are obtained. Specifically, remediation costs are estimated for the 20 year period of the analysis until 2031. In contrast, although the NES would avoid exposure to contamination over this same 20 year period, because of a latency period of potentially 10 to 20 years between exposure and the onset of chronic illnesses such as cancer, the public health benefits would not be expected to arise until later, eg 20 to 40 years into the future. Because of the discounting of these future impacts, any increase in the number of contaminated sites affected by the NES leads to a disproportionate increase in site investigation and remediation costs compared to public health benefits arising from reduced instance of future illnesses.

Another crucial factor to which this analysis is sensitive is the assumption regarding the degree to which addressing contaminated sites would reduce the incidence of future illnesses. In the absence of site-specific information, this analysis assumes that the risk of chronic illness could be as high as one in 1,000 for residents of contaminated sites. The introduction of the NES is assumed to reduce this risk to around one in 100,000. Consequently, the estimates outlined above in Table 2 are based on the number of avoided fatalities ranging from between zero and five (the number of fatalities avoided in the medium growth scenario ranges from zero to two).

However, these estimates may not account adequately for the possibility that the NES could avoid one or more major contamination incidents involving highly toxic sites that could result in a number of additional fatalities. Because the degree of contamination present on sites that may be developed in the future is unknown, and because little is known in advance of how these sites may be used and the nature of any potential future exposure, it is difficult to predict the reduction in exposure to contaminants that could occur because of the NES.

As a result, the estimates above may not sufficiently incorporate an unlikely, but possible, outcome in which there is a much higher number of fatalities caused by exposure to contaminants at highly toxic sites if the NES were not introduced. In this regard it is useful to consider some specific examples that came to light in the last few years of potentially highly contaminated sites being developed without adequate remediation or management. These include:

- Establishment of childcare centre which had a vegetable garden on the site of a former gasworks in Auckland;
- A number of former sawmill sites contaminated with dioxin and PCP that were re-zoned residential or rural residential without any clean-up, some of which have people living on them;
- Former landfill sites in Christchurch, Napier, Seatoun, and Otaki that were subdivided for residential land use;
- A closed landfill in Taranaki, that is now a park, where earthworks exposed potentially highly contaminated material and that required extensive testing and community consultation;
- Former farm land subdivided for high-density housing in Hamilton that contained a sheep dip contaminated by dieldrin; and
- Residential development on ex-horticultural soils with varying level of DDT, dieldrin, arsenic and lead. Instances have occurred in the Auckland region, Tasman and Hawke's Bay areas.

If one or more instances similar to these were repeated,, there is the risk that exposure to high levels of dangerous contamination could result in the poisoning and subsequent death of a greater number of individuals than have been estimated in this analysis. This would have a substantial impact on the benefits as estimated in this analysis. For instance, if the exposure to dangerous contamination led to an additional five fatalities, the estimated total benefit of the NES could increase by up to \$4 million.

## **Conclusion**

Given the high degree of uncertainty regarding the potential magnitude of several key impacts of the proposed NES, this analysis is not able to provide a strong conclusion as to whether or not the NES is likely to generate a net benefit to society. However, this analysis does suggest that, based on what is considered by stakeholders to be the most likely scenario, the magnitude of costs and benefits arising from the NES are expected to be broadly similar.

The impacts of the NES are expected to be more prevalent in rural areas given that a number of councils in larger urban centres already have in place either explicit contaminated land rules or processes to address potential contamination. This analysis also indicates that many of the costs imposed by the NES are likely to occur in advance of the benefits, which may not accrue until sometime further into the future.

Overall, a large proportion of the costs of the NES are expected to fall on landowners, as these individuals would be responsible for assessing and remediating soil contamination. The benefits of the NES are expected to accrue across the wider community, particularly the public health benefits of reduced risk of contamination-related illnesses. Fewer contamination incidents would also reduce costs to central government, and ultimately taxpayers. The impacts would differ across territorial authorities. Some would be largely unaffected while others would experience both costs and benefits (in the form of cost-savings) to differing degrees. Because the NES may reduce the risk of central and local government agencies having to respond to contamination issues by requiring more landowners to effectively remediate contaminated land, the NES may be perceived to lead to more equitable outcomes. This is because landowners, who gain from developing their properties for residential use, would be more likely to face the true costs of developing this land to a level that meets the expected safety standards.

# 1. Introduction

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This report applies a cost-benefit analysis framework to the proposed NES for assessing and managing contaminants in soil.

## 1.1. Background

MfE has carried out work to address gaps in the management of contaminated land. As a result of its work, MfE intends to ensure that greater central government leadership and direction concerning contaminated land be provided to councils through national environmental standards (NES) and supporting guidance.

If implemented the NES would provide planning controls for land affected, or potentially affected, by contaminants in soil, including a set of soil contaminant thresholds that would define an acceptable level of protection for human health. The NES would enable an economic use to be made of contaminated land by setting standards to ensure that:

- district planning controls are adequate and consistent (present controls are sometimes either absent or variable);
- councils will gather the information needed for efficient decision-making on contaminated or potentially contaminated land (present practice is judged as being seriously deficient);
- the soil guideline reference values used in New Zealand are scientifically defensible and appropriate to the circumstances (present practice is highly inconsistent).

The national set of soil guideline values (SGVs), methods for applying them, and district planning controls have been drafted in support of the proposed NES.

## 1.2. Proposed NES

The proposed planning controls within the NES for soil contaminants include:

- Permitted activity status (ie resource consent not required) for:
  - The removal of underground petroleum storage systems and associated impacted soil (under certain requirements);
  - Small scale and temporary soil disturbance activities, including subsurface investigations.
- Controlled activity status (ie resource consent required but cannot be denied) for the use, development, or subdivision of land where, on investigation, the risk to human health has been confirmed as being acceptable for the intended land use.
- A restricted discretionary activity status (ie resource consent required) for any use, development, or subdivision of land where the risk to human health from soil contamination exceeds the soil guideline value for the intended land use.

The NES also sets out soil contaminant levels that define concentrations of contaminants at or under which the risk to human health are considered acceptable. Territorial

authorities will be responsible for giving effect to, and enforcing, the requirements of the NES.

### **1.3. Analytical framework**

To ensure an accurate cost-benefit analysis of the proposed NES, all of the likely impacts that would result from its introduction need to be identified. Once the likely impacts have been identified, the potential magnitude of these impacts on the wider community is estimated where possible.

Because the cost-benefit analysis is applied from the perspective of society as whole, only those costs imposed on (or benefits received by) one party that are not offset by benefits (or costs) to another party are included. These ‘transfers’ from one party to another do not generate a net impact on the overall welfare of society and so do not impact on the estimated costs and benefits. Although transfers have no net impact on welfare, they can raise equity concerns, however. For this reason, any potentially significant equity concerns arising from the proposed NES are discussed.

In accordance with conventional economic analysis, costs include the value of additional resources that would be utilised as a result of implementing the proposed NES. The use of such resources in this manner generate ‘opportunity costs’ to society if these resources could otherwise be put to an alternative use.

#### **1.3.1. Status quo**

The cost and benefits included in this analysis are those that would only occur if the NES were implemented. Any impacts that would occur both with the NES and under the status quo are not relevant and are not analysed. For example, some territorial authorities have already instituted rules and standards that may result in outcomes that are similar to those that would result from the proposed NES. Consequently, these areas are less likely to incur any significant additional administration and/or compliance costs or obtain any additional public health and environmental benefits from the proposed NES. This is because the existing standards generate similar results to those that would result from the NES. Similarly, if the NES were not formally introduced, but the soil guidelines values it includes were instead published as guidance, areas that already have robust contaminated land rules may face the same outcomes as if the NES were introduced.

In contrast, a majority of territorial authorities do not currently impose effective rules, and therefore standards, for dealing with contaminated land. If the NES were not introduced, and even if the standards it contains were published as guidance, these areas may have significantly different outcomes compared to what would occur with the NES.

The extent to which outcomes in these areas would differ depends on what would occur if the NES were not introduced. For instance, without the NES some councils would be likely to carry out their own analysis and implement their own rules. Thus, the status quo with which the proposed NES is compared against is not static. Consequently,

potential changes in outcomes under the status quo that would be expected over time have been incorporated into this analysis.

One of the important changes that would be expected to occur if the NES were not formally introduced relates to some of the material within the proposed NES (ie a number of soil guideline values (SGVs) and methodology to determine site-specific SGVs). Even if the NES were not formally adopted, these aspects would be used to update the relevant sections of the existing MfE guidance. In the areas where councils have already instituted contaminated land rules, the updated guidance would effectively set new standards. Nonetheless, it would take up to ten years until the new rules would be incorporated in District Plans (ie based on the normal review cycle). As a result, whether or not the NES were formally introduced or were instead released as guidance would not have any major impact in these areas in the long-term.

To the extent that areas without contaminated land rules would introduce their own rules over time, the NES may also have a limited impact compared with the status quo (ie no NES). The extent of any impact depends on whether the rules developed in these areas would be different to those in the proposed NES.

The NES would have the most impact in those areas that do not have any specific rules currently, and would be unlikely to impose similar rules in the future. The councils in these areas may also be less likely to identify sites that are potentially contaminated if the NES are not introduced. For these areas, the NES would force these councils to address contaminated land issues to a much greater extent.

### **1.3.2. Discount rate**

To ensure that future impacts are compared appropriately against current impacts, future impacts quantified in monetary terms have been discounted. The rate used for discounting future impact in this analysis is 8%. This is consistent with that used by the Treasury for cost-benefit analysis of public sector projects.<sup>1</sup> To evaluate the sensitivity of this analysis to the choice of discount rate, alternative rates of 5% and 3.5% are also used as a comparison in the sensitivity analysis.<sup>2</sup>

### **1.3.3. Barriers to quantitative analysis**

Although the quantitative estimation of some impacts of this proposed NES cost-benefit analysis is relatively straight-forward, there are a number of uncertainties regarding other aspects of this analysis.

Specifically, there is a high degree of uncertainty regarding:

- the amount of land that would be developed for residential use in the future (which would be largely dependent on the rate of population growth);

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<sup>1</sup> The Treasury, "Public Sector Discount Rates for Cost Benefit Analysis" July 2008.

<sup>2</sup> That the US Environmental Protection Agency used rates of 7% and 3% for its sensitivity testing in its analysis of proposed regulations for arsenic in drinking water. See "Arsenic in Drinking Water Rule: Economic Analysis" prepared by Abt Associates Inc, 2000. The UK Treasury Green Book uses 3.5% as a Social Time Preference Rate.

- the amount this land used for development that could potentially be contaminated because of previous use and where this land is located;
- the amount of this potentially contaminated land that would be identified as such by councils and investigated for actual contamination in the absence of the NES;
- the amount of this potentially contaminated land which has levels of contaminants that exceed the soil guideline values specified in the NES, as well as the specific contaminants and the actual levels at which they are present;
- whether any contamination would be addressed by remediation or some other, potentially less costly, approach (eg altering the location of buildings);
- dependent on the contaminant type and concentration, the level of risk that residents would face if they were exposed to the contamination currently present on this land; and
- the number of individuals that would subsequently develop illnesses because of exposure to this contamination, what these illnesses would be, when they would occur, and whether these illnesses would be fatal.

The high degree of uncertainty and difficulty obtaining useful data regarding these aspects has constrained this analysis.

As a result, this analysis attempts to quantify the expected costs and benefits using assumptions based on discussions with selected stakeholders, including some councils and industry operators, as well as officials from MfE and the Ministry of Health. The limited timeframe for this analysis has constrained the level of consultation regarding the validity of these assumptions and some of the methods used to generate impact estimates. Sensitivity analysis also suggests that these estimates are sensitive to different assumptions regarding a number of the unknown factors listed above. Consequently, the estimates generated by this analysis should be considered as indicative only, and could be prone to alteration should more information become available.

## 2. Potential Effects of the Proposed NES

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Before evaluating the costs and benefits of the proposed NES, it is necessary to consider what outcomes are likely to result from its implementation and how these would differ from what would otherwise occur. Whether the NES would lead to different outcomes in any given area largely depends on how different the NES would be from the rules and standards that are currently imposed, and would otherwise be imposed in the future, by the relevant councils in that area.

Currently, councils implement soil contamination standards (where these have been promulgated) through Plan rules or Bylaws. The NES would provide planning controls for affected land, including a set of soil contaminant thresholds that would define an adequate level of protection for human health. Each territorial authority would be required to enforce the same standard. However, district and especially regional councils would continue to be able to apply stricter standards for environmental purposes.

Because the assessment and treatment of soil contaminants differs across councils, the impact of the NES is likely to differ across different locations. There are three scenarios that are relevant. These are:

1. The NES would impose resource consent rules and soil standards that are the same, or largely similar, to those that would be applied by the local authorities;
2. The NES would impose rules and standards that are more conservative than would otherwise exist (including where councils currently have no rules or standards regarding potential contamination and are unlikely to introduce any that are as comprehensive as those in the proposed NES); or
3. The NES would effectively result in standards that are less conservative than would otherwise be applied.

Regarding rules concerning potentially contaminated land, only around two-thirds of District Plans contain general objectives or policies, and only around a quarter contain specific rules. In the absence of the NES, the MfE would be expected to publish the soil guideline values from the proposed NES as guidance. Some councils would then be likely to introduce their own contaminated land rules, which in most cases are likely to mimic the rules in the guidance. Other councils may continue with the rules they already established. However, other councils would continue without specific rules, or may introduce rules that are not as comprehensive as those in the proposed NES.

As well as rules, a small number of councils have also established specific contamination standards, eg Auckland City Council. In other areas appropriate contamination levels are calculated using a mixture of domestic and international guidance. If the NES are introduced, the standards it sets out for the protection of human health would supersede those being currently used for that purpose. Consequently, depending on the standards that would otherwise be applied if the NES were not introduced – which differ across the country, the new standards for some contaminants are likely to be more strict (eg arsenic) and for others, the NES could result in more lenient standards (eg DDT).

This means that the effect of the NES would also depend on the particular contaminant of concern at any given site.

## **2.1. Nationwide effects of NES**

The proposed NES is likely to have some specific effects irrespective of the contaminated land rules currently imposed by councils. For instance, the number of disputes that may arise between landowners and councils regarding the councils' consenting of activity on contaminated land may fall. This is because the NES would create greater certainty regarding whether the assessment and remediation requirements required by territorial authorities were appropriate.

Consequently, the proposed NES are likely to reduce the scope for disagreement between local authorities and landowners and reduce the costs, both administrative and compliance, associated with the resource consent process.

Because the NES would automatically overwrite existing Plan rules, there would be no direct plan change costs imposed on councils.<sup>3</sup>

### **2.1.1. Where NES would be similar to current rules and standards**

Where the rules in the proposed NES and councils' current rules are largely similar, the introduction of the NES is unlikely to lead to any significant impacts. This is because if the NES are not introduced but instead released as guidance, these standards are likely to be adhered to in these areas. Consequently, in these areas the outcomes expected under either situation would not be significantly different.

### **2.1.2. Where NES would be stricter than current rules or standards**

There may be a number of impacts from the NES in areas where either:

- councils would not otherwise impose specific contaminated land rules; or
- councils' contaminated land rules would not be as comprehensive as those proposed in the NES; or
- the proposed NES contains stricter soil standards than councils' own standards.

In these cases the NES would effectively lead to stricter standards for dealing with contaminated land.

Of note is that only 18 out of 73 councils feature specific rules in respect of contaminated land.<sup>4</sup> However, many of these district plans are to be reviewed in the near future, with approximately 50 district plans to be reviewed in the next two years. These revisions will also incorporate the relevant amendments to the RMA which introduced a contaminated land definition and specific functions for local government.<sup>5</sup> Consequently, introducing the proposed NES would prevent many of the councils that do not currently have rules from having to carry out the necessary work and

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<sup>3</sup> Section 43B, RMA.

<sup>4</sup> MfE study, 2006.

<sup>5</sup> Resource Management Amendment Act 2005.

consultation relating to Plan changes. In the absence of the NES, some councils may also carry out a substantial amount of work not just in determining what their rules should be but also to establish their own contamination standards. This expense would also be avoided if the NES were introduced.

Additional effects include reduced costs to industry and NGO groups of submitting and appealing Plan provisions. These parties would not be engaged in consultation processes for every council that proposes amending their treatment of contaminated land.

The introduction of more robust rules and, consequently, stricter standards from the proposed NES could also result in significant impacts for some landowners. Where there are currently no specific rules and standards, and such rules would not be likely to be imposed in the absence of the NES, the NES could result in some landowners incurring greater assessment costs when seeking to develop contaminated land. These costs could arise if councils in these areas would not have otherwise required detailed soil assessments.

Another potential effect of this change could be the increase in the number of sites that need remediation and hence the total costs faced by landowners wishing to develop affected land. This could occur if councils would not otherwise require the potential contamination of a site to be addressed. This could also occur if the soil guideline values (SGVs) stemming from the NES are stricter than those from existing guidelines for contaminants of concern, eg arsenic. Sites that are identified as being contaminated could be dealt with in different ways. Specifically, landowners may decide:

- to avoid high remediation costs brought about by soil excavation and disposal by using other methods to reduce the risk of exposure to contaminants (eg a capping or containment option, in conjunction with a site-specific (Tier 2) human health risk assessment and resource consents for any ongoing management);
- not to develop the land and continue using it for existing uses because increased remediation costs make development unviable; or
- to develop the land in the same manner as they would have in the absence of the NES despite having to incur higher costs for remediation.

It is not possible to determine which of these outcomes would occur in relation to any given contaminated site. For instance, if higher remediation costs compromise the commercial viability of developing particular sites, the current uses of these sites may continue. Because there is no requirement for contaminated land to be assessed or remediated if there is no change to its use, persons who currently inhabit these sites may continue to be exposed to any contamination. However, it is more likely that once landowners are aware of contamination risks they would alter the use of their property to reduce potential exposure. Health agencies also have the ability to ensure that behaviour is changed or contamination mitigated so as to address any risks arising from contamination.

If any increase in costs for remediation were unlikely to alter landowners' decisions to develop, contaminated sites in these areas would be remediated and developed to the

standards contained in the NES. This would reduce the public health risk associated with these sites.

Early identification of contaminated sites due to the more stringent resource consent checks required by the NES would in turn reduce the risk of incurring more costly remediation after the development has taken place.

Although the NES are targeted at public health impacts rather than environmental impacts, its implementation may also have some impacts on the environment.

### **2.1.3. Where NES would lead to less conservative standards**

In relation to some contaminants, eg DDT, the NES would impose more lenient standards than existing guidelines. This would be unlikely to result in any impact on councils. However, there could be positive impacts for landowners. Consequently, in some areas implementing the NES could effectively reduce the costs associated with remediating affected land. The magnitude of any reduction would depend on the extent to which the standards in the NES differed from standards that would otherwise be applied.

However, it is possible for regional councils to impose stricter standards to protect the environment, if the site assessment shows there may be significant effects on the environment from the contamination. In these cases, regional councils may still require remediation or additional resource consent conditions to be complied with before any development of subdivision can go ahead.

## **2.2. Estimate of sites that would be affected by the NES**

To estimate the degree to which the impact of the proposed NES would differ across specific geographic locations it is useful to consider the locations in which development is likely to take place in the future.

Using Statistics New Zealand's population projections to 2031, along with some broad assumptions regarding the residential development which would be required to house this increased population, we have generated approximate estimates of the amount of land that may be used for such development over the 20 years to 2031. These results are included in Table 3 below.

Table 3: Population increase and new residential land use estimates, for 20 years to 2031

<b>Population increase</b>	<b>New dwellings*</b>	<b>Hectares*</b>
723,320	244,000	20,332

\* Excludes apartments

These estimates assume:

- The average number of people per dwelling is 2.7 (ie current national average);<sup>6</sup>

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<sup>6</sup> Statistics New Zealand.

- Apartments are not included as relevant dwellings. Apartments are assumed to comprise 30% of all new dwellings in:
  - North Shore City,
  - Auckland City,
  - Hamilton City,
  - Tauranga City,
  - Wellington City,
  - Christchurch City,
  - Queenstown-Lakes District, and
  - Dunedin City;<sup>7</sup>
- There is an average of 12 residential dwellings per hectare.

These estimates also account for the fact that the populations in some territories are projected to decrease over this period. This means that proportionally more land would be needed for development in other areas, as population shifts result in residential properties being left vacant in the areas of populations decrease. See Table 11 in Appendix 1 for a full list of expected population increases and residential land use by territorial authority area.

Our estimates suggest that around 11,090 new non-apartment dwellings will be built per year over the next 20 years. By way of comparison, since 2005 the number of non-apartment dwellings built annually has averaged around, 19,600, although this period include years of unusually high residential property building.<sup>8</sup> Over the last two years the rate of non-apartment residential building has been between 12,000 and 15,000.

Of the approximately 20,300 hectares of land that may be developed for new dwellings, around 73% (14,800 hectares) would occur in areas where the territorial authority either already has, or is expected to have, robust contaminated land rules, regardless of whether or not the NES were introduced. For instance, 57% of all future (non-apartment) residential development is expected to occur within the soon to be formed Auckland Council area. The Auckland Council is expected to institute robust contaminated land rules as such rules already exist in some of its constituent councils, eg Auckland City Council. Similarly, Wellington City Council also recently introduced comprehensive contaminated land rules.

Consequently, the remaining 27% (5,500 hectares) of land that may be developed would be in areas in which councils do not have, and are less likely to develop, formal systems for assessing potential contamination on sites to be developed for residential purposes.

Also of note is that a number of councils that do not have specific contaminated land rules are unlikely to be the location of any significant residential development. For example, according to Statistics New Zealand population projections, the number of people living in the South Waikato District is expected to fall over the next 20 years.

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<sup>7</sup> This assumption results in an estimated 14% of all new dwellings built over the next 20 years being apartments. In comparison, Statistics New Zealand Building Consents Issued, 2010 indicates that 12% of all new dwelling built since 2005 have been apartments.

<sup>8</sup> Statistics New Zealand, *ibid*.

Hence, the fact that this District does not have any specific contaminated land rules does not affect this analysis.

Table 4: Estimated land developed for residential use in areas without contaminated land rules

<b>Territory</b>	<b>Population increase</b>	<b>New dwellings</b>	<b>Hectares</b>
Far North District	1,000	370	31
Hamilton City	36,200	9,385	782
Waipa District	5,700	2,111	176
Western Bay of Plenty District	9,900	3,667	306
Tauranga City	38,200	9,904	825
New Plymouth District	2,500	926	77
Manawatu District	2,700	1,000	83
Palmerston North City	11,400	4,222	352
Kapiti Coast District	10,300	3,815	318
Porirua City	2,900	1,074	90
Lower Hutt City	1,600	593	49
Tasman District	5,300	1,963	164
Nelson City	4,000	1,481	123
Marlborough District	2,900	1,074	90
Kaikoura District	100	37	3
Hurunui District	1,300	481	40
Waimakariri District	15,800	5,852	488
Christchurch City	45,100	11,693	974
Ashburton District	2,600	963	80
Mackenzie District	50	19	2
Central Otago District	2,000	741	62
Queenstown-Lakes District	13,500	3,500	292
Dunedin City	4,900	1,270	106
<b>TOTAL</b>	<b>219,950</b>	<b>66,141</b>	<b>5,512</b>

Of the estimated 5,500 hectare of land (ie 66,000 non-apartment dwellings) to be developed for residential purposes in these territorial areas, some proportion would give rise to potential contamination issues. Based on figures supplied by Auckland and Hamilton City Councils, approximately 10% of resource consent applications for the development of land give rise to potential contamination issues. Applying this proportion to the 5,500 hectares estimated above suggests that around 550 hectares could give rise to contamination concerns.<sup>9</sup>

<sup>9</sup> Given that the proportion of sites that are potentially contaminated is likely to be higher close to urban areas, such as Auckland and Hamilton, because of greater levels of economic activity historically, this 10% proportion may overestimate the rate of potentially contamination sites in more rural areas.

In many instances, councils would require potential contamination issues be addressed, even if these councils do not have specific contaminated land rules. In particular, Christchurch City, Hamilton City, Tauranga City, Dunedin City and Tasman District Councils have some processes for addressing potential contamination. However, anecdotal evidence gathered by MfE suggests that a substantial proportion, perhaps on average around one third of all the sites within the territories listed in Table 4, are likely to be provided with resource consent for development without any consideration of potential contamination issues.<sup>10</sup> This amounts to around 200 hectares of land, housing 2,300 dwellings.

Of this 200 hectares for which contamination issues may not be considered, only some proportion would be likely to have soil contamination in excess of the SGVs. In advance of any investigation of such land it is impossible to know what proportion would contain harmful levels of contamination. Based on discussions with Auckland City Council and data from a study carried out on former horticultural land in the Auckland Region, we have assumed that around half of these sites may have levels of contamination that would present a danger to human health and require some form of remediation or management.<sup>11</sup> This suggests that perhaps around 100 hectares of land that contains ‘excessive’ contamination, housing around 1,200 dwellings, would go unremediated if the NES were not introduced. This analysis assumes that 100 hectares equates to 100 separate one hectare sites.<sup>12</sup>

Table 5: Estimate of land potentially affected by NES

	<b>New dwellings</b>	<b>Hectares</b>
Nationwide	244,000	20,332
In areas of no rules	66,141	5,512
Potentially contaminated	6,614	551
Not identified by council	2,315	193
Harmful contamination	1,157	96

This estimate is based on the Statistics New Zealand’s medium growth projection for 2031. If the low growth projection is used instead, which assumes that New Zealand’s population rises by 4% to 4.5 million, only around 50 hectares may be affected. Conversely, if the high growth scenario is used (29% growth to 5.8 million), the amount of land affected is estimated to be around 250 hectares. Further detail of sensitivity

<sup>10</sup> This assumes that a much greater proportion of potentially contaminated land would be addressed in councils that have some system of addressing contaminated land, even if no formal rules exist (ie 80%). These councils include Christchurch City, Hamilton City, Dunedin City, Tauranga City and Tasman District. The remaining councils are assumed to address a much smaller proportion of potential contamination issues (ie 50%). These assumptions are based on anecdotal evidence obtained by MfE.

<sup>11</sup> Auckland Regional Council and Auckland District Health Board, 2001. See: <http://www.aucklandcity.govt.nz/council/documents/soils/default.asp>

<sup>12</sup> Note that entire sites may not require remediation. For instance, contamination may present a problem only in a specific hotspot, eg a former sheep dip.

testing regarding the rate of population growth expected in New Zealand over the next 20 years, as well as other assumptions, is provided in the Appendix.

Land development on commercial or industrial sites is not considered in this analysis. This is because it is assumed that the contamination risk regarding such sites is already widely known, and many such sites are typically identified and remediated so as to largely minimise any public health risks. Consequently, the introduction of the NES is unlikely to have a material impact on a large proportion of these sites.

## 3. Costs

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A number of the impacts (described in Section 2) that would result from the introduction of the proposed NES would impose some costs, or negative effects, on various members of the wider society. These include:

- any additional administrative costs imposed on councils who would implement the new rules and standards;
- compliance costs incurred by landowners who would need to comply with new rules and standards, eg higher investigation and remediation costs; and
- reductions in value of affected land suffered by landowners for sites that are not subsequently developed because of an increase in remediation costs.

Estimates of the magnitude of these costs are outlined in Table 6. These estimates are discussed in more detail below.

Table 6: Estimate of costs of NES (next 20 years)

<b>Costs</b>	<b>Estimated Range</b>
Information system upgrade	\$0.5 – 1m
Increased consent application and site investigations	\$1m
Increased remediation	\$4.5m
Property value reductions	\$0 – 0.5m
<b>Total</b>	<b>\$6 - 7 million</b>

### 3.1. Administrative costs for councils

Under the RMA, local government has responsibility for controlling the effects of contaminated land and controlling activities that cause land to become contaminated. Section 31 of the RMA gives territorial authorities responsibility for the prevention or mitigation of any adverse effects of the development, subdivision, or use of contaminated land. Therefore, any costs related to these functions are likely to fall at a territorial authority level, rather than at a national level.

If the proposed NES were introduced, councils that do not currently address contaminated land issues would need to carry out new activities in addition to those that they carry out now. These activities would require additional resources, eg additional employees, external consultants, etc.

#### 3.1.1. Costs passed onto landowners

Most of the costs that would be incurred by the NES under controlled or restricted discretionary activity rules would be passed onto landowners applying for resource consent in the form of consent application fees. These activities may include carrying out assessments, reviewing assessments and deciding on resource consent applications.

Because these costs are ultimately borne by landowners who must comply with the rules and standards, they are private compliance costs, not public (council)

administrative costs. Consequently, these costs are considered in more detail in the compliance cost section, Section 3.2.

### **3.1.2. Costs borne by Councils**

Although the majority of costs incurred by councils would be passed onto 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 NES). Resources used in administering the NES could otherwise be put to other uses, hence these resources have an opportunity cost.

Additional administrative costs to councils may be generated by the NES to the extent that councils decide to upgrade their contaminated land information systems. Such upgrades are not a requirement of the NES and councils already have an obligation under the Resource Management Act to address issues of potential contamination that could affect human health. While councils that fail to adequately identify at the time of issuing development are already exposed to an increased risk of litigation, some councils consider that the NES increases this risk. Consequently, the NES may cause these councils to improve the way they identify and manage the information relating to contaminants on land, for instance by consolidating relevant information across the council in one specific database.

Some councils may have already budgeted for the cost of putting a sufficient information system in place. Alternatively, the NES may prompt other councils to improve their contaminated land information management systems. For some councils this may be achieved by establishing a new contaminated land database, for others this would require only a minor system upgrade. Such an upgrade may only mean improving council processes by providing better access to all relevant information that could currently be held in different files or locations or with regional councils. These improvements would constitute a one-off cost to these councils.

The magnitude of this cost would be expected to vary across councils. Discussions with various councils suggest that, the costs could be in the order of \$10,000 to \$20,000 for smaller councils, whereas for a small number of larger councils the costs could be in the order of \$100,000 or perhaps more. These costs are likely to be spread over the next two or three years.

Although some councils may carry out such an information system upgrade only because of the NES, others may instead carry out planned upgrades of contaminated land databases sooner than would have occurred without the NES. One such example is the soon to be established Auckland Council. Discussions with staff at various councils within the wider Auckland region suggest that, without the NES, the Auckland Council would be expected to establish an Auckland-wide contaminated land database within the next five years. However, the implementation of the NES is likely to expedite the creation of such a database. This means the expenditure, estimated to be in the vicinity of \$300,000 to \$400,000 would be more likely to be incurred over the next two years, rather than in four or five years time. The net cost of the NES in this context would

equate to the foregone interest associated with this amount, which is in the order of \$100,000 over this period.<sup>13</sup>

Consequently, the total expected costs for all councils could be in the vicinity of \$500,000 to \$1 million.<sup>14</sup> The corresponding benefits associated with these costs include those outlined in Sections 4.7 and 4.6.

The NES would also result in removal of petroleum underground storage tanks ('tank pulls') being a permitted activity in all areas, whereas currently there are a small number of councils for which this activity requires a resource consent. Consequently, any costs of reviewing information provided in relation to tank pulls would be borne by the councils in question as there would be no mechanism to recover these costs. Although this would increase councils' costs, landowners would benefit in the form of reduced resource consent fees. As a result there would be no net impact on the overall costs to the wider community from councils having to incur these costs. There would, however, be a benefit from the fact that landowners would no longer be required to produce Assessment of Environmental Effects reports. This impact is discussed in Section 4.3.

### **3.2. Compliance costs for landowners**

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

- Investigation costs, ie the costs of investigating sites for contamination to determine if resource consents are required;
- Application costs, ie the costs of obtaining resource consent to develop affected land; and
- Remediation costs, ie the costs of managing the risk from contaminated land.

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 in relation. Consequently, whether remediation costs would be affected by the NES depend on a number of site-specific characteristics.

#### **3.2.1. Investigation costs**

When seeking to obtain resource consent to develop land identified as potentially contaminated, landowners' applications would need to be supported by a site investigation report. If the site history indicates that contaminating activities have taken

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<sup>13</sup> This is calculated as 8% on \$400,000 over a three year period.

<sup>14</sup> This is based on average costs of around \$10,000 to \$20,000 per council for around 40 to 50 smaller councils with two or three larger councils incurring \$100,000 in costs. This cost is spread over the next two years.

place the NES requires a further more detailed sites investigation report including soil sampling. This could be done before or in the process of the resource consent application. Such assessments are undertaken at landowners' expense. In areas where soil assessments are already required, the NES 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 MfE Contaminated Land Management Guideline No. 5. Councils also usually require reporting standards according to the MfE Contaminated Land Management Guideline No. 1. The only change would relate to the benchmark that site contamination levels are evaluated against. Hence this would not result in higher assessment costs, but could result in higher or lower potential remediation costs (see Section 3.2.3 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 councils do not have specific rules or processes in place regarding potential 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 to determine there are no contamination issues, eg 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.

Based on a total of 100 contaminated sites affected by the NES (see Section 2.2), and an average subsurface investigation cost of \$12,500, the total increase in investigation costs is estimated to total around \$550,000 over the next 20 years.

### **3.2.2. Application costs**

If the proposed NES 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 application 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 onto landowners in the form of higher council fees for consent applications. The magnitude of 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.

Based on a total of 100 contaminated sites affected by the NES, and an application cost of \$10,000, the total increase in application costs is estimated to total around \$440,000 over the next 20 years.

### **3.2.3. Remediation costs**

The proposed NES could lead to increased remediation costs if they were to lead to the application of more conservative standards, ie in areas where rules and regional or district soil guideline values would otherwise be less conservative or, alternatively, non-

existent. Conversely, remediation costs could be decreased if the NES were to lead to more lenient rules and soil guideline values than would otherwise apply. The precise impact of the proposed NES also depends on various site-specific characteristics, including the type of site and the nature of the remediation work to be undertaken.

Of note is that, were the NES not formally implemented, the soil guideline values and soil guideline value methodology it contains would be released as public guidelines. Although it is likely that these guidelines would supersede existing guidelines in most areas, this may not occur in all locations. This is because in some areas the existing soil guideline values are enshrined in District Plans. This means that any new guidance would not be relevant until the District Plans are amended, which may not occur until the Plans are periodically reviewed, ie every 10 years. In these cases, remediation costs would be likely to change in the short-term only if the NES were introduced.

In other areas, a continued absence of specific contaminated land rules may mean that the risk of contamination on some sites would not be addressed at all unless the NES were introduced. In these cases, the implementation of the NES could lead to much bigger numbers of sites being identified as needing remediation. The resulting remediation costs for these sites could vary from zero, where no remediation occurs, up to \$200,000. For particularly complex sites these costs may be even higher.

Remediation typically consists of some combination of:

- excavation and offsite disposal; and/or
- vertical mixing; and/or
- capping and containing onsite.

Such remediation works are supported by a site investigation, remediation action plan, site validation, or, for capping and containment systems, engineering design. In some instances, ongoing monitoring and a site management plan is required.

Excavation and offsite disposal, aka '**dig and dump**', is the most common approach used for the development of low- or medium-density residential developments in areas that have relatively low levels of contamination. This method involves clearing topsoil, much of which is often excavated in the process of developing such land in any case, ie ground condition improvements. If this topsoil is contaminated, remediation costs typically arise in relation to the disposal of this soil. For instance, the costs of disposing of contaminated soil may range from around \$10 per tonne in cleanfill,<sup>15</sup> to around \$30 per tonne in managed fill and up to \$65 to \$200 per tonne for licensed landfills. The greater the volume of soil that must be disposed, the greater the cost.

Another form of remediation that may be carried out for these types of developments is '**vertical mixing**'. This method mixes contaminated topsoil with less contaminated soil below it so as to dilute the contaminants.

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<sup>15</sup> This cost would be applicable if the soil meets cleanfill soil acceptance criteria. Many cleanfills are not permitted to accept soils that have contamination levels that exceed natural background concentrations.

**‘Capping and containing’** is most typically used in the re-development of former industrial, service station or gasworks sites where there are relatively high levels of contamination. These sites are most commonly re-developed for high-density residential (eg apartment buildings) or for other commercial or industrial activities.

The NES formally incorporates the management (containment) outcome as a legitimate outcome for managing contaminants, providing the controls are adequate. The legitimising of this approach within a national instrument may encourage more landowners to use this option, especially if the costs are lower.

To illustrate how the NES may, or may not, impact on remediation costs, a number of different scenarios are set out below. These are the development of:

1. former timber treatment sites for rural lifestyle use;
2. former horticultural land for medium-density residential land;
3. former service station sites for (medium-density) residential townhouses;
4. new farmhouses adjacent to a former sheep dip sites;
5. former industrial sites for commercial or industrial use; and
6. former gasworks sites for commercial or industrial use.

#### **Former timber treatment site**

These sites are typically located in rural areas. They are most likely to be developed for subdivision into rural lifestyle sections. Generally, the main contaminants of concern for these sites are arsenic, copper, and chromium, with arsenic the most likely limiting contaminant. Occasionally PCP may be the contaminant of concern. A typical size for such a site may be one hectare.

The favoured remediation method for these sites is likely to be excavation and offsite disposal (‘dig and dump’) for hotspots. There is typically a higher level of contamination in the vicinity of the site of former treatment plants, drip pads, etc, with lower levels of contamination in former timber storage areas. Vertical mixing would typically be used for the remainder of the site.

If the NES were introduced, the cost of dig and dump for a typical former timber treatment site would be approximately \$200 per m<sup>3</sup> in relation to contamination hotspots. This cost largely reflects the cost of disposal, as contaminated soil would need to be disposed of safely in appropriate landfills.<sup>16</sup> Assuming a typical size for such hotspots of around 500m<sup>2</sup>, and soil removed down to a depth of one metre on average, the total dig and dump costs may be in the vicinity of \$100,000. This estimate is based on meeting the standard for arsenic set out in the proposed NES.

In contrast, the current standards relating to arsenic would tend to lead to costs of around \$100 per m<sup>3</sup> for hotspots, or \$50,000 in total for a typical site.

The NES could also lead to costs of around \$10.50 per m<sup>2</sup> for the use of vertical mixing, which would be used for former timber storage areas which would constitute most of the remainder of these sites (eg 9,500m<sup>2</sup>). This cost estimate assumes that 0.5m of topsoil

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<sup>16</sup> This cost estimate assumes that the average distance from a landfill is 20 km.

is required pre-mixing to meet the new standards. This would result in costs of around \$100,000 for a normal sized site.

In contrast, the current standards relating to arsenic would tend to lead to vertical mixing costs of around \$7 per m<sup>2</sup> (\$65,000 in total), assuming imported topsoil would not be required. Note that trials may indicate that the proposed NES SGVs cannot be achieved in former timber storage areas by vertical mixing. In this case, dig and dump would be the only appropriate remedial option.

Consequently, in those areas that would not otherwise introduce comprehensive contaminated land rules unless the proposed NES were introduced, the increase in remediation for each affected site would be expected to be in the order of \$200,000 for a one hectare site (ie the total remediation cost, as the site may not otherwise be remediated).

In those areas where rules are in place and remediation would have been undertaken, the more stringent soil guideline value proposed for arsenic would lead to increased remediation costs of \$85,000 per site.

Alternatively, in some cases it may be more cost-effective to instead use a cap and contain approach, possibly following a partial excavation. The cap could either be a clay cap with or without geotextile, or an impervious seal, followed by topsoil reinstatement. This would mean that the site would not be considered to be remediated to the same extent, although it would decrease the total remediation costs.

### **Former horticultural land**

This category includes remediation related to the development of urban fringe, undeveloped land that is subject to low-level contamination from previous horticultural use. This type of land could potentially include substantial areas of the Auckland Region (ie the west, south and north), Waikato, Hawke's Bay, parts of the Wellington Region (ie around Porirua and within the Wairarapa) and Nelson.

These areas are typically developed for medium-density residential subdivisions. The main contaminants of concern are arsenic, copper, lead, zinc, dieldrin and DDT.

The favoured remedial approach for hotspots is dig and dump, whereby the top 0.3m – 0.4m of topsoil are stripped and replaced with clean soil. The preferred remediation method for other parts of such sites is typically vertical mixing.

If the NES were introduced, the cost of dig and dump would be approximately \$200 per m<sup>3</sup> in relation to contamination hotspots where arsenic is prevalent, eg former glasshouse or mixing shed sites. Assuming a typical hotspot (eg glasshouse/s) covers an average of 2,000m<sup>2</sup> on a one hectare site, the total dig and dump costs would be around \$120,000. This estimate is based on meeting the standard for arsenic set out in the proposed NES. In contrast, the current standards relating to arsenic would tend to lead to costs of around \$100 per m<sup>3</sup> (\$60,000 in total) for hotspots.

If DDT is the contaminant of concern, the proposed NES would generate dig and dump costs that are similar to the current levels, ie \$100 per m<sup>3</sup> for hotspots (\$60,000 in total).

As with the development of former timber treatment sites, the NES could lead to costs of around \$10.50 per m<sup>2</sup> for the use of vertical mixing for areas that have lower levels of arsenic contamination. Assuming that this remedial method would be applied to approximately half of a one hectare site, the cost of vertical mixing would be around \$50,000. This compares with \$7 per m<sup>2</sup> (\$35,000) under the current guidelines.

If DDT is the contaminant of concern, the costs of vertical mixing could be lower according to the proposed NES as the SGV proposed is higher than the current guideline level.<sup>17</sup>

Consequently, in those areas that would not otherwise introduce comprehensive contaminated land rules, the NES could lead to increases in typical remediation costs for each affected site in the order of \$170,000 for a standard one hectare site (ie if the site may not otherwise be remediated).

#### **Former service stations**

These sites are typically located in urban areas. They are most likely to be developed for medium-density residential townhouses. The main contaminants of concern in this circumstance are likely to be TPH, BTEX, lead and PAHs.

Remediation around underground storage tank pits, fuel lines and pump island may be necessary. This typically requires dig and dump and/or cap and contain. More extensive remediation may be required if a contamination plume is present onsite.

Because of the known contamination risk regarding such sites, such sites are typically remediated to an appropriate level to minimise public health risks to an acceptable level. Assuming that the proposed NES applies a risk-based approach as is carried out currently, the introduction of the NES is unlikely to have any impact on remediation costs.

The only potential exception is if BaP<sub>eq</sub> (as an indicator of carcinogenic PAH) is the contaminant of concern. Because the proposed NES has a higher SGV for BaP<sub>eq</sub>, it is possible that in some cases the remediation costs may be lower if the NES were introduced.

#### **Former sheep dips**

These sites are typically located in rural areas. Contamination issues are most likely to arise if a new farmhouse is to be developed adjacent to a former sheep dip site. The main contaminants of concern are likely to be arsenic, dieldrin, lindane and DDT. The most appropriate remediation method for these sites is likely to be to dig and dump for affected hotspots and vertical mixing for the areas surrounding the former dip sites.

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<sup>17</sup> The NES SGV (rural lifestyle 25% produce) is 47 mg/kg whereas the current SGV (rural lifestyle 50% produce) is 8.4 mg/kg.

If the NES were introduced, the cost of dig and dump for sites contaminated with arsenic would be approximately \$200 per m<sup>3</sup> in relation to contamination hotspots. A typical hotspot would require soil removal from around 50m<sup>2</sup> at a depth of 1.5m, assuming arsenic is the contaminant of concern. This would result in costs of around \$15,000.

In contrast, the current standards relating to arsenic would tend to lead to costs of around \$100 per m<sup>3</sup> (\$7,500) for hotspots.

If DDT is the contaminant of concern, the remediation costs under the proposed NES are likely to be similar to the current levels, ie \$100 per m<sup>3</sup> (\$7,500).

Vertical mixing would be used for the area surrounding the dip site, approximately 20m<sup>2</sup>. The NES could lead to costs of around \$10.50 per m<sup>2</sup> for these areas, totalling \$210. This cost estimate assumes that 0.5m of topsoil is required pre-mixing to meet the new standards. In contrast, the current standards relating to arsenic would tend to lead to costs of around \$7 per m<sup>2</sup> (\$140), assuming imported topsoil would not be required.

If DDT is the contaminant of concern, the remediation costs under the proposed NES could be less than the current levels, ie lower than \$140.

In some cases, a cap and contain approach may be used, for instance in conjunction with an initial excavation. In the event capping and containing is the preferred option, the NES would not be expected to alter remediation costs.

Consequently, in those areas that would not otherwise introduce comprehensive contaminated land rules, the increase in remediation costs for each affected site because of the NES would be expected to be in the order of \$15,000 (ie the total remediation cost, as these sites may not otherwise be remediated).

### **Former industrial sites**

These sites are typically located in urban areas and are most likely to be developed for commercial or alternative industrial activities. The main contaminants of concern are likely to be metals and hydrocarbons.

Remediation typically involves having sites paved with concrete floorpads or asphalt following initial excavation, eg for subsurface basement carparks. Vapour barriers are not required unless volatile organic compounds are present. It is assumed that in many cases, organic contamination levels are moderate.

Because of the known contamination risk regarding such sites, many such sites are typically remediated so as to largely minimise the public health risks. Consequently, the introduction of the NES is unlikely have a material impact on remediation costs in a large proportion of these sites.

Of note, however, is that the precise impact would depend on the exact nature of and extent of the individual inorganic and organic compounds present. Because of the large

range of different activities that may have occurred on industrial sites, the contaminants of concern are highly variable.

### **Former gasworks sites**

These sites are typically located in urban areas and are most likely to be developed for commercial or alternative industrial activities. The main contaminants of concern are likely to be TPH, BTEX, PAHs, metals and cyanide.

Remediation typically involves dig and dump for high level contamination in tar wells, pipeworks, etc, followed by a cap and contain approach for remainder of site. Vapour barriers are typically required because of the presence of volatile organic compounds.

Because of the known contamination risk regarding such sites, most such sites are typically remediated so as to minimise the risk of human contamination. Consequently, the introduction of the NES is unlikely to have any material impact on remediation costs for these sites.

As with other scenarios, the effect on remediation costs of the proposed NES would depend on the key contaminant of concern that drive any assessment and/or remediation. For former gasworks sites, these are petroleum and polyaromatic hydrocarbons, benzene, cyanide and other metals. Of these potential contaminants, only BaP<sub>eq</sub> (as an indicator of carcinogenic PAH) has a SGV in the proposed NES. In general, the proposed SGV is higher than existing BaP<sub>eq</sub> criteria set out in the MfE Gasworks guidelines.

### **Total remediation costs**

For a large number of the sites that would be developed for residential use in the future, the implementation of the NES would not be expected to have any material impact on remediation costs. This is because 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 likely to occur because the soil guideline values contained in the proposed NES would become widely used as public guidelines and the majority of future residential development is expected to occur in areas where there would be rules regarding the development of potentially contaminated land.

However, the NES would be likely to have an impact on the number of sites identified as contaminated, and where some level of risk management is required. The NES is most likely to increase remediation costs for some sites in areas where no specific contaminated land rules are likely. As outlined in Section 2.2, this analysis estimates that around 100 contaminated sites would be remediated over the next 20 years only if the proposed NES were introduced.

For simplicity, the 100 contaminated sites are assumed to relate to 100 individual one hectare sites. These are assumed to be developed into medium density residential dwellings. As indicated in Table 7 below, around five percent of these sites are assumed to be contaminated because of previous use as locations for timber treatment, 45% are assumed to be former horticultural land, and the remaining half are assumed to sites on which harmful contamination exists because of sheep dips. The total additional

remediation cost generated under this scenario over the next 20 years is \$4.3 million, as outlined in Table 7.

Based on an estimated 100 contaminated sites, this suggests that approximately five sites would be former timber treatment locations. This is around 2% of the 255 total timber treatment sites nationwide.<sup>18</sup> The estimated forty eight sheep dip sites equate to around 0.1% of the 50,000 such sites estimated to exist.<sup>19</sup> Figures regarding the amount of land that was used for horticultural purposes nationwide during the period within which harmful chemicals were widely used were unable to be obtained.

Table 7: Estimated remediation costs

Site type (former use)	Typical cost	Assumed prevalence	Number (est)	Cost (est)*
Timber treatment	\$200,000 per hectare	5%	5	\$440,000
Horticulture	\$170,000 per hectare	45%	43	\$3,400,000
Sheep dip	\$15,000 per site**	50%	48	\$170,000
<b>Total</b>				<b>\$4,250,000</b>

\* These estimates assume costs are spread evenly over 20 years. Future costs discounted at 8%.

\*\* Assumed that half of these sites require remediation. Risk is managed on remaining half by altering dwelling location.

Of note is that this estimate is sensitive to the amount of land that would be remediated as a result of the NES. The above estimate uses Statistics New Zealand medium growth population projections. If the low growth population projections are used, which would suggest around 50 contaminated sites would be remediated because of the NES, the resulting remediation cost estimate is \$2.2 million. Alternatively, if high-growth population projections are used, resulting in an estimated 250 sites being remediated, the total cost could be around \$11 million.

In contrast, in some areas and in relation to many of the contaminants of interest, the NES may lead to smaller remediation costs, eg where the NES's SGVs are more lenient than the SGVs that would be applied otherwise.<sup>20</sup>

### 3.3. Reductions in values of affected properties

As described above, implementing the NES could lead to an increase in compliance costs for those seeking to develop land in some areas. Although in many cases this increase in costs would not prevent the development of contaminated land, in other

<sup>18</sup> MfE. See <http://www.mfe.govt.nz/publications/hazardous/assessment-dioxin-contamination-sawmill-sites-2008-10/html/page5.html>

<sup>19</sup> MfE 'Identifying, Investigating and Managing Risks Associated with Former Sheep-dip Sites. A Guide for Local Authorities' 2006. MfE officials have suggested that somewhere between 0 to 200 sheep dip sites may be captured by the NES if it were introduced.

<sup>20</sup> For example, some of the SGVs used in Auckland City are more stringent than those in the NES. In some other cases, landowners may decide to use lower-cost remediation options than those outlined above even if the NES were to lead to more stringent standards. However, such lower-cost, less-extensive remediation options are likely to result in lower property values than if full remediation were carried out.

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, because of differences in profitability, the un-developed contaminated sites would be expected to lose value. Thus, to the extent that 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 to some extent 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.<sup>21</sup> Thus, the estimates of potential increases in remediation costs for affected sites as outlined in Section 3.2 provide approximate estimates of the magnitude of any reductions in the value of sites that could be adversely affected by the NES.

In terms of the number of sites that may not be remediated because of the NES, this is likely to be relatively small in relation to the number that are remediated.<sup>22</sup> For instance, if for every 10 former timber treatment or horticultural sites that are remediated, there is one site that is not remediated and developed because of the NES, the total reduction in property values could be of the order of \$400,000.<sup>23</sup>

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<sup>21</sup> This assumes that current property values do not adequately account for the possibility of contamination.

<sup>22</sup> This is based on the assumption that many landowners who decide to develop properties for residential use will have some awareness of the potential for their land to have some degree of contamination.

<sup>23</sup> This is calculated as approximately equal to 10% of the total remediation costs relating to timber treatment and horticultural sites as estimated in Section 3.2.3.

## 4. Benefits

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The introduction of the proposed NES would generate several benefits to society. These include:

- reduced administrative costs by avoiding the need for councils to make Plan changes and introduce their own contaminated land rules and standards;
- avoided submission costs that would otherwise be incurred by those who would submit on councils' proposed Plan changes;
- avoided compliance costs for oil industry;
- fewer application and dispute costs relating to the resource consent process regarding the development of affected land because of greater certainty; and
- less un-remediated development of contaminated sites, leading to:
  - improved public health outcomes;
  - avoided post-development disputes;
  - avoided contamination response measures;
  - avoided post-developmental remediation; and
  - potential environmental benefits.

Estimates of the magnitude of these benefits are outlined in Table 8. These estimates are discussed in more detail below.

Table 8: Estimate of benefits of NES (next 20 years)

<b>Benefits</b>	<b>Estimated Range</b>
Avoided Plan change costs – councils	\$1m
Avoided Plan change submission costs	\$1.5m
Reduced consent application costs	\$0.5m
Reduced consent costs – tank pulls	\$1 - 2m
Avoided contamination response costs	\$0 – 2m
Avoided public health costs	\$0 – 1.5m
Avoided post-development remediation costs	\$0 – 0.5m
Avoided post-development dispute costs	\$0.5 – 1m
Potential environmental benefits	Unquantified
<b>Total</b>	<b>\$4.5 – 10 million</b>

### 4.1. Avoided administrative costs of Plan changes for councils

In the absence of national environmental standards, some councils have already carried out their own analysis and developed their own rules and specific standards regarding contaminated land. For example, Auckland City Council has developed a set of human health criteria to assist in determining whether sites are contaminated and, therefore, require resource consents to remediate or develop. These standards are compared against the proposed NES in Table 1 in Appendix 1.

If the NES were not introduced, a large number of councils are likely to implement their own contaminated land rules. According to MfE over 50 of the 73 different territories 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. A small number may also develop their own specific contamination standards. Consequently, the introduction of the NES would prevent these councils from incurring these costs. The value of avoided administrative costs would constitute a benefit from the NES.

Although the majority of councils that would introduce such rules would largely copy the existing rules that have already been implemented by other councils (eg Auckland City Council, Wellington City Council), because of the technical nature of contamination issues, many councils are likely to engage technical experts as consultants. Additionally, there would also be administrative costs imposed in the consultation process, including: internal staff time; facilitating and reviewing public consultation (including advertising public notices); engaging Commissioners for hearings; etc. Based on preliminary discussions with industry participants and selected councils who have implemented specific contaminated land rules, including Wellington City Council, these costs could be in the vicinity of \$15,000 - \$20,000 per council. If councils' Plan changes were appealed, the costs involved in this process may be much higher. For instance, if the matter ended up in the Environment Court, the total administrative cost of enacting a Plan could be around \$50,000 or as high as \$80,000 - \$100,000, including the cost of the Court's time.

As well as introducing their own contaminated land rules, a small number of councils may also decide to develop their own specific contaminated land standards. Discussions with selected councils and industry practitioners, eg Tonkin and Taylor, indicate that the cost to a territorial authority of developing its own standards could include the time of one FTE for around 18 months, as well as the cost of external specialist consultants. Assuming annual average staff costs of around \$70,000<sup>24</sup> and consultant costs of around \$25,000,<sup>25</sup> the total cost per authority could be in the order of \$125,000. Although a large proportion of councils are likely to introduce their own rules in the absence of the NES, only a small number of councils may develop their own standards.

Given the number of councils that may introduce their own specific rules if the NES were not implemented, the total administrative costs that would be avoided could be in the order of \$1 million. This estimate is based on around 50 councils implementing their own rules over the next 5 to 10 years, with three councils implementing their own standards. This estimate also assumes that five councils have their proposed changes appealed to the Environment Court.

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<sup>24</sup> Average wage per FTE in 12 surveyed councils is \$70,271, Sunday Star Times "Ratepayers hoping for supercity savings might be disappointed" 5 April 2009. Policy and planning roles are the highest paid in the local body sector relative to job size, Strategic Pay Ltd "Remuneration in Local Government: An Overview" March 2007.

<sup>25</sup> Based on discussions with selected councils.

## **4.2. Avoided submission costs regarding Plan changes**

As discussed above, if the NES were not introduced a large number of councils that do not currently have specific rules concerning contamination would introduce their own contaminated land rules. Some councils that already have contaminated land rules may amend these rules to account for the new guidance that the MfE would publish if there NES were not introduced.

In either of these cases, 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 territory. There are a number of private parties that would be likely to be involved in these consultation processes, ranging from large, national organisations (Horticulture NZ, Federated Farmers, oil companies, New Zealand Winegrowers, Carter Holt Harvey, etc) to locally resident individuals.

Consequently, the introduction of the NES would eliminate the need for consultation and submissions across the country in each territory that altered or introduced contaminated land rules in District Plans. This would reduce the time and expense faced by these parties as they would only incur one-off submission costs in relation to 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 to \$2,000 per Plan change. For other, larger, organisations the costs avoided for each Plan change may be much higher. Horticulture New Zealand estimates that submission costs may range from as low as \$5,000 to as high as \$80,000 to \$100,000 if the NES prevents a dispute that would otherwise end up being resolved in the Environment Court.

The total cost of private submissions that could be avoided if the NES were introduced could be in the vicinity of \$1.5 million. This estimate is based on an assumption that, without the NES, around 50 councils would amend the contaminated land provisions within their District Plans. These amendments would occur when these District Plans are up for their regular 10 year review. This analysis assumes that each proposed change to contaminated land rules would attract an average of 10 'small' (local) submitters and four 'large' (national) submitters, with five proposed changes appealed to the Environment Court.

## **4.3. Avoided consent costs for tank pulls**

If implemented, the proposed NES would ensure that the removal of underground petroleum storage systems (ie 'tank pulls'), typically from former petrol station sites, would be a permitted activity. Currently, this activity is a controlled activity in a number of territories. This change would reduce resource consent applications costs for landowners in those areas that would otherwise require consent.

According to industry sources, there are around 200 tank pulls per year, with around 10% currently requiring resource consent. The additional cost to applicants of obtaining

resource consent is typically in the order of \$5,000 to \$10,000. This incorporates the cost of producing an Assessment of Environmental Effects report, liaisons with councils and, where necessary, hearings. Additionally, changing the activity status to permitted in those areas where it is currently controlled may have the potential to decrease the time taken carrying out tank pulls by reducing the administrative burden for the petroleum industry.

Consequently, the consent costs avoided from the NES could be in the vicinity of \$1 million to \$2 million over the next 20 years.

#### **4.4. Reduced costs for resource consent applications**

Introduction of NES could also reduce the costs associated with obtaining resource consents. This is likely because the NES would reduce uncertainty regarding the appropriate use of the different guidelines that would otherwise be available. The NES would also ensure that there is national consistency regarding the resource consent requirements. Having one set of rules for the entire country would reduce the time and expense required interpreting and ascertaining various District Plans for landowners and consultants that operate across different areas.

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.

The costs incurred in such 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, including Wellington City Council, and engineering and planning consultants, such as Tonkin and Taylor, the costs to a party of purchasing these services or utilising their own internal staff or resources can often range around \$10,000 to \$20,000. In some circumstances, costs may be considerably higher if a dispute is taken to the Environment or High Court. Factoring in the cost of the court's time, costs may be as high as \$80,000 to \$100,000.

The prevalence of these types of disputes would be expected to decline to some degree even if the NES were not formally adopted, because the standards within the NES would instead be published as informal guidance. However, resource consent disputes, or at least additional process costs, would be unlikely to be eradicated altogether. This is because some councils would not be able to adopt the new guidelines, at least not immediately. This would be because some councils have references to existing guidelines enshrined within their District Plans. Such references may not be able to be amended until these Plans come up for review, which occurs every 10 years. Additionally, despite such standards being published as guidance, some councils would be unlikely to implement any specific contaminated land rules.

This means that if the NES were not formally implemented, the scope for disagreements, uncertainty, lack of understanding or confusion between landowners

and councils regarding the appropriate treatment of potential contamination would still exist in some areas. Consequently, some of the resource consent costs that are generated in such situations could be avoided if the NES were implemented.

Assuming that the NES reduces minor disagreements regarding one or two consent applications per year this could avoid costs of around \$20,000 to \$40,000 per year (for both parties combined). Additionally, if over the next 20 years three application disputes that would otherwise have been resolved in the Environment Court are also avoided, the total benefit could be in the order of \$400,000.

#### **4.5. Public health benefits**

The primary objective of the NES is to reduce the risks to human health from toxic contaminants. To the extent that the NES would reduce exposure to contaminants, it would provide public health benefits. The three main pathways by which health impacts from soil contamination arise are:

- direct contact with contaminated soil;
- ingestion of contaminated water or food; or
- inhalation.

The potential health impacts are varied and depend on the contaminant present and the degree of exposure. For example, exposure to lead contamination can lead to reduced brain development in children. Similarly, contamination from previously used pesticides, eg cyclodienes, can result in kidney and liver damage. Other impacts which can be caused by a range of contaminants include cancer, leukaemia, headache, eye and skin irritation, nausea and fatigue. The impacts that may result can be roughly grouped into:

- Chronic effects: carcinogenic or developmental effects, which are likely to lead to adverse impacts (eg cancer or reduced brain development) at some date after exposure; or
- Acute effects: toxic effects, which may result in more immediate adverse health impacts.

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

Toxic impacts may lead to adverse health impacts as soon as individuals are exposed to contaminants. In extreme but rare cases, the effects of exposure to toxic contaminants may be fatal. The individuals most at risk in residential areas are likely to be children, who may come into close contact with contaminated soil through outdoor activity.

To provide an indication of the potential public health impacts of the proposed NES we consider three contamination scenarios:

1. Contamination that leads to cancer (eg arsenic, dioxins, etc);
2. Lead that leads to reduced brain development in infants;
3. Cadmium contamination that leads to permanent kidney damage.

Within these scenarios we assess the potential costs that may be generated if an individual is exposed to contamination which exceeds the tolerable intake and, subsequently, suffers illness because of this exposure. For the purposes of these scenarios, it is assumed that the individual in question is a child under five. The pathway by which this individual is exposed to the contaminant is by ingestions, eg consuming contaminated soil or vegetables grown in contaminated soil. For more details regarding the toxicity of these contaminants, see MfE's report on the toxicology of various contaminants found in New Zealand soils.<sup>26</sup>

These scenarios assume that it is exposure to the contaminants in question that result in illness. The costs that arise because of such illness can include:

- Mortality – as measured by the Value of Statistical Life;
- Morbidity, ie reduced quality of life because of illness;
- Cost of medical treatment;
- Developmental impairment of infants.

#### **4.5.1. Cancer arising from contamination**

Carcinogens addressed by the soil guideline values in the proposed NES include arsenic and benzo(a)pyrene. All these contaminants can be present on land previously used for horticulture or industrial uses. They are considered non-threshold contaminants in that there is no known safe level of exposure. In general, the greater the level of exposure, the greater the negative health impacts. An acceptable risk level of 1 in 100,000 is used in New Zealand by Government Agencies<sup>27</sup> to define the acceptable level for non-threshold contaminants under which their presence is considered to pose an acceptable level of risk. Above these thresholds, the risk of various illnesses is considered unacceptable.

##### *Avoided fatality*

This scenario assumes that the level of arsenic present on a site exceeds the acceptable level of risk and that exposure subsequently leads to a fatality from cancer. We expect that exposure would occur at some stage over the next 20 years, this being the period over which the development of contaminated land is considered for this analysis. Additionally, the typical latency period between exposure and development of cancer is assumed to range from 10 to 20 years.<sup>28</sup> Consequently, this analysis considers that on average, the expected public health impacts that would occur from carcinogenic contamination would not occur until 20 to 40 years into the future.

Based on a Value of Statistical Life of \$3.5 million,<sup>29</sup> the current value placed on a fatality that occurs 20 to 40 years in the future would range from approximately \$160,000 to

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<sup>26</sup> Ministry for the Environment.2010.Draft Toxicological Intake Values for Priority Contaminants in Soil. Wellington: Ministry for the Environment. See: <http://www.mfe.govt.nz/publications/land/draft-toxicological-intake-values/>.

<sup>27</sup> Ministry of Health, Ministry for the Environment.

<sup>28</sup> US Environmental Protection Agency, *ibid*.

<sup>29</sup> Ministry of Transport "Understanding Transport Costs and Charges" December 2009. See: [http://www.transport.govt.nz/research/Documents/UTCC%20 Value of statistical life.pdf](http://www.transport.govt.nz/research/Documents/UTCC%20Value%20of%20statistical%20life.pdf)

\$750,000.<sup>30</sup> This amount represents the current value of the benefit of avoiding a cancer fatality in the future.

The Value of a Statistical Life (VOSL) is an estimate of the value that society places on a death deferred, commonly referred to as a life saved. The VOSL used here is based on a 'Willingness to Pay' approach that seeks to measure the amount society would be prepared to pay to avoid one premature statistical death. This approach involves carrying out surveys that ask for the amount individuals would pay for improvements in safety. Based on this trade-off, the marginal rate of substitution between wealth and the risk of death or injury is estimated. This forms the basis for the VOSL.<sup>31</sup>

The VOSL represents an average value across the different individuals that would expect to be otherwise affected by the absence of some safety measure. The VOSL we have used is that developed by the Ministry of Transport in relation to potential road safety investments. This VOSL assumes that the age profile of road accident victims reflects that of the wider population. If a potential safety measure or health promoting regulation is expected to have a greater impact upon those with a specific age profile, it may be appropriate to alter the VOSL. For example, a measure that reduces air pollution may tend to benefit older individuals by reducing the premature death of individuals that are significantly older than the average age. If the major health impact of a measure is relatively small extension to expected lifespans, a smaller VOSL may be justified.

Regarding the proposed NES, a large proportion of any health benefit is expected to arise from reduced exposure of young children to contaminated soil. Because there is typically a latency period (ie delay) before chronic illnesses develop, many of the negative health impacts from childhood exposure may not develop until adulthood. Childhood exposure and typical latency periods of around 10 to 20 years suggests that the average age of those who would be affected by contamination would be broadly similar to the nationwide average, ie 37 years. This suggests that the VOSL developed by the Ministry of Transport would be appropriate for this analysis.

To the extent that the degree of pain and suffering from cancer deaths is worse than death from traffic accidents, the VOSL developed by the Ministry of Transport may underestimate the actual benefit to society of avoiding cancer deaths from contamination. However, no New Zealand-specific willingness-to-pay survey data regarding cancer deaths is available.

#### *Avoided non-fatal case*

If the proposed NES were to avoid a case of cancer that would otherwise be treated successfully, there would be benefits from:

- Improved quality of life from avoiding the stress and suffering from cancer; and
- Additional economic output from fewer working days lost to illness.

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<sup>30</sup> This discounting approach is consistent with that used by US Environmental Protection Agency, *ibid*.

<sup>31</sup> Ministry of Transport, *ibid*.

To determine the value that society would place on avoiding such an illness, an appropriate measure could be obtained from a New Zealand-specific survey identifying the willingness to pay to avoid non-fatal cancer. However, we are not aware of any such study.

An Australian study has provided estimates of the willingness to pay to avoid chronic conditions, such as breast and lung cancer.<sup>32</sup> Adjusting these values for New Zealand suggests that the value of avoiding one year of suffering cancer could be in the vicinity of \$65,000. Discounting this value to account for the timing of land development and exposure and a latency period between exposure and illness suggests that the current value of the benefit from the proposed NES of \$3,000 to \$14,000 per case of non-fatal cancer.

To estimate the additional economic output that would otherwise have been lost during periods of incapacitation we have used the average per capita weekly income from wage, salary and self-employed income (\$370).<sup>33</sup> Assuming that someone who contracts non-fatal cancer would be unable to earn income for an average of nine months, and that this loss of income is likely to occur between 20 to 40 years into the future, the current value of this benefit is approximately \$700 to \$3,000.

#### *Avoided medical costs*

A further benefit that would arise from avoided cases of cancer, whether fatal or non-fatal, is the avoided cost of medical treatment. The medical treatment provided for individuals with cancer typically include chemotherapy, radiotherapy and surgery. The cost of treating cancer arising from arsenic contamination may be around \$10,000 for bladder cancer diagnosed early, to well in excess of \$50,000 for more complex cases of lung or liver cancer that require all three methods of treatment. This analysis uses an average cost of \$25,000.<sup>34</sup> The current discounted value of avoiding these treatments costs from 20 to 40 years into the future is around \$1,000 to \$5,000.

#### **4.5.2. Developmental impacts arising from lead poisoning**

Lead is a threshold contaminant, which means there is a level under which its presence does not cause any toxic effects. Above this threshold, lead is toxic to many organs and tissues, including the heart, bones, intestines, kidneys, as well as the reproductive and nervous systems.

Effects can include abdominal pain, headache, anaemia, irritability, and in severe cases, seizures, coma, and death. Effects on the kidneys are generally reversible and less serious effects on adults typically cease once exposure ceases. More serious impacts are likely to occur in young children for whom effects can be permanent.

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<sup>32</sup> Abelson P. "The Value of Life and Health for Public Policy", 31<sup>st</sup>Conference of the Economic Society of Australia', Adelaide, 2002. This estimated the willingness to pay to avoid one year of lung cancer was A\$75,000. The same estimate for breast cancer ranged from A\$25,000 to A\$85,000 depending on whether the cancer was non-invasive or disseminated.

<sup>33</sup> Statistics New Zealand.

<sup>34</sup> Ministry of Health.

### *Developmental effects*

Because of lead's effects on the development of the nervous system, it is particularly toxic to children. Exposure to lead can result in permanent learning and behaviour disorders. Such developmental impairment, often reflected in lower IQ scores, is linked to lower lifetime earnings for the individuals affected.

Several overseas studies have estimated this link between lower IQ and lifetime earnings.<sup>35</sup> Applying the results of these studies to New Zealand, and accounting for differences in GDP, suggests that the present value of lost lifetime earnings from a one point reduction in IQ could be around \$17,000.

As well as costs associated with reduced earnings, other costs may arise from special education requirements, behavioural problems and increased criminal activity. The cost of residential care for an adult with severe intellectual and/or physical impairment can be as high as \$50,000 per year.<sup>36</sup> Depending on when during the 20 year period of site development exposure occurs, this equates to a current value of between \$130,000 and \$600,000 for lifetime care.

#### **4.5.3. Kidney damage arising from cadmium**

Cadmium is a non-carcinogen threshold contaminant that can result in permanent kidney damage if ingested in a sufficient quantity. Exposure to cadmium can cause severe kidney damage and in some cases may be fatal.

Damage to kidneys from cadmium exposure is irreversible. In a serious case, an individual affected by cadmium may suffer renal failure and would require dialysis. The cost of dialysis can vary from around \$20,000 to \$70,000 depending on the type and location of treatment, ie peritoneal or haemodialysis, which may be provided at home or in a hospital.<sup>37</sup> A weighted average of these costs, based on the prevalence of each treatment type, is \$41,000 per year. This analysis assumes that the typical patient with renal failure has a life expectancy of 20 years from when contract kidney problems occur. The latency period between exposure and the development of illness is assumed to average around 10 years.<sup>38</sup> This cost has an estimated current value of between \$44,000 and \$200,000 depending on when exposure occurs.

If suitable, and if an appropriate replacement kidney is available, an individual may be able to obtain a kidney transplant. The cost of a kidney transplant is approximately \$30,000,<sup>39</sup> and would typically occur after a couple of years of dialysis treatment.

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<sup>35</sup> Gould E., "Childhood Lead Poisoning: Conservative Estimate of the Social and Economic Benefits of Lead Hazard Control" Economic Policy Institute, Washington DC, USA, July 2009.

<sup>36</sup> Milne, R. "Valuing Prevention: Discounting Health Benefits and Costs in New Zealand" New Zealand Medical Journal, 6 May 2005.

<sup>37</sup> Endre, Beaven & Buttimore "Preventable kidney failure: the cost of diabetes neglect?" New Zealand Medical Journal, December 2006 Vol 119 No 1246. See <http://www.nzma.org.nz/journal/119-1246/2338/>.

<sup>38</sup> Agency for Toxic Substances & Disease Registry. See [http://www.atsdr.cdc.gov/csem/cadmium/cdchronic\\_effects.html](http://www.atsdr.cdc.gov/csem/cadmium/cdchronic_effects.html)

<sup>39</sup> Endre et al, *ibid*.

Consequently, the current value of the benefit from avoiding kidney damage that would have otherwise resulted in a transplant could range from around \$10,500 to \$48,500.

#### 4.5.4. Reduction in exposure to contaminants by NES

To estimate the number of individuals who may contract illnesses because of exposure to harmful contamination, we have used the estimated number of contaminated land that could be affected by the NES, ie 100 (see Section 2.2). Of these 100 sites, we have assumed that around 50 are contaminated by sheep dips.

Given the relatively small but concentrated nature of contaminants located at sheep dip sites, the number of individuals exposed would tend to be relatively small at each site, ie the number of occupants resident at the dwelling that may otherwise be built near to the location of the former sheep dip. According to figures from Statistics New Zealand, the average number of occupants per dwelling is 2.7. Based on an estimated 50 former sheep dips sites being inappropriately developed in the absence of the NES, the NES could prevent around 130 residents being exposed to harmful contamination from these sites.

Similarly, by preventing the inappropriate development of around 43 hectares of land contaminated by former horticultural use, and around five former timber treatment sites, the NES would avoid a further 1,555 individuals from exposure. In total, around 1,685 individuals would be prevented from exposure to excessive levels of harmful contamination.

Table 9: Estimated reduction in exposure to contamination

Site type	Number of sites	Exposure reduction
Timber treatment	5	155
Horticulture	43	1,400
Sheep dips	48	130
<b>Total</b>	<b>98</b>	<b>1,685</b>

This estimate assumes that only these individuals reside in the dwellings in question. Should these individuals move out and be replaced by others, more people would be potentially exposed to harmful contamination, although the risk of illness for original residents may be reduced if their exposure is reduced by vacating these dwellings.

#### 4.5.5. Reduction in risk of illnesses

Because the level of contamination and the exact contaminants at any given site are unknown prior to a site investigation, it is not possible to produce a robust estimate of the average level of risk reduction across the estimated 100 contaminated sites that would be affected by the NES. Similarly, the likely exposure of future residents to contaminants is also unknown. This means that it is not possible to estimate the exact degree by which risk would be reduced.

Despite this high degree of uncertainty, the high levels of contaminants present at some contaminated sites suggest that it is possible that the NES could reduce risks by

significant amounts. Calculations regarding the reduced risk from different levels of arsenic and benzo(a)pyrene indicate that risks could be as high as one in 10,000 or one in 1,000 in relation to some contaminated sites. In contrast, the SGVs outlined in the proposed NES are based on risk levels of one in 100,000.

Assuming that the 1,685 individuals who would otherwise be exposed to excessive contamination would face a higher risk ranging up to one in 1,000, the NES could avoid one or two individuals from contracting an illness. The public health benefits arising from could be relatively insignificant, for example if these illnesses are non-fatal cancers that do not occur until well into the future. Alternatively, these benefits could be substantial if two individuals would otherwise contract fatal illnesses, such as cancer, in the near future. The avoidance of two fatalities would generate public health benefits in the order of \$270,000 to \$1.3 million depending on when these incidents occurred within the next 20 to 40 years.

#### ***Potential to avoid serious contamination incidents***

In addition to avoiding illnesses as estimated above, there is a small, but positive probability, that the NES could also avoid one or more major contamination incidents involving highly toxic sites that could result in a number of additional fatalities.

Some examples of incidents of exposure to highly toxic material include:

- Establishment of a childcare centre which had a vegetable garden on the site of a former gasworks in Auckland;
- A number of former sawmill sites contaminated with dioxin and PCP that were re-zoned residential or rural residential without any clean-up, some of which have people living on them;
- Former landfill sites in Christchurch, Napier, Seatoun, and Otaki that were subdivided for residential land use;
- A closed landfill in Taranaki, that is now a park, where earthworks exposed potentially highly contaminated material and that required extensive testing and community consultation; and
- Former farm land subdivided for high-density housing in Hamilton that contained a sheep dip contaminated by dieldrin; and
- Residential development on ex-horticultural soils with varying level of DDT, dieldrin, arsenic and lead, eg in the Auckland region, Tasman and Hawke's Bay areas.

Given the nature of contaminants typically present on such sites, there could be scope for a relatively large degree of exposure which would have the potential to lead to a number of fatalities.

To the extent that the NES reduced the likelihood of such incidents, which could otherwise result in a number of fatalities, the public health benefits would be substantially greater. For instance, if the exposure to dangerous contamination led to an additional five fatalities, the estimated total benefit of the NES could potentially increase by up to \$4 million.

#### **4.5.6. Potential for negative public health impacts of NES**

Negative public health impacts could potentially arise because of the NES for two reasons:

- The NES were less conservative than the local standards imposed in a particular area; or
- The NES results in some sites not being remediated, because the costs of doing so are increased. In this case those who inhabit or work on such sites may continue to be exposed to potentially harmful contamination.

In practice, any such negative impacts are likely to be insignificant. The NES standards are based on the best available toxicological information and are set based on the assumption that there would be no effects, or no more than minor effects, at or below the standards. Additionally, the current uses of sites that may otherwise be developed tend to have low-population or low-employee densities, eg agricultural uses.

Central and local government also have powers to act if contamination has been identified as posing significant health risks, for instance in accordance with the public health provisions of the Health Act. The contaminated sites remediation fund also provides resources to address sites that pose a significant risk to human health and the environment.

As a result of these factors, relatively few people are likely to be exposed to contamination on these sites. This suggests that any potential negative public health impacts of the proposed NES would be insignificant.

#### **4.6. Avoided contamination response costs**

The proposed NES may also avoid the costs to central and local government agencies of responding to discoveries of dangerous contamination on land that has already been developed.

When potentially harmful contamination is discovered, particularly in residential areas, there may be strong responses of anxiety and outrage from members of the affected community. Addressing these incidents and dealing with outraged individuals or groups can use significant amount of central government and councils' time and resources.

An example of the magnitude of these costs is provided by the costs of the Government's response to contamination discovered at Mapua in the Tasman District, close to Nelson. This site previously housed a pesticide factory and was used to store toxic chemicals. It was subsequently found to have been leaching DDT and other contaminants into the nearby Mapua estuary.

Outside of any costs of remediation, the Ministry of Health has estimated costs have been incurred in excess of \$400,000 in responding to the communities concerns of being potentially exposed during the remediation of the land.

These costs include:

- Public health report, costing \$20,000. This excludes salary and operating costs for Nelson Marlborough District Health Board and costs for Environmental Science and Research in providing expert advice on toxicology and air discharges;
- The development of response options by external consultants for the Ministry of Health, \$50,000;
- Implementation of response action, including referral for one-off health check following attendance at a Ministry of Health clinic, \$15,000. This excludes dioxin blood tests which cost \$200 per person and is an ongoing services provided at no charge to affected individuals.
- Epidemiological study, commissioned by the Health Research Council of New Zealand, costing \$150,000;
- Costs to MfE, including:
  - Costs of consultants and expert opinions, \$10,000;
  - Additional soil sampling, \$20,000 to \$40,000;
- Public Health Unit costs associated with advice provided to Nelson Marlborough District Health Board on the site remediation, around \$150,000

Other relevant costs that are not included in the above estimate include those costs faced by the Tasman District Council in responding to the issue. These costs may be similar in scale to those incurred in relation to the recent discovery of potentially dangerous contamination at Marfell Park in New Plymouth. In this case, the discovery of contamination generated 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.<sup>40</sup>

According to additional Ministry of Health information, two other cases illustrate the potential costs generated in responding to historical contamination events. One is the exposure to dioxin at the former Ivon Watkins-Dow plant in New Plymouth. This incident generated costs of around \$2 million over three years. Half of this cost relates to the serum dioxin study undertaken by ESR, with the remainder relating to:

- development of options, \$280,000;
- development of services, \$220,000; and
- implementation of services, costing \$350,000 per annum.

The other case is the exposure of former sawmill workers to pentachlorophenol (PCP). The total cost of responding to this issue has not been calculated to date, but informal estimates suggest that the total cost could be in the order of \$5 million over ten years.

This cost includes:

- epidemiological study, potentially \$150,000;
- development of options, \$350,000; and
- implementation of service, \$400,000-\$550,000 per annum.

This cost does not include the bioremediation project and various contaminated land remediation works by HNZA and individual land owner.

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<sup>40</sup> MfE.

If the NES were to prevent one or two instances of inappropriate development of contaminated land that avoid the need for similar post development responses as those outlined above, the total benefits could range up to around \$2 million.

#### **4.7. Avoided post-development dispute costs**

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.

Based on the current rate of contaminated land claims made against councils, the NES could potentially 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<sup>41</sup> 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.

Consequently, if the NES eradicated up to 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.

#### **4.8. Avoided post-development remediation costs**

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. These 'excess' remediation costs and the costs of resolving disputes could be reduced if the NES were introduced.

This is because the NES would be expected to prompt some councils to better identify sites of potential concern and better address potential contamination issues before sites are developed. In this regard, the NES could result in better development decisions by landowners. This would result in less need for costly post-development remediation.

Where a site is found to be contaminated after it has been developed for residential use, the costs of retrospectively remediating a site can be considerable, particularly if work must be carried out in residential areas within which individuals continue to reside. However, it is not necessarily the case that the costs of remediation would be any higher than if the remediation were carried out prior to development. The main issue would be in relation to whether soils are safe to retain below building floor pads. Soils

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<sup>41</sup> Riskpool is the mutual fund that indemnifies councils against liability claims.

contaminated with metals, for instance, are likely to be less of an issue if retained beneath a building.

For instance, the presence of benzene, could present an ongoing health risk because to vapour migration. Hence, unacceptable levels of this compound could significantly increase post-development remediation costs, compared to remediating an undeveloped site. This is because buildings constructed on the site may need to be altered or demolished. The costs of altering or demolishing and re-constructing buildings can be considerable, for example around \$200,000 or more.

There have been a number of instances of contaminated sites being inappropriately developed and subsequently requiring post-development remediation. Some examples include:

- Former landfill sites in Christchurch, Napier, Seatoun, and Otaki that were subdivided for residential land use;
- Former farm land subdivided for high-density housing in Hamilton that contained a sheep dip contaminated by dieldrin;
- Residential development on ex-horticultural soils with varying level of DDT, dieldrin, arsenic and lead in the Auckland region, Tasman and Hawke's Bay areas.

Although it is not possible to predict the number of sites for which the NES could avoid retrospective remediation, a cost estimate may provide an indication of the potential magnitude of any potential costs avoided. For example, if five sites were to avoid incurring an additional \$100,000 in post-development remediation costs over the next 20 years, the total benefit could be in the vicinity of \$260,000.

#### **4.9. Environmental benefits**

The proposed NES are targeted at achieving positive human health impacts, and are not focused on obtaining improved environmental impacts. Therefore, any improvement in environmental impacts would be an unintended, but welcome, side-effect of the NES, although such benefits may arise nevertheless.

Potential environmental effects of contaminated land include adverse effects on aquatic flora and fauna due to the migration of contamination from the site. The principal modes of contaminant transport from contaminated land to offsite sensitive receiving environments include:

- Contaminants adsorbed to particulate matter transported from the site e.g. in air or stormwater;
- Dissolved contaminants leaching through the soil profile to groundwater, and subsequently transported in groundwater to a receiving surface water body, eg watercourse or estuary; and
- Phytotoxic effects within and adjacent to the contaminated site.

The magnitude of the potential adverse environmental effects is related to the toxicity of the compound, whether the exposure pathway is complete, the physical characteristic of the transporting media and receiving environment, and the sensitivity of the organisms

affected. These factors determine the bioavailability of the contaminants and hence the nature and magnitude of effects. The environmental effects of such discharges include toxicological and mutagenic effects. Some compounds are also potential endocrine disrupters.

As with the potential public health impacts, while the introduction of the NES may result in improved environmental outcomes to the extent that developed sites are remediated to a higher level, there may also be some negative impacts. Specifically, if the NES results in some contaminated sites not being developed, because increased remediation costs make this prohibitively expensive, these sites may continue being put to their existing use. These may result in the current contamination continuing to impact negatively on the environment. However, this negative impact may be minor because of the existing controls in place to avoid or mitigate these effects, eg regional councils can enforce discharge controls in accordance with Section 15 of the Resource Management Act.

## 5. Distribution of impacts

This section outlines the distribution of the potential impacts of the NES on different sections of the community.

### 5.1. Impacts on councils

The proposed NES could have a number of impacts on some councils. These impacts are summarised in Table 10 below. These impacts would differ across councils and over time depending on what contaminated land rules councils currently have and what rules these councils might otherwise institute in the future.

Table 10: Potential impacts for an individual council

Potential impact	Possible magnitude
Contaminated land information system upgrade	\$10–20,000, up to \$100,000
Avoided plan change costs	\$15–20,000, up to \$125,000
Avoid consent application disputes	up to \$100,000 per dispute
Avoided contamination response costs	\$100,000 per incident
Avoided post-development disputes	\$20–60,000, up to \$100,000 per dispute
Avoided post-development remediation	\$100,000 per site

Any increase in administrative costs for councils are ultimately borne by ratepayers in the affected areas. Conversely, to the extent that the NES reduces costs to councils, ratepayers benefit in the form of lower rates.

### 5.2. Impact on landowners

The range of different impacts on landowners is indicated in Table 11 below.

Table 11: Potential impacts for landowners

Potential impact	Possible magnitude
Increased application and investigation costs	\$10–20,000, up to \$100,000
Increased remediation costs	Variable, from minor to up to \$200,000 per site
Avoid consent application disputes	\$10 – 20,000, up to \$100,000 per dispute
Avoided tank pull consent costs	\$5-10,000 per site
Avoided post-development disputes	\$20–60,000, up to \$100,000 per dispute
Avoided post-development remediation	\$100,000 per site
Avoided Plan change submission costs	\$1-5,000, up to \$100,000

Where the NES were to result in increasing the costs of developing land for residential use, some proportion of these costs may be passed onto any subsequent purchasers.

### **5.3. Impacts on wider society**

The NES may also generate impacts on the wider society, including the central government. The main impact could be reduced public health costs. This includes not only reduced public health system costs of treating any illnesses, but also less pain and suffering from fewer people with illnesses and fewer fatalities. These benefits can range up around \$3.5 million per fatal illness avoided.

The central government would also have less risk of having to cover potential costs involved with respond to contamination incidents. The costs of this can range greatly, and could potentially be around \$400,000 to \$2 million.

### **5.4. Equity concerns**

Because the NES may reduce the risk of central and local government agencies having to respond to contamination issues by requiring more landowners to effectively remediate contaminated land, the NES may be perceived to lead to more equitable outcomes. This is because landowners, who gain from developing their properties for residential use, would be more likely to face the true costs of developing this land to a level that meets the expected safety standards. Consequently, there is less risk of the wider community (eg ratepayers or taxpayers) having to fund responses to contamination issues that may be more effectively dealt with at the time a site is developed.

## Appendix 1: Land use estimates

To estimate the total amount of contaminated land that may be affected by the NES, this analysis uses population projections by territorial authority provided by Statistics New Zealand. These are outlined in Table 12.

Table 11: Estimate of land development to 2031

	Population increase	New dwellings (excl apts)	Hectares required	% of land developed
Far North District	1,000	370	31	0%
Whangarei District	11,700	4,333	361	2%
Kaipara District	(600)	-	-	-
Rodney District	37,700	13,963	1,164	6%
NorthShore City	58,400	15,141	1,262	6%
Waitakere City	60,100	22,259	1,855	9%
Auckland City	126,300	32,744	2,729	13%
Manukau City	148,200	54,889	4,574	22%
Papakura District	13,500	5,000	417	2%
Franklin District	19,600	7,259	605	3%
Thames-Coromandel District	(100)	-	-	-
Hauraki District	(1,750)	-	-	-
Waikato District	9,500	3,519	293	1%
Matamata-Piako District	(500)	-	-	-
Hamilton City	36,200	9,385	782	4%
Waipa District	5,700	2,111	176	1%
Otorohanga District	(870)	-	-	-
SouthWaikato District	(4,000)	-	-	-
Waitomo District	(830)	-	-	-
Taupo District	1,100	407	34	0%
WesternBayofPlenty District	9,900	3,667	306	2%
Tauranga City	38,200	9,904	825	4%
Rotorua District	600	222	19	0%
Whakatane District	(1,800)	-	-	-
Kawerau District	(1,660)	-	-	-
Opotiki District	(1,010)	-	-	-
Gisborne District	(1,000)	-	-	-
Wairoa District	(1,330)	-	-	-
Hastings District	5,000	1,852	154	1%
Napier City	200	74	6	0%
CentralHawke'sBay District	(900)	-	-	-
NewPlymouth District	2,500	926	77	0%
Stratford District	(1,210)	-	-	-
SouthTaranaki District	(2,400)	-	-	-
Ruapehu District	(2,450)	-	-	-
Wanganui District	(3,300)	-	-	-

Rangitikei District	(2,150)	-	-	-
Manawatu District	2,700	1,000	83	0%
PalmerstonNorth City	11,400	4,222	352	2%
Tararua District	(1,300)	-	-	-
Horowhenua District	(1,400)	-	-	-
KapitiCoast District	10,300	3,815	318	2%
Porirua City	2,900	1,074	90	0%
UpperHutt City	300	111	9	0%
LowerHutt City	1,600	593	49	0%
Wellington City	38,200	9,904	825	4%
Masterton District	(900)	-	-	-
Carterton District	260	96	8	0%
SouthWairarapa District	(460)	-	-	-
Tasman District	5,300	1,963	164	1%
Nelson City	4,000	1,481	123	1%
Marlborough District	2,900	1,074	90	0%
Kaikoura District	100	37	3	0%
Buller District	(890)	-	-	-
Grey District	(550)	-	-	-
Westland District	(360)	-	-	-
Hurunui District	1,300	481	40	0%
Waimakariri District	15,800	5,852	488	2%
Christchurch City	45,100	11,693	974	5%
Selwyn District	17,000	6,296	525	3%
Ashburton District	2,600	963	80	0%
Timaru District	(1,100)	-	-	-
Mackenzie District	50	19	2	0%
Waimate District	(30)	-	-	-
ChathamIslandsTerritory	(90)	-	-	-
Waitaki District	(2,250)	-	-	-
CentralOtago District	2,000	741	62	0%
Queenstown-Lakes District	13,500	3,500	292	1%
Dunedin City	4,900	1,270	106	1%
Clutha District	(850)	-	-	-
Southland District	(500)	-	-	-
Gore District	(1,850)	-	-	-
Invercargill City	(3,900)	-	-	-
<b>Total New Zealand</b>	<b>723,100</b>	<b>243,989</b>	<b>20,332</b>	<b>100%</b>

Population figures sourced from Statistics New Zealand Population Projections, medium growth scenario

## Appendix 2: Sensitivity testing (discount rates)

The indicative estimates calculated in this analysis are based on a number of assumptions as outlined in the relevant sections. One of these assumptions is the use of an 8% discount rate. Of note is that other similar cost-benefit analysis have applied a range of different discount rates to policy proposals of a similar nature, eg the US Environmental Protection Agency has used 7% and 3%.<sup>42</sup> The UK Treasury Green Book also discusses the use of a rate of a Social Time Preference Rate of 3.5% which may be appropriate in this instance.<sup>43</sup>

The Tables below indicate the impact on cost and benefit estimates of using different discount rates and different population projections.

Table 12: Indicative cost estimates (\$m), using different discount rates, medium growth scenario

<b>Costs</b>	<b>Discount rate</b>		
	<b>8%</b>	<b>5%</b>	<b>3.5%</b>
Information system upgrade	0.7 – 1.1m	0.7 – 1.2m	0.7 – 1.2m
Increased remediation	4.3m	5.4m	6.2m
Increased consent application and site investigations	1m	1.3m	1.5m
Property value reductions	0.4m	0.5m	0.6m
<b>Total</b>	<b>\$6.4 – \$6.8m</b>	<b>\$7.9 – \$8.4m</b>	<b>\$9 – \$9.5m</b>

Table 13: Indicative cost estimates (\$m), using different discount rates, medium growth scenario

<b>Benefits</b>	<b>Discount rate</b>		
	<b>8%</b>	<b>5%</b>	<b>3.5%</b>
Avoided Plan change costs – councils	1m	1.1m	1.2m
Avoided Plan change submission costs	1.4m	1.7m	1.8m
Reduced consent application and dispute costs	0.5m	0.7m	0.8m
Reduced consent costs – tank pulls	1m – 1.9m	1.2m – 2.4m	1.4m – 2.7m
Avoided public health costs	0 – 1.5m	0 – 2.7m	0 – 3.5m
Avoided contamination response costs	0 – 2.2m	0 – 2.3m	0 – 2.4m
Avoided post-development dispute costs	0.4 – 0.8m	0.5 – 1.2m	0.6 – 1.4m
Avoided post-development remediation costs	0 – 0.3m	0 – 0.3m	0 – 0.4m
Potential environmental benefits	-	-	-
<b>Total</b>	<b>\$4.3 – 9.8m</b>	<b>5.2 – 12.4m</b>	<b>\$5.8 – 14.2m</b>

<sup>42</sup> Ibid.

<sup>43</sup> [http://www.hm-treasury.gov.uk/d/green\\_book\\_complete.pdf](http://www.hm-treasury.gov.uk/d/green_book_complete.pdf)

Table 14: Indicative cost estimates (\$m), using different discount rates, low growth scenario

<b>Costs</b>	<b>Discount rate</b>		
	<b>8%</b>	<b>5%</b>	<b>3.5%</b>
Information system upgrade	0.7 – 1.1m	0.7 – 1.2m	0.7 – 1.2m
Increased remediation	2.2m	2.8m	3.2m
Increased consent application and site investigations	0.5m	0.7m	0.8m
Property value reductions	0.2m	0.3m	0.3m
<b>Total</b>	<b>\$3.6 – \$4.1m</b>	<b>\$4.5 – \$4.9m</b>	<b>\$5 – \$5.5m</b>

Table 15: Indicative cost estimates (\$m), using different discount rates, low growth scenario

<b>Benefits</b>	<b>Discount rate</b>		
	<b>8%</b>	<b>5%</b>	<b>3.5%</b>
Avoided Plan change costs – councils	1m	1.1m	1.2m
Avoided Plan change submission costs	1.4m	1.7m	1.8m
Reduced consent application and dispute costs	0.5m	0.7m	0.8m
Reduced consent costs – tank pulls	1m – 1.9m	1.2m – 2.4m	1.4m – 2.7m
Avoided public health costs	0 – 0.8m	0 – 1.3m	0 – 1.8m
Avoided contamination response costs	0 – 2.2m	0 – 2.3m	0 – 2.4m
Avoided post-development dispute costs	0.4 – 0.8m	0.5 – 1.2m	0.6 – 1.4m
Avoided post-development remediation costs	0 – 0.3m	0 – 0.3m	0 – 0.4m
Potential environmental benefits	-	-	-
<b>Total</b>	<b>\$4.3 – 9.1m</b>	<b>\$5.2 – 11.1m</b>	<b>\$5.3 – 12.4m</b>

Table 16: Indicative cost estimates (\$m), using different discount rates, high growth scenario

<b>Costs</b>	<b>Discount rate</b>		
	<b>8%</b>	<b>5%</b>	<b>3.5%</b>
Information system upgrade	0.7 – 1.1m	0.7 – 1.2m	0.7 – 1.2m
Increased remediation	11.1m	14.1m	16m
Increased consent application and site investigations	2.7m	3.4m	3.9m
Property value reductions	1m	1.4m	1.5m
<b>Total</b>	<b>\$15.5 – \$15.9m</b>	<b>\$19.5 – \$20m</b>	<b>\$22.2 – \$22.7m</b>

Table 17: Indicative cost estimates (\$m), using different discount rates, high growth scenario

<b>Benefits</b>	<b>Discount rate</b>		
	<b>8%</b>	<b>5%</b>	<b>3.5%</b>
Avoided Plan change costs – councils	1m	1.1m	1.2m
Avoided Plan change submission costs	1.4m	1.7m	1.8m
Reduced consent application and dispute costs	0.5m	0.7m	0.8m
Reduced consent costs – tank pulls	1m – 1.9m	1.2m – 2.4m	1.4m – 2.7m
Avoided public health costs	0 – 3.8m	0 – 6.6m	0 – 8.9m
Avoided contamination response costs	0 – 2.2m	0 – 2.3m	0 – 2.4m
Avoided post-development dispute costs	0.4 – 0.8m	0.5 – 1.2m	0.6 – 1.4m
Avoided post-development remediation costs	0 – 0.3m	0 – 0.3m	0 – 0.4m
Potential environmental benefits	-	-	-
<b>Total</b>	<b>\$4.3 – 12.1m</b>	<b>\$5.2 – 16.4m</b>	<b>\$5.8 – 19.5m</b>

## Appendix 3: References

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