ASBESTOS IN SOIL – WHEN THE NEW ZEALAND REGULATIONS APPLY.

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INTRODUCTION

Whilst there is clear guidance on how to address asbestos in buildings, there is a serious gap in understanding when New Zealand Regulations apply to asbestos in soil. This paper examines when the following New Zealand regulations apply:

- Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011 (the NES);
- Health and Safety in Employment (Asbestos) Regulations 1998 (H&S Regulations);
- Health Act 1956.

This paper provides a brief overview of the regulations, the application of which depend on whether there is a risk to human health. Determination of whether or not there is a health risk from asbestos in soil, in the context of the regulations, is then discussed.

THE NES

The NES took effect on 1st January 2012. The Purpose of the NES is to ensure that human health effects from contamination are adequately addressed by district and city councils at the critical stage of development and subdivision.

The NES applies to sites containing asbestos if there is (or has been) a HAIL activity on the site, and one of a number of activities defined by Reg 5 are being undertaken (eg ground disturbance or a change in land use). The HAIL mentions asbestos specifically only once – "Asbestos products manufacture or disposal, including sites with buildings containing asbestos products known to be in a deteriorated condition", but two other activities mention the risk of asbestos as potential contaminants - Electricity generation sites and brake linings manufacturers.

One of the key sources of asbestos in the ground is not mentioned in the HAIL, ie where buildings containing asbestos elements are demolished without regard to the generation of

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asbestos fragments or free fibres, and may even be dropped into the basement with little or no encapsulation. This could however be picked up by Categories H or I of the HAIL, which cover hazardous substances that have been released or have migrated onto the land. For Category H or I to apply, then the asbestos must be present "in sufficient quantity that it could be a risk to human health."

In relation to the change of land use, the permitted activity criterion is whether the activity is highly unlikely to be a risk to harm human health. Under the NES, if permitted activity criteria cannot be met, then a land use consent is required. The next stage of evaluating the consent status of an activity is to establish whether the activity is controlled or restricted discretionary. This depends upon whether the results of testing are above or below a level indicative of a human health risk.

H&S REGULATIONS

The H&S Regulations were first promulgated in 1978 and apply to "every place of work under the control of an employer at which employees carry out work involving asbestos" and is the responsibility for enforcement falls to Worksafe New Zealand.

The H&S Regulations are principally designed to ensure that the number of fibres inhaled by workers every day does not exceed the Workplace Exposure Standard (WES) of approximately eight million chrysotile fibres[2]. If the concentration of asbestos in air is below the WES, then the regulations mostly do not apply. There is no clear New Zealand guidance for assessing, remediating or managing asbestos- contaminated soils in the workplace (MBIE NZ, 2014). New H&S Regulations are currently being developed, which are proposed to only apply to soil if a competent person has determined that the soil does not contain any visible asbestos-containing material or friable asbestos. If friable asbestos is visible, then the new regulations are proposed not to apply if that soil contains only "trace" levels of asbestos, with "trace" being implied to be the detection limit of method AS 4964:2004 (ie $0.01\%^{W}/_{W}$).

Worksafe have recently issued a Position Statement (Worksafe NZ, 2014) recommending that the assessment, remediation and management of asbestos-contaminated soils is undertaken in accordance with WADH, 2009. These guidelines involve "remediation goals"

[2] Based on $8m^3$ (MfE, 2011b) air breathed in over an 8-hour period and a chrysotile WES of 1f/ml.

of 0.001%$^{W}/_{W}$ for friable asbestos and free fibres in soil and 0.01%$^{W}/_{W}$ to 0.05%$^{W}/_{W}$ for bonded asbestos (dependent on site use). The guideline also has an air quality limit of 10,000f/m^3 (0.01f/ml) to protect the public around contaminated sites.

HEALTH ACT

The Heath Act is the principal health statute and was first promulgated in 1872. The Act had the main function of bringing about healthy living conditions in our larger towns, and to control diseases caused by "filth". Over the years many functions have been added to the Act so that it now covers control of infectious diseases, quarantine of ships and aircraft, safe water supplies, sewerage systems, refuse disposal, healthy homes, food hygiene, control of nuisances and offensive trades (McLintock, 2009). The promulgation of the Resource Management Act 1991 also saw the removal of many clauses in relation to discharges, amongst other things air quality.

Amongst these plethora of functions, the Health Act requires that local authorities make regular inspections of their districts to ascertain if there are any conditions that are likely to be injurious to health. If a condition likely to be injurious to health is found, then the local authority has a duty to ensure that the nuisance is abated or removed.

OTHER REGULATIONS

The Building Act, 2004 addresses site contamination where there is an intention to carry out building work. The Act requires that buildings shall be constructed to avoid the likelihood of people within being adversely affected by hazardous agents or contaminants on site.

Under the Local Government Official Information and Meetings Act 1987 (LGOIMA) territorial authorities are required to disclose everything they know about a parcel of land, including any information they hold about the "likely presence of hazardous contaminants".

Of note is that the Hazardous Substances and New Organisms (HSNO) Act does not apply as asbestos is an inert inorganic mineral that lacks the hazardous properties subject to the Act. Also, the Food Act, 1981 has no direct link between food standards and soil contamination. However, asbestos does not present an ingestion health risk and it is anticipated that food is unlikely to be significant source of airborne fibres especially when washed.

INTERACTION OF THE REGULATIONS

The NES was specifically designed to not overlap with current legislation. However, the H&S Regulations apply to the workplace and anywhere has the potential to become a workplace (eg maintenance workers at a park) and there is also arguably a significant overlap with the Building Act. Both the NES and the H&S Regulations require the expertise of a competent person (a Suitably Qualified and Experienced Practitioner in the case of the NES). One of the main differences is that the NES is broadly risk based, whereas the H&S Regulations are broadly hazard based.

In the non-occupational environment, the NES applies to soils and the Health Act applies to both buildings and soils (along with the Building Act). The NES is generally designed to avoid situations injurious to health, and the Health Act is designed to address them if they do occur. Contrasting to the risk-based nature of the NES, the Health Act is often qualitatively driven, and can arguably succumb to public concern or outrage.

WHAT CONSTITUTES A NON-OCCUPATIONAL HEALTH RISK?

Whether or not the Health Act and the NES apply to asbestos in soil at a particular site depends on how much asbestos is a human health risk.

Asbestos is considered to be a non-threshold compound. In New Zealand the specified acceptable risk to the public from non-threshold compounds is one additional cancer in 100,000 people (10^{-5}) over a lifetime.

UNITS USED IN THIS PAPER

Different units of measurement for asbestos concentrations in air and soil are used in the literature. For consistency, f/m^3 and $\%^{w}/_{w}$ are used respectively in this paper. All measurements are assumed to be by optical methods, unless otherwise stated. A comparison of units is as follows:

- $100f/m^3$ = 100 fibres per metre cubed = 0.0001f/ml
- $0.01\%^{w}/_{w}$ = 0.01 percent weight for weight = 100mg/kg

There is an unwillingness globally to set anything other than occupational exposure limits for asbestos (Otness, 2003). However the World Health Organisation (WHO) has published non-occupational air quality criteria (WHO, 2005) and these are referred to in the asbestos in soil guidance published in Australia, the Netherlands and the UK (WADH, 2009; NEPC, 2013; RIVM, 2003; CIRIA 2014). The WHO guidelines indicate that long term asbestos concentrations of $100f/m^3$ results in a lifetime risk of approximately 2×10^{-5} and concentrations of $500f/m^3$, a lifetime risk of 10^{-5} to 10^{-4}. These risks are based on a range of studies and WHO states that the validity of these studies is

difficult to judge. In addition, although there is evidence that chrysotile asbestos is less potent than amphiboles (generally by a factor of ten), WHO take the precautionary approach of attributing chrysotile with the same risk as amphiboles.

Recent research by the Dutch National Research Council has indicated that air concentrations of 280f/m^3 chrysotile, and 30f/m^3 amphiboles, are likely to carry a lifetime risk of 10^{-5} (Health Council of the Netherlands, 2014). Based on this, 100f/m^3 appears to be a conservative value that approximates to New Zealand's lifetime risk policy for chrysotile, the most common form of asbestos.

For the H&S Regulations, the above guidelines indicate that if air quality at a workplace equals the Workplace Exposure Standard, then the lifetime risk may be significantly higher than the New Zealand 10^{-5} policy. Also the Western Australian air quality guideline of 10,000f/m^3 for protecting the public from air borne asbestos may not meet New Zealand lifetime risks policy for long term exposure.

ASBESTOS IN SOIL – HOW MUCH IS TOO MUCH?

Asbestos in soil is not in itself a risk to human health. Asbestos in soil is only a risk if that soil is disturbed such that dust clouds that can be inhaled are generated. Therefore, asbestos in soil beneath a building or wetted, for example, will not create a risk to human health.

The quantity of dust created when soils are disturbed depends on a number of conditions, such as soil type, moisture, activity undertaken and the nature of the asbestos.

Australia, the Netherlands, the United States and the UK all provide methodologies to assess the concentrations of asbestos generated by disturbing asbestos-contaminated soils. All of these methods are uncertain and require an understanding of the specific site conditions (eg asbestos type, activity type, soil conditions).

The Dutch and Australian methods rely on the comparison of the concentrations of asbestos in soil against guideline values. These are discussed in more detail in Appendix 1, however, in summary these guidelines are likely to be conservative while asbestos remains bonded (eg bound within cement products), but the research on which the guidelines are based indicates that they may not meet New Zealand lifetime exposure criteria for friable asbestos.

The USEPA method involves Activity Based Sampling (ABS), where the site activities proposed are recreated in controlled conditions and the air quality monitored. This enables direct measurement of the concentrations in air generated, however, there are a number of limitations, such as ABS results only being valid for the conditions present during sampling.

The UK method involves assessing published relationships between air and disturbed soil and ABS, with the associated limitations.

CONCLUSIONS

The New Zealand regulations that address asbestos in soil are the NES, the Health Act and the Health and Safety in Employment Act. None of these regulations had asbestos-contaminated soil in mind when they were written and all hinge on assessing whether the asbestos present will cause a health risk.

Each of the regulations were written at different times and for different purposes, with the NES being broadly risk based, the H&S Regulations broadly hazard based and the Health Act generally applied qualitatively. The NES is designed to avoid situations injurious to health and the Health Act to deal with those situations if they arise.

Asbestos only presents a health risk if inhaled and, for non-occupational situations, there is uncertainty about how much asbestos is a health risk. There is even more uncertainty about what concentration of asbestos in soil, when disturbed, could potentially cause concentrations in air that present a health risk.

There are a limited number of methods for assessing the relationship between asbestos in soil and asbestos in air. All of these methods include uncertainties and rely on understanding the influence of site conditions (eg asbestos type, activity type, soil conditions). In particular, in terms of New Zealand contaminated land policies, the NEPM and Western Australian guidelines are indicated to be conservative for bonded asbestos, but may not be adequately protective of human health for friable asbestos and free fibres (dependent on site-specific conditions). Thus the NES and Health Act may apply even if friable asbestos is only present below NEPM, Western Australian and Dutch guidelines (again this will be dependent on site conditions). These guidelines are indicated to be appropriate for meeting the H&S Regulations workplace exposure criteria for the workforce, although the air quality criteria

for protecting the public adjacent to sites under remediation may not be applicable in all cases.

DISCLAIMER

The opinions within this paper have been provided by the authors to foster debate and should not be taken as those of Tonkin & Taylor or Auckland Council.

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APPENDIX 1 – Deriving asbestos in soil criteria (CLMG 2 Methodology)

There are no New Zealand guidelines for assessing whether concentrations of asbestos in soil would present an unacceptable risk to human health, however both Australia and the Netherlands have risk based criteria for residential use and Australia has threshold based criteria for other land uses. These guidelines are tabulated in the table below.

Country	Name	Purpose	Land use	Grouping	Bonded ACM (% $^{w}/_{w}$)	Friable asbestos
Netherlands (VROM, 2008)	Intervention value	Remediation urgency assessment	All uses	International risk based	0.01	
Australia (NEPM, 2013)	Health Screening Level	Site Investigation	Residential A	International threshold based	0.01	0.001 (See Note 1)
			High Density Residential		0.04	
			Recreational		0.02	
			Commercial/ Industrial		0.05	

Note 1: The 0.001%$^{w}/_{w}$ value for the Australian guidelines is a risk based number for friable asbestos and asbestos fines. The NEPM states that this is not appropriate for free fibres.

In deriving an appropriate soil guideline, New Zealand policy and climate needs to be considered (MfE, 2011a). Policy and climate assumptions within the Australian and Netherlands criteria are listed in the table below.

Factor	Australia (NEPM)	Netherlands
Differentiation of types of asbestos	All mineralogical forms of asbestos are treated as equivalent.	Differentiate between serpentine and amphibole asbestos.
Climate	Derived from the Western Australian guidelines, which in turn were derived from the Dutch guidelines, with a reduction by a factor of ten, to account for the dustier conditions in Australia and asbestos differentiation.	Likely to be broadly similar to New Zealand.
Fibre length	No criteria given.	Dutch make adjustments if fibre length is less than 5µm.
Lifetime risk	See text below.	See text below.
Sampling method	Based on sampling and testing undertaken in accordance with specified guidelines.	Based on sampling and testing undertaken in accordance with specified guidelines.
Bonded asbestos	Applies a factor of ten for bonded asbestos, which may be based on Netherlands risk assessment practice.	No differentiation made between bonded, friable or free fibres until Tier 2 assessment undertaken. For Tier 2 assessment, bonded asbestos has a criterion ten times greater than friable asbestos.

New Zealand does not have the same dusty conditions as Australia and the New Zealand H&S Regulations treat chrysotile and amphibole asbestos differently. Therefore the factor of ten that is applied by the Western Australian and NEPM guidelines is probably not appropriate to the New Zealand context. This adjustment brings the NEPM residential criterion equal the Dutch criteria, ie 0.01%$^{w}/_{w}$ for friable asbestos and 0.1 to 0.5%$^{w}/_{w}$ for bonded asbestos.

The Dutch Intervention value was introduced as a threshold based guideline of 0.01%$^{W}/_{W}$ in 1993. Subsequent research (Swartjes, 2008) showed that sites with less than 0.01%$^{W}/_{W}$ asbestos in soil were unlikely to exceed the Dutch Maximum Permissible Risk level (MPR). The MPR was based on an air quality criterion of 100,000 fibres/m^3, which at the time was thought to provide a lifetime risk of 10^{-4}. However the Dutch Health Council has recently reassessed the data and concluded that to provide a lifetime risk of 10^{-4}, the 100,000f/m^3 value should be reduced to 2800f/m^3 (280f/m^3 chrysotile to meet a 10^{-5} lifetime risk). Despite the reassessment, we understand that the Dutch guideline is unlikely to change.

The Australian NEPM is based on the Western Australian Guidelines, which is based on the Dutch guidelines. The Western Australian guidelines state that the Dutch Intervention value of 0.01%$^{W}/_{W}$ should keep asbestos air levels below 1000f/m^3 and <u>probably</u> around 100f/m^3. WHO air quality guidelines indicate that 100f/m^3 equates to a lifetime risk of 10^{-5}.

The Dutch, Western Australian and NEPM guidelines are based on Dutch research (Swartjes, 2008). This research is summarised in a figure plotting soil concentration against corresponding air concentrations (Figure 2 in Swartjes, 2008). Space restrictions prevent reproduction of the figure here. The research data includes average data from field tests[3] (reportedly often reflecting damp conditions that would inhibit asbestos entrainment to air) and "worst case" simulated activities[4]. For bound asbestos, the results are all well below the 100f/m^3 guideline. However, for friable asbestos, the field data upper 95% confidence limits of the averages exceed the 100f/m^3 air quality criterion (ie exceed the New Zealand 10^{-5} lifetime risk) for all soil concentrations for which there is field data (ie down to 0.01%$^{W}/_{W}$). The "worst case" data exceed the 100f/m^3 even for concentrations as low as 0.001%$^{W}/_{W}$.

In conclusion, the above indicates that the NEPM and Dutch guidelines are conservative when asbestos is contained within bonded products, but that they may underestimate the risk presented by friable asbestos.

[3] For example driving on contaminated roads and digging, dumping and sifting of soil.

[4] Using a windblower on dry soil with loose asbestos fibres