Guidance for assessment of sites in accordance with category A10 of the Hazardous and Activities Industry List (HAIL)

Report summary

Tasman District Council has sought advice on the definition of a persistent pesticide and guidance for the assessment of sites in accordance with HAIL A10. The HAIL Category A10 is defined as *Persistent pesticide bulk storage or use including sport turfs, market gardens, orchards, glass houses or spray sheds*. For the purposes of this report this definition was considered to include agricultural land, plant broad acre cropping, school playing fields, plant nurseries and tunnel houses.

The available information on current and historic pesticide use on HAIL Category A10 sites has been reviewed.

Taking into account the known information on likely pesticide use over different time periods and for different land uses, the following 5 HAIL sub-categories have been proposed.

- HAIL A10-1 Horticultural, agricultural and forestry sites developed prior to 1989.
- HAIL A10-2 Horticultural, agricultural and forestry sites developed after 1989 and not actively sprayed in the last 5 years
- HAIL A10-3 Horticultural, agricultural and forestry sites developed after 1989 and actively sprayed in the last 5 years.
- HAILA10-4 Sports turf and school playing fields developed prior to 2010
- HAILA10-5 Persistent pesticide bulk storage – other.

A suite of target persistent pesticides for each sub-category has been identified.

The preparation of this report has highlighted the following data gaps and policy requirements that need to be addressed to facilitate management of potentially contaminated land.

- Compilation of existing data held in territorial local authority and regional council files for HAIL A10 properties to inform risk assessment and policy development.
- Assessment of potential hotspots including storage and spraysheds and surrounding area
- Assessment of turf and in particular school playing fields where MSMA has been used.
- Determine if cadmium based fungicides were available in New Zealand
- Information requirements from landowners to confirm extent of pesticide use on property
- Risk assessment process for HAIL A10 sites that have been sprayed in the last 5 years.
- Lack of data and soil guidelines for more recently used pesticides identified as persistent
- Agreement on a definition of a pesticide for use in New Zealand government policy.
- Expansion of the description for HAIL A10 to include other landuses where persistent pesticides have been used.

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1.0 Introduction

The *National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health (NES)* came into effect in 2012. This standard introduced new provisions regulating land use activities including subdivision of land identified as being contaminated or potentially contaminated land. The NES introduced a nationwide set of consistent planning controls for land affected or potentially affected by soil contamination. The regulations state " land is considered to be actually or potentially contaminated if an activity industry on the Hazardous Activities or Industries List (HAIL) has been, is, or is more likely than not to have been, undertaken on that land". The HAIL is a list of activities and industries considered likely to cause land contamination from the use, storage and disposal of hazardous substances. The list was last revised in October 2011.

Tasman District Council has sought advice on the definition of a persistent pesticide and guidance for the assessment of sites in accordance with HAIL A10. The HAIL Category A10 is defined as *Persistent pesticide bulk storage or use including sport turfs, market gardens, orchards, glass houses or spray sheds*. For the purposes of this report this definition also includes agricultural land, plant broad acre cropping, school playing fields, plant nurseries and tunnel houses. This advice is funded through two Envirolink medium advice grants (1472-TSDC103 and 1473-TSDC104) prepared by Sally Gaw (University of Canterbury) and Trevor James (AgResearch). This report presents the guidance for the assessment of sites in accordance with category A10 of the Hazardous Activities and Industry List (HAIL).

2.0 Definition of a persistent pesticide

A definition for a persistent pesticide was selected as part of the aligned Envirolink project 1472-TSDC104 (James and Gaw, 2014). The United Nations Environment Programme definition of persistence used to identify persistent chemicals of a half-life in soils of greater than 6 months (168 days) was selected (UNEP, 2009). This definition is comparable to the European Union definition for a very persistent pesticide of a half-life in soil of greater than 6 months (Regulation EC No 1107/2009 Concerning the placing of plant protection products on the market).

New Zealand does not have a consistent definition of a pesticide that is used in policy and regulations for management of hazardous substances. In New Zealand hazardous substances are more commonly classified into sub-groups including agrichemicals, veterinary medicines, vertebrate toxins and timber treatment chemicals. All of these groups of chemicals include some classes of pesticides as defined by the United Nations. The United Nations Food and Agricultural Organisation's definition of a pesticide is

> *Any substance or mixture of substances intended for preventing, destroying or controlling any pest, including vectors of human or animal disease, unwanted species of plants or animals causing harm during or otherwise interfering with the production, processing, storage, transport or marketing of food, agricultural commodities, wood and wood products or animal feedstuffs,*

or substances which may be administered to animals for the control of insects, arachnids or other pests in or on their bodies. The term includes substances intended for use as a plant growth regulator, defoliant, desiccant or agent for thinning fruit or preventing the premature fall of fruit, and substances applied to crops either before or after harvest to protect the commodity from deterioration during storage and transport (FAO, 1999).

This report focuses on pesticides used for plant protection including herbicides, fungicides and insecticides. Anti-fouling paints, timber treatment chemicals and veterinary medicines used to control parasites are not considered in detail.

3.0 Existing guidance on identifying HAIL A10 sites

The Users Guide for the National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health (MfE, 2012) provides guidance on how to identify potentially contaminated land using desktop studies including review of council files and aerial photographs, and preliminary site investigations but does not provide guidance on the specific landuses covered by each HAIL category.

It is useful to consider examples where territorial local authorities and regional councils have incorporated specific guidance into planning documents and/or undertaken projects to identify potentially contaminated land using the HAIL categories.

Selwyn District Council

Selwyn District Council has introduced new requirements for subdivision or change of landuse for rural land. Applicants are required to submit a preliminary site investigation report to Selwyn District Council where rural land is more than likely to have included HAIL activities. Their web information specifically states "*In particular this is a new requirement that needs to be met for the majority of rural subdivisions."*

Hastings District Council

Hastings District Council was one of the first territorial local authorities to incorporate planning rules specific to soil contamination as a result of horticulture and agriculture. Plan Change 28 *Agrichemical Residues in the Soil* came into force in 2006. The Operative Hastings District Plan Section 4.5.1 requires applications for subdivision consent to include the following information:

Soils with Potential to Contain Historic Persistent Chemical Residues or Other Potentially Hazardous Soil Residues

i. Sufficient background data on whether the site has any history of horticulture and, agriculture or any other uses that are likely to have resulted in historic persistent chemical residues in the soil or residues from other persistent harmful contaminants, in the soil.

Historic persistent chemical residues were defined as **"**Soil residues of copper, lead, arsenic, DDT and its derivatives. In the case of lead, arsenic and DDT, residues remain in the soil from persistent

compounds that were used in agriculture and horticulture prior to 1975. In the case of copper, it is still used with the potential for residues to build up in the soil from long term use". The Hastings District Plan is currently being revised.

4.0 Landuses to be included under the HAIL A10 Category

The examples presented in section 3 above indicate that there is inconsistency between councils on the land uses identified as falling under the HAIL A10 category. The HAIL Category A10 is defined as *Persistent pesticide bulk storage or use including sport turfs, market gardens, orchards, glass houses or spray sheds*. Further landuses or activities that involve bulk storage or use of pesticides include forestry, plant nurseries, commercial flower growing, school playing fields, storage depots for pesticides used in pest control operations, agricultural land including pasture and cropping, and former tobacco land.

In this report the definition of a sports turf developed for the Environment Canterbury commissioned Sports turf scoping study is used (Environment Canterbury, 2013). This report defined sports turf as "a playing surface for a particular sport that features grasses which have been selected and managed such that they provide a resilient, close knit surface and playing characteristics appropriate for that particular sport." Sports turfs include any grassed or turf surface including football and rugby fields, cricket grounds, bowling and golf greens and grassed tennis courts.

5.0 Potential contaminants

The contaminants that are likely to be present on a HAIL A10 site will depend on the time and duration of pesticide application as well as the pesticides applied. The definition of a persistent pesticide of a half-life of greater than 6 months potentially captures a larger number of pesticides than are included as priority contaminants under the NES. It is considered unlikely that these more modern pesticides will accumulate in cropping or broadacre soils to concentrations that pose a long-term risk to human health. It is likely that concentrations of pesticides currently registered for use could be present at elevated concentrations in soils around spraysheds, storage facilities and mixing areas at unacceptable concentrations due to spills or poor handling and disposal practices.

There is very limited data on current concentrations of persistent pesticides in New Zealand soils as this type of data is not routinely collected. There is no national repository or database for reports from site investigations of potentially contaminated land. A limited number of studies have measured degradation of pesticides in NZ soils under field conditions (for example Sarmah *et al*., 2009). These studies however only included single applications of pesticides and did not consider the potential for accumulation in soil.

Current use of pesticides

There is limited data on the current use of pesticides in New Zealand. There are no regulations requiring mandatory recording of pesticide use or volume of sales. Statistics on usage patterns are not routinely collected. The most recent assessment of actual pesticide use based on volunteered

data for pesticides sales was undertaken in 2004 by Manktelow *et al*. (2005). More recent assessments have had to rely on other sources of information to infer usage of pesticides. For example the Environment Canterbury scoping report for sports turf (Environment Canterbury, 2013) and a recent review of insecticide use on pastures and forage crops used agrichemical manuals to identify the pesticides which are currently in use (Chapman, 2010).

Historic pesticide use

The use of pesticides to control insect pests and fungal diseases in New Zealand began in the late 1800s. Pesticides used in New Zealand until the 1970s tended to contain active ingredients that were more persistent than would be considered acceptable today. These active ingredients included the organochlorine pesticides such as DDT and dieldrin, lead, arsenic and copper. Organochlorine pesticides were used on pasture to control insect pests including grass grub. A timeline for pesticide use and manufacture in New Zealand is presented in Table 1. Restrictions on the use of organochlorine pesticides were introduced in the late 1960s (MfE, 2011). The history of pesticide manufacture at the former Fruit Growers Chemical Company (FCC) site at Mapua (PCE, 2008) can be used as an indication of when the various historic active ingredients were in use in New Zealand. The history of pesticide use in New Zealand is reviewed in Gaw (2002) and MfE (2011).

Table 1: Timeline of historic pesticide use and manufacture in New Zealand (Gaw, 2002, PCE, 2008, ERMA, 2009)

Time Period	**Pesticides**
Late 1800s/ early 1900s	Spraying for insect pests commenced Lead and arsenic were active ingredients in early pesticides Copper was an active ingredient in early pesticides and fungicides
1940s	Organomercury compounds introduced Arsenical compounds stored at FFC in Mapua
1945	Organochlorine pesticides including DDT, DDD, and dieldrin produced at FCC. Other pesticides manufactured at FCC included 2-4,D and paraquat .
1962	FCC stops producing organomercury pesticides, dieldrin and lindane
1967	FCC stops producing DDT
1970	DDT banned for use on pasture
1970s	Lead-arsenate still in use Range of arsenical herbicides withdrawn from use
1983	MAF advisory note recommends the use of DDT on capsicums in glasshouses Dieldrin still registered for use in NZ
1989	Persistent organochlorine pesticides deregistered for use in NZ
1991	Pentachlorophenol deregistered for use in NZ
2008	Endosulfan deregistered for use in New Zealand
2010	Last remaining arsenic based herbicide (methylarsenic acid MSMA) deregistered

Unlike the more recently used pesticides there is data on soil concentrations for persistent pesticides that were historically used. These investigations focussed on the use of organochlorine pesticides and trace metals. Several regional and unitary agencies including Auckland Regional Council, Environment Bay of Plenty, Environment Canterbury, Environment Waikato, Tasman District Council, Hastings District Council, Hawkes Bay have commissioned reports on historic pesticide concentrations in horticultural and agricultural soils. These reports are summarised in Table 2. DDT and its degradation products DDD and DDE followed by dieldrin are the two organochlorine pesticides most commonly detected in horticultural soils. The highest concentrations of historic pesticide residues tended to be found in glasshouse followed by orchard soils. Arsenic in orchard soils is the contaminant that most frequently exceeds a soil guideline value (SGV).

Table 2: Summary of available data for historic pesticide residues in agricultural and horticultural soils (PDP, 2007). Units are mg/kg.

Land use	Result range	Arsenic	Copper	Lead	Total DDT[1]
Orchard	Auckland	2-34	21-490	11.4-178	<0.03-24.4
	Bay of Plenty	3-48	6-304	4.6-184	<0.03-6.09
	Canterbury	6-40	14-334	17-135	<0.03-24.1
	Hawke's Bay	4-73	28-542	16-341	0.02-15.3
	Tasman	3-48	10-123	15-243	1.49-7.14
	Waikato	4-58	242-523	14-251	0.73-34.5
Glasshouses	Auckland	<2-20	7-253	6.0-1250	<0.03-289
	Canterbury	6-64	13-129	36-562	0.005-8.38
Market gardens/vegetables	Auckland	4-11	21-137	14.4-45.7	0.08-0.91
	Bay of Plenty	<2-28	11-215	6.2-63.2	<0.03-4.37
	Canterbury	3-31	9-961	22-797	0.003-0.74
	Hawke's Bay	3-10	8-58	10-32	<0.01-0.12
	Tasman	2-21	6-67	8-21	0.06-1.16
	Waikato	6-11	26-112	21-48	0.04-1.68
Vineyards	Auckland	<2-14	16-152	2.7-87.6	<0.03-2.84
	Hawke's Bay	2-7	43-119	12-56	0.02-0.35
	Waikato	6-15	22-115	22-51	<0.03-1.26

[1]Sum of DDT, DDE and DDD

Auckland Regional Council and Waikato Regional Council also investigated historic pesticide concentrations in soils on former horticultural properties that had been developed for residential housing. Waikato Regional Council measured concentrations of arsenic in soil above the current SGV on former orchard land (unpublished data) and Auckland Regional Council reported concentrations of lead (96-3160 mg/kg) and arsenic (6-102 mg/kg) above the current SGVs on former glasshouse sites developed for housing (Eckersley *et al*., undated).

Sports turf

The potential contaminant profile for sports turf is likely to be different to that found on horticultural, pastoral and cropping properties. Sports turf are often very intensively managed to control weeds, insect pests and fungal diseases. Historically DDT, dieldrin and lead-arsenate based pesticides were used to control insects in turf. In 1970 while the use of DDT to control grass grub in pasture was banned, DDT could still be used under permit to control grass grub in playing fields and bowling greens (Osborne, 1976). The herbicide methylarsenic acid (MSMA) was used to control paspalum and kikuyu grass in turf north of Taupo (ERMA, 2009) and was permitted to be used in New Zealand until 2010. Pentachlorophenol was used on turf to control moss (Environment Canterbury, 2013). Endosulfan was used to kill earthworms in sports grounds and was permitted for use in New Zealand until 2008 (ERMA, 2008). A range of mercury based fungicides were available in New Zealand (Department of Health, 1962) and based on their tradenames and known usage overseas are likely to have been used to control fungal diseases in turf.

Information from overseas indicates that cadmium based fungicides may have been used to control fungal diseases on turf grasses (Walsh *et al.*, 1999). These fungal diseases also occur on turf in New Zealand. Cadmium based fungicides were registered for use overseas including Australia (Victorian Government, 1969). If cadmium based fungicides were used on sports turf in New Zealand, cadmium concentrations may be greater than would be expected from fertiliser application. Studies from overseas have reported extremely elevated soil concentrations of mercury in soil under managed turf (McCartney *et al.*, 2001).

Limited publicly available data could be found for concentrations of pesticides in sports turf including golfing greens and school playing fields for New Zealand. A detailed site investigation report for subdivision of a bowling club prepared for South Taranaki District Council reported arsenic concentrations (25-59 mg/kg) exceeding the SGV for residential use with 10% produce of 20 mg/kg and dieldrin concentrations exceeding the SGV for 25% produce of 1.1 mg/kg. Concentrations of cadmium, lead and mercury did not exceed the current SGVs for residential land use. Endosulfan (<0.01-0.28 mg/kg), ΣDDT (1.1-4.1 mg/kg) and heptachlor epoxide (<0.01-0.02 mg/kg) were also detected in the bowling green soil (South Taranaki District Council, 2013). The Waikato Pesticide Awareness Committee (Waipac) measured soil concentrations of arsenic (58 mg/kg), dieldrin (0.44 mg/kg) and the three main isomers of DDT and DDE (0.78 mg/kg) (unpublished data). The Waipac study did not measure other trace elements.

Hotspots

To date there is very limited publicly available data for the assessment of spraysheds and other pesticide storage facilities as well as spills of pesticides. The 2002 ARC scoping study in included five potential pesticide hotspots including soil from three spraysheds, bare soil outside of a glasshouse and the site of a pesticide spill. Elevated ΣDDT concentrations were measured at two of the spraysheds and the maximum concentration was 270 mg/kg. Soil from two of the spray sheds still in active use also contained elevated concentrations (5-21 mg/kg) of more recently used pesticides including chlorothalonil, fenamirol, prothiofos and oxyfluorfen (Gaw 2002).

The later ARC study focussing on developed glasshouse sites measured elevated concentrations of arsenic (11- 56 mg/kg), lead (195-3160 mg/kg) and ΣDDT (0.9-112 mg/kg) in soil samples collected from around a spray/boiler shed on a glasshouse property (Eckersley *et al*., undated).

Pattle Delamore Partners (2004) in a report written for Hastings District Council based on work undertaken for clients stated that 'concentrations of hundreds and even thousands of mg/kg of the priority substances (As, Cu, Pb and ΣDDT) are possible" for hotspots such as spray and storage sheds. It is probable that further data for hotspots on HAIL A10 properties and in particular horticultural properties is held in regional and territorial local authority files.

Factors that may enhance pesticide persistence

On some properties pesticide persistence may be enhanced. Co-contamination with metals copper and arsenic can enhance the persistence of pesticides in soil (Gaw et al., 2003, (Van Zwieten, Ayres, & Morris, 2003)). If elevated concentrations of copper and arsenic are detected around spraysheds, further assessment is recommended. Pesticides may also have enhanced persistence in soil that has been covered as degradation by sunlight will be prevented. Examples where covering soil may enhance persistence include polythene covering of soil for asparagus and strawberries and glasshouses.

6.0 Guidance for assessing HAIL A10 sites

The HAIL A10 category can be divided into sub categories based on period of active spraying and the likelihood of pesticide use to guide site assessment requirements. The proposed five sub categories are:

- HAIL A10-1 Horticultural, agricultural and forestry sites developed prior to 1989.
- HAIL A10-2 Horticultural, agricultural and forestry sites developed after 1989 and not actively sprayed in the last 5 years
- HAIL A10-3 Horticultural, agricultural and forestry sites developed after 1989 and actively sprayed in the last 5 years.
- HAILA10-4 Sports turf and school playing fields developed prior to 2010
- HAILA10-5 Persistent pesticide bulk storage – other.

The target persistent pesticide residues for each sub-category are presented in Tables 3 and 4. The identified "recent persistent pesticides" are listed in Table 4. These pesticides were identified as part of the aligned Envirolink project 1472-TSDC2014 (James and Gaw, 2014). Soil concentrations of the recent persistent pesticides should be assessed on sites where these pesticides are likely to have been used. A site specific assessment for sites still in active use (HAIL A10-1 and HAIL A10-3) would need to be undertaken to identify potential pesticide residues as there may be residues from less persistent pesticides that are still sufficiently high to pose hazards to human health or ecological receptors in the short-term.

Timeframes for risk assessment

The priority pollutants currently listed in the NES include metals and organic chemicals with half-lives in soil of many years. The proposed definition of a persistent pesticide of a half-life in soil of greater than six months means that some pesticides classified as persistent are likely to only pose a

hazard to human health and ecological receptors for a much shorter time period than the exposure duration of 6 years used for the derivation of the NES soil guideline values. There is a need to develop guidance for site specific risk assessments where pesticide concentrations will reduce more rapidly due to degradation. The Food and Agriculture Organisation's rule of thumb for identifying the timeframe of contamination from a pesticide spill that a pesticide will have fully degraded after a time period of five times the half-life of the compound in soil (FAO, 2000).

Table 3: **Target persistent pesticides according to HAIL A10 sub-category**

Landuse category	Sample types	Target persistent pesticide residues	Rationale for inclusion
HAIL A10-1	• Broad acre • Spraysheds • Pesticide mixing areas • Spill sites • Tunnel houses • Glasshouses	• Organochlorine pesticides • Endosulfan • Recent persistent pesticides* • Lead • Arsenic • Copper • Cadmium • Mercury	• Use of organochlorines was restricted during 1970s, last reference to DDT use was in 1983 • Endosulfan banned in 2008 • Historically used until approximately the 1970s • Active ingredient in insecticides and herbicides • Active ingredient in fungicides and herbicides • Contaminant in fertiliser • Active ingredient in historically used fungicides
HAIL A10-2	• Broad acre • Spraysheds • Pesticide mixing areas • Spill sites • Tunnel houses • Glasshouses	• Arsenic • Copper • Endosulfan	• still permitted for use and elevated copper can enhance the persistence of other pesticides • Endosulfan banned in 2008
HAIL A10-3	• Broad acre • Spraysheds • Pesticide mixing areas • Spill sites • Tunnel houses • Glasshouses	• Endosulfan • Copper • Arsenic • Recent persistent pesticides* • Site specific based on spray history	• Copper can enhance the persistence of other pesticides • Last arsenic based herbicide was banned in 2010 • Less persistent pesticides may pose hazards in the short term
HAIL A10-4	• Sports turf • Spraysheds • Pesticide mixing areas • Spill sites	• Endosulfan • Mercury • Cadmium • Arsenic • Lead • Pentachlorophenol (PCP) • Organochlorine pesticides • Recent persistent pesticides* • Site specific based on spray history	• Used to control earthworms; deregistered for use in 2008 • Used as a fungicide on turf • Potentially used as fungicide on turf and fertiliser contaminant • MSMA banned in 2010 • PCP used to control moss in turf • Less persistent pesticides may pose hazards in the short term
HAIL A10-5	• Bulk persistent pesticides storage areas	• Site specific based on landuse history • Veterinary medicines • Vertebrate toxic agents	• Consistency with the FAO definition of a pesticide

***Recent persistent pesticides are listed in Table 4.**

Table 4**: Recent persistent pesticides**

Pesticide	Type
Cresol	Plant growth regulator
Dicloran	Fungicide
Epoxiconazole	Fungicide
Fenarimol	Fungicide
Flupropanate	Herbicide
Flusilazole	Fungicide
Imidacloprid	Insecticide
Myclobutanil	Fungicide

7.0 Linkages to other HAIL categories

The guidance in this report is specific to the HAIL Category A10. However land used for HAIL A10 activities such as agriculture, forestry and horticulture may also trigger other HAIL categories including:

A1. Agrichemicals including commercial premises used by spray contractors for filling, storing or washing out tanks for agrichemical application

A2. Chemical manufacture, formulation or bulk storage

A6. Fertiliser manufacture or bulk storage

A8. Livestock dip or spray race operations

A11. Pest control including the premises of commercial pest control operators or any authorities that carry out pest control where bulk storage or preparation of pesticide occurs, including preparation of poisoned baits or filling or washing of tanks for pesticide application

A13. Petroleum or petrochemical industries including a petroleum depot, terminal, blending plant or refinery, or facilities for recovery, reprocessing or recycling petroleum-based materials, or bulk storage of petroleum or petrochemicals above or below ground

A17. Storage tanks or drums for fuel, chemicals or liquid wastes

C2. Gun clubs or rifle ranges, including clay targets clubs that use lead munitions outdoors

G5. Waste disposal to land (excluding where biosolids have been used as soil conditioners)

8.0 Additional data and policy requirements

Data gaps

The following data needs were identified during the preparation of this report

- Compilation of existing data held in territorial local authority and regional council files for HAIL A10 properties to inform risk assessment and policy development.
- Assessment of potential hotspots including storage and spraysheds and surrounding areas
- Assessment of soil concentrations of the more recently used pesticides identified as persistent
- Assessment of turf and in particular school playing fields where MSMA has been used.
- Determine if cadmium based fungicides were available in New Zealand

Policy requirements

- Information requirements from landowners to confirm extent of pesticide use on property
- Risk assessment process for HAIL A10 sites that have been sprayed in the last 5 years.
- Agreement on a definition of a pesticide for use in New Zealand government policy.
- Expansion of the description for HAIL A10 to include other landuses where persistent pesticides have been used.

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