RANKING OF HAIL SITES IN THE CANTERBURY REGION USING THE RISK SCREENING SYSTEM

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INTRODUCTION

Environment Canterbury (ECan) maintains a Listed Land Use Register (LLUR) to manage information it holds about sites that have accommodated land uses or activities that have the potential to cause contamination. This electronic database records information obtained about each site in a standardised format which also helps to manage information releases.

The registration of a site on the LLUR serves as a prompt for site owners to take responsibility for managing any hazardous substances on their property.

The LLUR has recently been expanded to incorporate effective risk management of contaminated sites by allowing ECan to prioritise sites where further investigation is required.

The development and optimisation of the LLUR are essential parts of a broader Contaminated Land Management Strategy (ECan 2004b). This strategy has been developed to set the strategic goals for contaminated land management in the region and to define work programmes to meet those goals. The five components of this strategy are:

- Desktop investigations to identify sites within the Canterbury region that have accommodated any activities on the Hazardous Activities and Industries List (HAIL) (MfE 2004b);
- Registration of these sites on the LLUR;
- Prioritisation of sites for allocating resources;
- Field investigations of high risk sites;
- Remediation and ongoing management of sites.

As part of the process of prioritising sites for further investigation, information is collected about the contaminants typically associated with the activities carried out on the site and the physical characteristics of a site. This information is used to assess the possible risk to human health and the environment from likely contaminants. The initial assessment of risk is made using the Risk Screening System (RSS), a methodology developed by the Ministry for the Environment (MfE) (MfE 2004a).

ECan has completed risk screening more than 700 sites within the Canterbury region. This paper presents the results of this first phase of work.

METHODOLOGY

A series of Contaminated Land Management Guidelines (CLMG) has been produced by the MfE to assist regional councils and unitary authorities in managing contaminated land issues. CLMG No.3 entitled “Risk Screening System” describes a system that can be used to rank sites that are or suspected of being contaminated so that they can be prioritised for further investigation (MfE 2004a).
Following the release of the guideline, ECan engaged Pattle Delamore Partners (PDP) to develop a user’s guide to facilitate and standardise the use of the RSS (PDP 2004). In this guide, each of the contaminants associated with the HAIL has been assigned a value for toxicity, extent/quantity, mobility, containment and depth to hazard. These generic values ensure similar types of sites are given the same input parameter values. It also significantly speeds up the risk screening process (Davies et al. 2004). In the process of trialling the RSS, the contents of the guide have been expanded, and an internal procedure document produced.

To facilitate management of the data collected, the RSS has been integrated in the LLUR. A database tab is used to input all Risk Screening results, as shown in Figure 1. Comments and justifications for each assigned value are recorded within the tab for future reference. Once all the parameters have been entered, the spreadsheet developed for the RSS guideline (MfE 2004a) is used to calculate the risk for each exposure pathway and the overall risk present at the site.

![Figure 1: Risk Screening tab of the LLUR](image)

The RSS values describe the three components of contaminated sites that contribute to risk – the **hazard**, the **exposure pathway** and the **receptor**. The hazard component covers the type of contaminant, its toxicity and mobility in the receiving environment and the likely extent or quantity on site. The exposure pathway has been divided into three – surface water, groundwater and direct contact. The receptor pathway covers the sensitivity of the water and land at the site.

The risk screening process outlined in the flow diagram in Figure 2 is detailed in the remainder of this section.
Selection of **sites** to risk screened

Identification of **HAIL activities** and **contaminants** involved

Assess **Hazard** component:
- Toxicity
- Mobility
- Extent
- Containment

**Exposure Pathways**

**Surface Water**
- Surface Cover
- Runoff potential
- Water use

**Ground Water**
- Surface Cover
- Soil Permeability
- Distance to wells
- Water use

**Direct Contact**
- Surface cover
- Surface soils
- Depth to hazard
- Land use

**Receptor** component:
Land or water use

Repeat for all HAIL types

Assign **Overall site risk**

*Figure 2:* Flow Diagram for Risk Screening process
Pre-selection

Where there are a large number of sites needing to be risk screened, an effective strategy is needed to focus resources into areas with particularly sensitive environments. With nearly 3,000 sites on ECan’s LLUR, a subset of sites to be risk screened had to be selected for this first phase of work.

Four zones of Christchurch’s aquifer system were selected as they represent particularly sensitive receiving environments in the Canterbury region.

These zones are:

- the high, medium-high and medium risk zones identified in Weeber (2002) that divided the Christchurch area into five contamination risk zones based on a combined interpretation of geological well log data and groundwater pressure data, and
- the Christchurch Groundwater Recharge Zone (as defined in the proposed Natural Resources Regional Plan (NRRP) (ECan 2004a) where groundwater is replenished by rainfall and inflows from the Waimakariri River and the groundwater flows into the confined aquifers underlying Christchurch City.

Figure 3 shows the location of the four groundwater zones in relation to the urban areas.

Figure 3: Christchurch aquifer zones

All sites registered under the category “Verified”1 in the LLUR and located in the above mentioned zones were risk screened for this project.

HAIL identification

The next stage in the risk screening process was to identify all HAIL activities that have occurred at a site and ascertain what contaminants are likely to be present on site. This information was readily available in the LLUR entry for each site.

Hazard Component

The Users Guide, developed by PDP (PDP 2004) contains values for toxicity, extent/quantity and mobility. It was used to assign generic values for the hazard component of each HAIL activity at a site. The generic values have been assigned by making assumptions about the typical chemicals associated with the HAIL activities, and hence typical chemical toxicity,

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1 This category is for sites for which it is known that an activity or use as defined in the HAIL has taken place on the site, but there is insufficient information to characterise any risks to human health or the environment from those activities undertaken on the site. Contamination may have occurred, but should not be assumed to have occurred.
mobility and likely attenuation with time, typical quantities of chemicals, and typical storage, operational and waste disposal practices (PDP 2004). Where information on a site is held to suggest that a generic value is not appropriate because the particular site is not typical of its kind, a site-specific input value was then used for the input parameter concerned, based on the guidance provided in the RSS document (MfE 2004a).

**Exposure Pathways**

The next stage was to determine the site-specific characteristics for each exposure pathway. This involved extracting available information held at ECAn regarding the location of the site. Much of this information is held electronically and can be accessed using GIS software. To assist with this process, an Excel template and a GIS project have been created for sourcing input values related to the environmental setting for each site. The GIS project was developed to present all known information about the physical characteristics of general areas with a separate “view” for each exposure pathway that displays the necessary information for assigning a value to each parameter. The info gained from GIS and other sources was converted into a value to input in the RSS using recommendations in the RSS guideline document and the internal procedure.

The site-specific exposure pathway parameters for **surface water** is the direct sediment runoff and flood potential at the site. The runoff potential was determined by assessing the average yearly rainfall, surface cover at the site, slope, distance to the nearest waterway and the location of any preferential pathways such as stormwater drains. The flood potential was derived from the results of previous flood hazard assessments conducted in the vicinity of the site.

The site-specific exposure pathway parameters for **groundwater** are the thickness of any low permeability layer over the aquifer system, the distance to the nearest groundwater user downgradient of the site and the aquifer type. GIS maps of the aquifer zones and soil types within Christchurch were used to assess the likelihood that contaminants would infiltrate into the aquifer system. Piezometric contours gave the direction of groundwater flow, while ECAn’s wells database provided details on any wells in the area.

The site-specific exposure pathway parameters for **direct contact** are surface cover and soil permeability and depth to hazard. These values were determined using soil maps and aerial photos.

**Receptors**

The final part of the risk screening assessment involved assigning a value to the receptor component (water use and land use). Sources such as details from Valuation New Zealand database, aerial photos and ECAn’s wells and consents databases were used to assign values for the land use at the site or water use at the nearest surface water feature or downgradient well.

**Overall Risk Ranking**

Once all the values have been entered, the spreadsheet developed for the RSS guideline (MfE 2004a) is used to calculate the risk for each exposure pathway independently and the overall risk present at the site obtained by choosing the worst case exposure pathway. Individual HAIL activities are risk screened separately for each site. This allows comparison between the different potentially contaminating activities that may have occurred at the site. The highest risk value from any of the HAIL activities is entered in the database as the overall risk value for that site.
RESULTS

At the end of June 2005, there were a total of 2690 sites entered on the LLUR classified as described in Table 1 below.

<table>
<thead>
<tr>
<th>Category</th>
<th>Number of Sites</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unverified HAIL</td>
<td>589</td>
</tr>
<tr>
<td>Verified HAIL</td>
<td>1916</td>
</tr>
<tr>
<td>Not Contaminated</td>
<td>26</td>
</tr>
<tr>
<td>Managed/Remediated</td>
<td>102</td>
</tr>
<tr>
<td>Contaminated</td>
<td>7</td>
</tr>
<tr>
<td>Entered in Error</td>
<td>49</td>
</tr>
<tr>
<td>Not Categorised</td>
<td>1</td>
</tr>
</tbody>
</table>

In June 2005, 795 verified sites from the LLUR had been risk screened. This represents 41 % of the total number of verified sites (1916) listed in the database as of the end of June 2005.

The results of this first phase of work are summarised in Figure 4 which presents the distribution of sites according to the overall level of risk present at the site. One percent of the sites that have been risk-screened (i.e. 2 sites) returned a “low” risk value, 88% (703 sites) a “medium” value and 11% (90 sites) a “high” value.

![Figure 4](image)

Figure 4. Distribution of risk-screened sites by overall risk score

Figure 5 presents a breakdown of how these sites are distributed according to each exposure pathway. Of relevance to the Christchurch Artesian System, out of 90 sites with an overall risk score of “high”, 61 (68%) returned a score of “high” for the groundwater pathway. This indicates a high theoretical level of risk to groundwater quality presented by the sites assessed.
DISCUSSION

The RSS is a coarse screening tool based on the use of readily available information that allows desktop classification of sites according to the risk to the environment and human health present at a site.

This first phase of the project has enabled to streamline the screening process by using a minimum set of data to enable a rapid assessment. Several issues and limitations of the system, essentially related to some of the generic input values used and access to the various sources of information were identified. These issues were resolved in order to make the screening process more consistent.

The results of this first phase of work presented in this paper will be used by ECan to identify sites that require further investigation (i.e. all the sites that returned an overall risk value of “High”). This presents an effective mechanism to allocate resources most effectively in meeting the regional council function for the investigation of land for the purpose of identifying and monitoring contaminated land (s30 RMA 1991).

CONCLUSION

The results of this first phase of Risk Screening have enabled ECan to make progress towards reaching the targets for contaminated sites in the New Zealand Waste Strategy (MfE 2002) and the environmental result detailed in Chapter 4 of the proposed NRRP (ECAn 2004a). The New Zealand Waste Strategy has set targets for contaminated sites as follows:

1. By December 2008, all sites on the Hazardous Activities and Industries List will have been identified and 50 percent will have been subject to a rapid screening system in accordance with Ministry guidelines;
2. By December 2010, all sites on the Hazardous Activities and Industries List will have been subject to a rapid screening system in accordance with Ministry guidelines, and a remediation programme will have been developed for those that qualify as high risk; 

3. By December 2015, all high risk contaminated sites will have been managed or remediated. A timeframe will also have been developed to address the management or remediation of remaining sites.

These targets are unlikely to be achievable in the timeframe proposed, but it is anticipated that the environmental result set out in the proposed NRRP to be achieved within 10 years of the plan becoming operative objective is more realistic. This result states that ‘All land where activities listed in Schedule WQL3 have occurred or are occurring has been identified, registered on the LLUR, and an assessment of the potential risk to the environment, using national procedures for screening contaminated land, has been completed’ (ECan 2004a, p4.234).

The results presented in this paper and the initiatives taken to enable large scale use of the RSS may be useful to other Regional Councils planning on using this system to prioritise sites for further investigation.

ACKNOWLEDGMENTS

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REFERENCES


Environment Canterbury (ECan) 2004a. proposed Natural Resources and Regional Plan, Environment Canterbury, Christchurch.


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2 This schedule is based on the HAIL.