



**Resilient Organisations
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Discussion Paper

Should waste management be considered a lifeline in New Zealand?

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Resilient Organisations Research Programme

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Executive Summary

Lifelines (also referred to as Critical Infrastructure) provide the essential services that support the life of our community. Maintaining provision of these services in an emergency response situation is critical to the recovery of a community.

In New Zealand regional lifeline groups have been established to promote planning, resource sharing and coordination between lifeline service providers. In addition to this, New Zealand emergency law has provision for certain designated *Lifeline Utilities* to act as necessary to restore services in an emergency situation. However, solid waste management is not included in either the planning process nor is it provided for under the emergency legislation.

A qualitative assessment of the importance of waste management to a community recovery effort and semi quantitative assessment on the impact of waste management on other lifeline provisions has been carried out. In a recovery, it is shown that waste management has the potential to pose health and safety hazards such as disease and environmental pollution. Waste management is also shown to be important to the provision of many lifelines. Given this importance and dependence, great benefit would be gained from including waste management activities in lifeline planning and coordination to facilitate more effective resource planning and prioritisation.

From a legal perspective, the complexity of the waste management system would make it difficult to legislate as a Lifeline Utility. Not only are there multiple components to a solid waste system (disposal, treatment, recycling and collection), pre-disaster solid waste capacities would need to be significantly augmented to cater for the disaster generated waste and often this would entail the operation of organisations not normally involved in solid waste management. However, there would be benefits in providing legislation to require and give regulatory flexibility to pre-disaster solid waste operators and facilities to restore pre-disaster services following a disaster. This allowance would facilitate the first stage of the clean-up effort before an integrated disaster waste management system could be implemented.

1 Introduction

1.1 *What is a lifeline and a Lifeline Utility¹?*

The New Zealand Ministry for Civil Defence and Emergency Management (MCDEM) website describes lifelines as:

“the essential infrastructure and services that support the life of our community – utility services such as water, wastewater and stormwater, electricity, gas, telecommunications, and transportation networks including road, rail, airports and ports” (MCDEM 2009).

In emergencies, the provision of these lifeline services, by both public and private organisations, becomes a critical priority. To improve the response of lifeline service providers in emergencies in New Zealand regional lifeline groups have been established to promote planning, resource sharing and coordination.

From a legal perspective, New Zealand law includes provision for certain pre-defined lifelines service providers, herein referred to as *Lifeline Utilities*, to act quickly to restore critical infrastructure and services in an emergency. The Resource Management Act (RMA) 1991 provides special powers for Lifeline Utilities to act to restore any lost lifelines in an emergency and the Civil Defence and Emergency Management (CDEM) Act 2002 stipulates certain obligations for Lifelines Utilities to restore services in an emergency (see Section 3.2).

The RMA and CDEM Act have slightly differing definitions of Lifeline Utilities², but essentially they include:

- Distribution or transmission of fuel / energy
- Telecommunications and radiocommunications
- Electricity operation and distribution
- Supply and distribution of water
- Drainage or sewerage system and disposal
- Construction or operation of road or railway line
- Operation of an airport
- Operation of an air traffic control service

In the CDEM Act the Minister may only recommend addition of a Lifeline Utility to Part B, Schedule 1 if “the business provides a service or system the reduced availability, or non-availability, of which would constitute a hazard”³.

Note that not all lifelines involved in regional lifelines groups are “Lifeline Utilities” under New Zealand law.

1.2 *Should waste management be included as a lifeline or a Lifeline Utility?*

Currently, waste management services are not routinely included in lifeline groups and are not legally identified as Lifeline Utilities. Therefore, the aim of this discussion paper is to analyse whether provision of waste management services should be included as a lifeline

¹ Lifeline may also be referred to as “critical infrastructure”

² RMA s167 (a)-(h) and CDEM Act Schedule 1 Part B

³ CDEM Act s61(3)

and/or a Lifeline Utility. Using the definition given in the CDEM Act, we need to ask ‘*would non-availability of some or all parts of a waste management system constitute a hazard?*’

To answer this question we need to look at what the impact of waste service provision or non-provision would have in peace-time and in a disaster situation, including impact on other lifelines. Secondly we need to consider what advantages and disadvantages there would be if waste management was included as a lifeline and/or Lifeline Utility.

2 Waste impact

2.1 General

The presence of human generated solid waste in our environment has many potential public health, safety and environmental hazards associated with it. Left unmanaged waste can: become a breeding ground for disease carrying vectors (e.g. mosquitoes, vermin etc); contaminate waterways; create visual and odour problems; release toxic pollutants to the environment; introduce secondary hazards such as blocked waterways and fire hazards etc. Immediately following a disaster waste and debris can block access ways and can hinder rescue efforts, welfare and lifeline provision. In addition to physical hazards poor waste management also affects the economic and social functioning of a community.

In peace-time⁴ there are generally two main waste streams (Tchobanoglous, Thiesen et al. 1993):

- municipal solid waste (including residential, commercial, institutional, construction & demolition)
- industrial wastes (including agricultural, mining)

Following a disaster three additional waste streams may be generated:

- disaster generated debris and waste (including construction and demolition, spoiled food, vegetation, vehicular, household hazardous wastes, electrical equipment etc)
- emergency and relief service waste (e.g. individually packaged food, plastic bottles, medical wastes etc)
- surplus in-kind donations

It is likely, in a large scale event, that the peace-time municipal and industrial waste streams will also be altered due to business disruptions and displaced persons.

For the purpose of this discussion the (altered) pre-disaster waste streams and the disaster waste streams will be considered separately – herein referred to as municipal waste and disaster waste respectively. There are organisational reasons for this distinction which are discussed later (refer Section 4.1).

2.2 Impact on Lifelines

Firstly we can explore waste management using a qualitative approach. New Zealand MCDEM states five emergency response priorities and five main (not prioritised) recovery tasks (MCDEM 2005). Table 2.1 lists these tasks and makes a general comment on the impact of non-provision of municipal and disaster waste services on each activity.

⁴ The term ‘peace-time’ refers to any time outside and emergency response or recovery period.

Table 2.1 Municipal and disaster waste impact on disaster response and recovery (if poorly managed)

	Municipal Waste	Disaster Waste
Response		
Preserve life	Poses a public health risk	Blocks access
Maintain law and order		Blocks police and armed forces access Contributes to perception of chaos
Care of sick, injured and welfare provision	Potentially contaminates water supply Poses a public health risk	Blocks access of essential services
Property protection		Blocks access Generates secondary hazards (fire and flood due to blocked waterways)
Re-establish essential services	Potentially contaminates water supply	Blocks access – roads and service corridors Potentially contaminates water supply
Recovery		
Community	Contributes to a sense of abnormality through the absence of peace-time service	Reminds of disaster
Social Environment	Poses a public health risk	Poses a public health and safety hazard
Built Environment		Delays reconstruction activities
Economic Environment	Poses a public health risk affecting workforce	Disrupts business activities (access, health and safety concerns etc) Delays reconstruction activities and return to economic normalcy
Natural Environment	Causes illegal dumping Contaminates land and/or water Minimises resource recovery through mixing with 'clean' debris ⁵	Poses a risk of hazardous material spills Poses a risk of long-term environmental effects from inappropriate treatment /disposal of waste

From this cursory qualitative analysis we can see that waste has a direct impact on the key response and recovery tasks. However, to determine its relative importance we need to measure it against other key lifelines in the New Zealand context. Table 2.2 uses the same key response and recovery activities as above. Against each activity, each lifeline is rated as

⁵ Clean debris refers to material that may be separated for recycling or reuse. If mixed with municipal waste then recycling and reuse of debris becomes more labour intensive and time consuming.

to its importance to the success of each activity. 5=High and 1=Low. Each activity is also given an importance weighting relative to the overall response and recovery respectively. The weighting for response activities is based on the prioritised MCDEM list and assuming a linear regression of importance down the list. For the recovery activities it is assumed that all components are of equal weighting or importance to the overall effectiveness of the recovery. The aggregated scores are the weighted total. Note for the purposes of this analysis a large scale earthquake scenario in Wellington, New Zealand has been selected.

Due to the subjective nature of the risk assessment (for assigning both weighting and importance values), any activity scoring above, say 4, would be considered high priority, 3-4 average importance and below 2 low importance (subject of course to dependencies between lifelines, refer Section 2.3).

During the response activities (up to 1 week) the highest priority activities are roading and telecommunications. Disaster waste is of average importance and municipal waste management in the response phase is very low priority, alongside rail and sea transport.

In the recovery phase (after 1 week) the relative priorities change. Roding still remains the highest priority, while municipal waste and disaster waste (due to the potential for public health risk and social disruption if left unmanaged) were seventh equal (out of fourteen lifelines) priorities. Rail and sea transport and gas provision were the lowest priorities in this analysis.

Despite the subjective nature of this assessment, it is clear that both municipal and disaster waste management rank alongside and in some cases above other currently designated lifelines and Lifeline Utilities for importance to response and recovery activities.

Table 2.2 Lifeline importance for main response and recovery activities after a major urban earthquake in Wellington, New Zealand

	Weighting	Roading	Rail Transport	Sea Transport	Air Transport	Water Supply	Sanitary Drainage	Stormwater Drainage	Electricity	Gas	Fuel Supply	Broadcasting	Telecommunications	Municipal Waste	Disaster Waste
Response (1st week)															
Preserve life	0.3	5	3	3	4	5	3	4	4	3	5	5	5	1	4
Maintain law and order	0.25	5	2	2	4	5	4	3	5	3	4	5	5	3	4
Care of sick, injured and welfare provision	0.2	5	2	3	5	5	4	2	5	4	5	4	4	3	3
Property protection	0.15	5	1	2	2	3	4	4	4	3	3	3	4	1	2
Re-establish essential services	0.1	5	2	3	4	3	3	3	3	3	5	4	5	1	3
Total Importance - response		5	2.15	2.6	3.9	4.5	3.6	3.25	4.35	3.2	4.45	4.4	4.65	1.9	3.4
Recovery (1 week onwards)															
Community	0.2	5	3	2	3	5	5	3	4	2	5	5	5	5	4
Social Environment	0.2	5	2	3	4	5	5	4	4	3	4	5	5	5	4
Built Environment	0.2	5	3	3	3	4	4	4	5	4	5	4	4	3	5
Economic Environment	0.2	5	4	5	5	5	5	4	5	4	5	4	4	3	3
Natural Environment	0.2	4	2	2	2	3	5	5	1	1	2	3	3	4	4
Total Importance - recovery		4.8	2.8	3	3.4	4.4	4.8	4	3.8	2.8	4.2	4.2	4.2	4	4

2.3 Lifeline dependency

Provision or non-provision of one lifeline service can directly impact provision of other lifelines – this is referred to as lifeline dependency. Table 2.3 below is a matrix of 12 lifelines plus municipal waste and disaster waste. The matrix was adapted from a number of regional interdependency analyses (Centre for Advanced Engineering 1991; Auckland Regional Council 1999; Hawke's Bay Engineering Lifelines Project 2001). The matrix assesses the dependency of lifelines (along the top row of the matrix) on all the other lifeline (along the rows of the matrix).

A similar ranking process to the previous analysis was used. For each lifeline along the top row of the table, a dependency rating on the other lifelines was qualitatively assessed. The ranking refers to the ability of a certain lifeline to function without the functioning of a given lifeline. As for the previous assessment 5=high dependency on a given lifeline (i.e. air traffic cannot function without fuel supply so it is given a 5 for high dependency) and 0=no dependency. The scores for each lifeline were totalled vertically and horizontally to indicate lifeline dependency and importance respectively. This type of assessment is useful in determining the prioritisation of resources – priority given to lifelines with high importance to other utilities. Lifelines with high dependencies are very vulnerable in a disaster situation.

The results of this analysis are consistent with an Auckland Engineering Lifelines Report which surveyed Lifeline Utilities (of which waste management services are currently not included) on which services they most relied on. The results showed road transportation, mains electricity, mobile telephone communications, VHF radio and backup electricity are the most important (AELG 2005).

In terms of waste, the table shows that disaster waste management is moderately important to provision of other lifelines (7/14 in this analysis). This is primarily as a result of the potential for disaster waste to block access to lifeline infrastructure and the potential for unmanaged waste to disrupt other lifelines such as blocking of sanitary sewers and obstruction of stormwater drains and overland flowpaths.

Disaster waste is also very dependent on other lifelines. In particular: roading, fuel, and telecommunications (for collection and transportation equipment and general logistics); water supply and sanitary and stormwater drainage (for management of hazardous goods, treatment of recycled goods and management of disposal sites).

Municipal waste collection, however, shows a very low importance and low dependency on other lifelines.

Table 2.3 Interdependency Analysis: 1 Week to 1 Month after a major urban earthquake in New Zealand

Assessing the dependency of these lifelines															
On these lifelines	Roading	Rail Transport	Sea Transport	Air Transport	Water Supply	Sanitary Drainage	Stormwater Drainage	Electricity	Gas	Fuel Supply	Broadcasting	Telecommunications	Municipal Waste	Disaster Waste	Total Importance
Roading		5	5	5	5	5	5	5	5	5	5	5	5	5	65
Rail Transport	4		4	4	1	1	1	4	3	4	4	4	1	2	37
Sea Transport	3	4		2	2	2	2	4	3	5	3	3	1	3	37
Air Transport	3	3	3		3	3	3	4	2	3	3	3	1	1	35
Water Supply	4	4	3	5		5	4	4	3	4	4	4	2	5	51
Sanitary Drainage	3	3	2	3	3		4	1	2	4	3	3	3	3	37
Stormwater Drainage	2	2	2	3	3	4		3	3	4	3	3	3	3	38
Electricity	5	5	4	5	3	3	3		4	5	5	5	3	4	54
Gas	5	5	3	4	3	3	3	2		4	4	4	2	2	44
Fuel Supply	5	5	5	5	1	1	1	5	4		4	4	5	5	50
Broadcasting	2	2	2	5	1	1	1	3	4	4		4	2	4	35
Telecommunications	5	5	5	5	4	4	4	5	5	5	4		3	4	58
Municipal Waste	2	2	1	1	4	4	4	1	1	1	1	1		3	26
Disaster Waste	4	4	3	2	3	4	4	3	3	4	2	3	4		43
Total Dependency	47	49	42	49	36	40	39	44	42	52	45	46	35	44	

3 Advantages in becoming a lifeline and/or Lifeline Utility

3.1 Resourcing

Following a large-scale disaster resources are likely to be at a premium. During both the response and the recovery periods private and public entities will be competing for limited plant, equipment and personnel. Prioritisation of these resource demands needs to be approached in a collaborative way. The regional lifeline groups established in New Zealand are an effective way to plan for disasters. The groups help utility operators to prioritise their resourcing needs to effectively meet the community's needs. Given the moderate dependency of other lifelines on disaster waste management shown in Section 2.3, the advantage of including the waste management sector as a whole in this coordination and collaboration process, both pre and post disaster, is clear.

3.2 Legislative authority

Current legislation in New Zealand applicable to Lifeline Utilities in a disaster include the CDEM Act and RMA.

The CDEM Act requires Lifeline Utilities to ensure their facilities and services are able to function to the fullest possible extent⁶. Currently, aside from any commercial agreements, solid waste management entities are not legally required to operate and maintain their service in a disaster event. However, the provision of solid waste management facilities and services, as shown in Section 2, is very important in both the recovery and response period.

The RMA provides powers to Lifeline Utilities to act as necessary without prior consent to mitigate adverse effects of an emergency⁷. If the waste management facilities were identified as Lifeline Utilities (or network utility operators as defined in the RMA⁸) prior to the event they would, under the emergency provision of the RMA, automatically have authority to quickly undertake any repairs necessary to 'mitigate any actual or likely effect of, the emergency'⁹.

Following Hurricane Katrina, both the Louisiana and Mississippi Departments of Environmental Quality used their powers under emergency waivers to authorise waste management facilities to make all necessary repairs to their facilities (leachate and stormwater systems etc) without prior notification to the environmental department (LDEQ 2005) (MDEQ 2005). If waste management entities were established as Lifeline Utilities prior to a disaster the delay, in waiting for an emergency order or authority such as this issued under the RMA, would be removed.

⁶ CDEM Act s60(a)

⁷ RMA s330(1)(c)

⁸ RMA s167

⁹ RMA s330(1)

4 Obstacles in becoming a lifeline and/or Lifeline Utility

4.1 Organisational Complexity

The waste management system, from collection to disposal is often operated by a number of separate entities. Potentially several entities may be involved in each of the four waste system aspects:

- Kerbside collection (including bin / bag provision)
- Recycling / Composting facility and/or exporter
- Treatment facility (e.g. incineration, hazardous material treatment)
- Final disposal (e.g. landfill, land reclamation)

Following a disaster waste management strategy will often include demolition activities. This may further complicate the organisational structure and makes the roles and responsibility of disaster waste management as a potential lifeline less clear.

From a legislative point of view it is likely that each of these aspects / entities would need to be considered as separate Lifeline Utilities.

4.2 Problem of scale

Following a disaster, as discussed in Section 2, waste and emergency managers must deal with both municipal and disaster waste. Depending on the scale and nature of the disaster, peace-time municipal waste entities will be called on, to varying degrees to assist in the disaster waste management. In some cases, such as the response to the Victorian Bushfires 2009, the municipal and disaster waste management systems will be run almost entirely independently. There may be some aspects of the peace-time system used to handle disaster waste, such as disposal and treatment facilities but it is likely an entirely different system will be used to collect, handle and dispose of the disaster waste including provision of new treatment and disposal facilities.

For most utility service providers their task is clear-cut – to return their services to pre-disaster levels (or at least to meet the short and then longer term needs of the community). Operators will generally have in-house crews or contractors that will be able to restore utility function. However, to meet the needs of disaster waste management, additional facilities, equipment and personnel (potentially from organisations not involved in peace-time waste management) are likely to be required to deal with the high volume of waste produced.

The question is then, if waste management was to be included as a Lifeline Utility, would the legal provisions apply to only pre-disaster waste management operators or would additional service providers, brought in to deal solely with disaster waste be granted the special emergency powers described in Section 3.2?

In terms of accountability, Lifeline Utilities have responsibilities to function under the CDEM Act. According to an Auckland Engineering Lifelines Group survey of utility operators (AELG 2005), in general, it is in the commercial interest of utility services to act quickly and meet community expectations as well as legal responsibilities. Short-term or new waste facility operators, introduced to deal with disaster waste only may not feel the same level commercial accountability, therefore legal obligations would be needed to ensure adequate service provision. For contractors this could be done through contract terms, however, for any new entity established to manage disaster waste, legal requirements such as those in the CDEM Act would ideally be applicable.

At the same time, the RMA provides flexibility to Lifeline Utilities to act outside the peace-time requirements of the RMA to mitigate effects of emergencies. There is also a potential for short term operators to use this legal flexibility for short term gain if legal boundaries for acceptable actions are not established (refer below).

4.3 Legal boundaries

The definition of the actions that can be taken by Lifeline Utilities under the RMA may need refining to clarify whether the actions to be taken are just to return to pre-disaster functioning or whether actions should be taken to manage the additional waste. ‘Mitigate any actual or likely adverse effect of, the emergency’¹⁰ could be interpreted to mean that Lifeline Utilities were entitled to not just make repairs to existing systems but to also move to augment existing facilities to handle the additional waste (as provision of waste management services is their responsibility as a Lifeline Utility). Should ‘actions’ include expanding an existing facility to accept additional waste? Or perhaps altering incineration standards to process more waste? Or is it just to return the service to its pre-disaster functioning?

Under the CDEM Act Lifeline Utilities must ensure they are able to “function to the fullest possible extent”.

The extent of allowable / required actions under both these legislation, would need to be clarified for disaster waste management.

4.4 System cohesion

In a complex system like waste management, with multiple organisations (often augmented in a disaster situation, refer Section 4.1), if each entity is given latitude to act independently, there is potential for lack of coordination and strategic decision-making for overall management of disaster waste. Most utility services or networks are largely run by one organisation or in a commercial partnership with a common goal. Disaster waste management requires strategic decision making specific to that event. Overall waste management goals and strategies need to be determined. Individual entities in the waste management system are likely to have differing and potentially conflicting goals (eg landfill operator wants to accept as much waste as possible, recycling operator wants to recycle as much as possible). The waste system needs overall coordination and latitude for individual entities within the system needs to be bounded.

5 Summary

Waste management clearly meets the definition of a lifeline is “a utility service which supports life”. Without appropriate waste management facilities and services, in peace-time or in a disaster situation, communities would be vulnerable to health and safety hazards such as disease and environmental pollution.

As shown in the lifeline dependency analysis, disaster waste management is important to the provision of many lifelines. Great benefit would be gained from including waste management activities in lifeline planning and coordination to facilitate more effective resource planning and prioritisation.

¹⁰ RMA s330(1)

Due to the complexity of the waste management system it is likely that waste management activities would need to be separated into disposal, treatment, recycling and collection to effectively be operated as Lifeline Utilities.

While most Lifeline Utilities will need to provide their pre-disaster service only, waste management entities would potentially be required to provide augmented services to deal with the disaster generated waste. To account for this, waste activities need to be separated into municipal (or pre-disaster) and disaster (or post-disaster) services. Provision of municipal waste services will remain largely unchanged, however, certain aspects of the waste management system, such as disposal and treatment facilities, are likely to be required to handle disaster waste as well.

Under current emergency provisions of the RMA for Lifeline Utilities it is unclear whether entities would simply have authority to restore their pre-disaster service or whether they would be able to go ahead and manage the additional disaster waste. In addition disaster waste management will often involve entities which are not part of the municipal system. It is questionable (for commercial and accountability reasons) whether or not these additional, potentially short-term operations / operators should be given the same legal provisions, as Lifeline Utilities. Given, these factors and the need for overall strategic and cohesive management of disaster waste (Brown and Milke 2009), it would seem beneficial to limit the autonomy of waste entities to restoring pre-event services until a clear and coordinated approach to management of the disaster generated waste could be established.

6 Recommendations

- At a minimum waste management should be included in lifelines coordination, prioritisation and planning.
- Municipal (pre-disaster) waste management entities (that is all parties involved in municipal waste management) should be included as Lifeline Utilities.
- Under the RMA provisions for Lifeline Utilities, actions should be limited to restoration of pre-disaster functioning (including municipal waste collection where applicable).
- It follows that waste management entities and facilities established specifically for disaster recovery should not be operated as Lifeline Utilities.
- Expansion of existing services and/or facilities should be carried out under a strategic disaster waste management plan and should be authorised / directed under the designated RMA authority, not the waste facility / entity itself.

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