# Disaster Demolition and Debris Management Guidelines and Policy Recommendations

**Prepared for** Environment Canterbury
Ministry of Civil Defence and Emergency Management

**Written by** Charlotte Brown

**Date:** April 2012

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PART ONE: Disaster Demolition and Debris Management Guidelines

**Forward**

The first draft of the guidelines was developed based on the experiences managing disaster waste following the February 2011 Christchurch earthquake response and the findings of the author’s PhD thesis entitled “Disaster Waste Management: a systems approach”. The author’s thesis reviews the disaster waste management responses following the 2011 Christchurch earthquakes, New Zealand; 2009 Victorian Bushfires, Australia; 2009 Samoan Tsunami; 2009 L’Aquila earthquake, Italy; and 2005 Hurricane Katrina, United States.

The second draft of the guidelines incorporates comments from a number of local government Authorities (both civil defence and waste management) and waste management contractors obtained during a review process carried out in March 2012.
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1. Introduction

New Zealand is vulnerable to many natural and man-made hazards, including: earthquakes, volcanic eruptions, floods, wildfires, tsunamis, snowstorms, tornadoes, pandemics, oil spills, and industrial failures. Depending on the size and location of impact, these events can generate significant volumes of waste.

The presence of disaster waste impacts almost every aspect of an emergency response and recovery effort. In the immediate response disaster debris can cause road blockages which in turn impedes rescuers, emergency services and lifeline support reaching survivors. Waste presence in a community also potentially poses a public health risk. Organic wastes and standing pools of water (caused by debris blocking flow paths) can become vector breeding grounds.

In the longer term, poor management of a clean-up can result in a slow and costly recovery. Limited rebuilding / repair can be carried out before the waste is removed. The prolonged exposure to the waste is also potentially risky to public and environmental health. If managed effectively, debris can become a valuable resource in the recovery and rebuilding process and can have a positive effect on social and economic recovery.

Both Civil Defence and waste managers at local, regional and national level should be planning for management of disaster waste.

The following guidelines have been prepared to assist communities to prepare for and respond to disaster events. Because different disaster events have different impacts and require different responses, the guidelines have primarily been written to assist in decision-making post-event rather than as a prescriptive plan. There are a number of important steps, which have been identified, that can be taken to prepare for management of disaster waste pre-event to enable a more efficient and effective waste management programme.

The guidelines include a number of examples from previous disaster events in New Zealand and internationally. A significant number of examples are provided from the 2011 Christchurch earthquake response. Case study examples are provided in boxes throughout the guidelines.
A post-disaster waste management plan template is included in Appendix A. The guidelines provide the background and decision-making guidance to enable plan development.

2. Legal context

2.1.1 State of Emergency

During a State of Emergency the Civil Defence and Emergency Management Act 2002 provides full powers to act to protect the public and property.

2.1.2 Recovery phase

In New Zealand, generally, outside a state of emergency, ‘peace-time’ laws must be adhered to. New Zealand laws currently have several emergency provisions which may be applicable to management of disaster waste. The provisions are summarised in Table 2.1 and explained in Appendix B. Generally these provisions can only be used when there is a direct threat to public health and safety and therefore may not always be suitable to facilitate long term disaster waste management.

Table 2.1 Emergency powers in current ‘peace-time’ New Zealand law

<table>
<thead>
<tr>
<th>Act or Rule</th>
<th>Emergency powers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biosecurity Act 1993</td>
<td>Full powers to remove any biosecurity threat</td>
</tr>
<tr>
<td>Building Act 2004</td>
<td>Powers to remediate or demolish dangerous or insanitary buildings.</td>
</tr>
<tr>
<td>Fire Service Act 1975</td>
<td>Full powers to act to save lives and property</td>
</tr>
<tr>
<td>Government Roading Powers Act 1989 No. 75</td>
<td>Powers to clear state highways and associated drainage (including private property access)</td>
</tr>
<tr>
<td>Hazardous Substances and New Organisms Act 1996</td>
<td>Powers to remove hazard in any emergency</td>
</tr>
<tr>
<td>Health Act 1956</td>
<td>Provision for Governor General to make regulations to protect health at any time by Order in Council.</td>
</tr>
<tr>
<td>Land Transport Act 1998</td>
<td>Some emergency powers but unlikely to be activated in relation to waste management</td>
</tr>
<tr>
<td>Local Government Act 2002</td>
<td>Emergency right of entry powers</td>
</tr>
<tr>
<td>Maritime Transport Act 1994</td>
<td>Emergency powers to respond to oil spills only</td>
</tr>
<tr>
<td>Public Works Act 1981</td>
<td>Right of entry and power to act where there is imminent</td>
</tr>
</tbody>
</table>
danger to life or property or serious interference with any public work.

<table>
<thead>
<tr>
<th>Act/Matter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resource Management Act 1991</td>
<td>Power to take emergency actions to protect life, property and/or the environment.</td>
</tr>
<tr>
<td>Waste Minimisation Act 2008</td>
<td>Power to waive waste levy</td>
</tr>
</tbody>
</table>

Other Acts and Rules which may be relevant to disaster waste management but do not have emergency powers include:

- Health and Safety in Employment Act 1992
- Dangerous Goods Rule 2007
- Radiation Protection Act 1965

The Civil Defence and Emergency Management Act 2002 has provisions for a Recovery Coordinator to be appointed, however, they have limited regulatory and legislative authority to facilitate recovery (and disaster waste management).

Following extreme events, recovery specific legislation may be developed and this may have provisions suitable for facilitating management of disaster waste (see Box 2.1).

Decision-makers must ensure that regional and local plans and bylaws are reviewed and considered during system design (see Box 2.2).

**Box 2.1   Recovery specific legislation**

The Canterbury Earthquake Recovery Act 2011 (the CER Act) was established to facilitate a timely and effective recovery of Christchurch. The CER Act established the Canterbury Earthquake Recovery Authority (CERA). The CER Act included provisions for CERA to instruct and/or carry out demolition of a dangerous building (and to recover associated costs from building owners); and to change a large number of pieces of legislation, by Orders in Council, to facilitate recovery. In terms of waste management, Orders in Council were primarily used to expedite the Resource Management Act process to: establish additional waste handling facilities and alter operating parameters at existing facilities; expedite heritage and archaeological processes prior to building demolition; and to increase allowable truck loads.
Box 2.2 Regional and local plans and bylaws
Following the Canterbury earthquake in September 2010, the Christchurch City Cleanfill Bylaw (a law which ensures consistent disposal standards are applied across all cleanfill (construction and demolition landfill) sites in Christchurch and encourages recycling) was suspended to increase the disposal capacity in Christchurch. However, due to confusion over the waste acceptance criteria at each site, some cleanfills accepted material which breached their regional resource consent conditions. As a consequence, the cleanfill bylaw remained in place following the more destructive February 2011 Christchurch earthquake.

3. Funding mechanism
Generally in New Zealand, there is an expectation that waste management on private properties will be paid for through private insurance. However, in several recent events in New Zealand, public funding has been provided for some disaster clean-up activities. For example, kerbside collections following the 2011 Central Hawke’s Bay floods, 2007 & 2011 Taranaki tornadoes, and for silt collection following the 2010 & 2011 Christchurch earthquakes. It would be beneficial for local authorities to determine the extent of private-public funding responsibilities pre-event. There are several issues to consider and these are discussed below.

One of the drawbacks to private funding systems is that the recovery is dependent on individuals acting expediently and effectively. If private funding is to be relied upon, for any aspects of the clean-up mechanisms should be put in place to ensure that the community recovery (from an environmental, economic and social perspective) is not adversely affected by the actions of individual entities. For example, by slow debris removal or improper waste handling such as illegal dumping. Funding for residential, commercial and public infrastructure should all be considered (see Box 3.1).

Box 3.1 Making private funding systems operationally effective
Following the 2011 Christchurch earthquake, the CER Act gave authority to CERA to direct private building owners to take remedial action on dangerous properties within a specified time to ensure that the recovery was not slowed by individual (property owner or insurer) inaction.
Due to the limitations on private funding system (above), there may be instances where it would be beneficial to advocate for and mobilise public funding to manage disaster waste. Public funding generally provides a low risk funding option as authorities have greater control on how the funds are managed. In particular it is recommended that public funding be considered when there is:

- A high number of displaced people
- A high human health hazard
- Movement of waste across property boundaries
- A low level of private insurance

In general, where the risk (likelihood and consequence) of mismanagement waste is high, then a low risk (quantity, quality and timeliness) funding source should be used.

Whether private or public funding, disaster waste authorities must be aware of potential funding gaps. If funding scope is limited, efforts need to be made to provide education, assistance and incentives for individuals to appropriately deal with that waste. This is particularly important when dealing with potentially hazardous wastes.

4. Strategic management

To enable successful disaster waste management, an organisation and role within that organisation needs to take ownership and responsibility for the disaster waste. Local and regional councils will need to determine whether responsibility for disaster waste management should sit with a) waste management or civil defence personnel and b) local or regional or national authorities.

In terms of a), the civil defence structure in most regions in New Zealand lends itself to a joint approach between waste and civil defence personnel. It would be valuable to have one or more waste management personnel (at local and regional level) linked to and trained in the civil defence structure. Ideally a pre-event (and post-event) plan would be developed jointly between waste and civil defence personnel. Generally, it is recommended that the plan and strategic management post-disaster should ‘officially’ sit within the civil defence framework / structure as they have ultimate responsibility and legal mandate for restoration following a
disaster event. It is likely that waste management would sit under Operations in the Civil Defence response structure and the Built Environment Group in the recovery structure.

In terms of b), it is recommended that, pre-disaster, plans are prepared at local / regional level (to be determined within each region) (not that municipal waste management contingency plans should be in place at local level). Post-disaster, it is recommended that an authority at the level of the state of emergency declaration should take responsibility for the strategic management of the waste. For example, a national declaration would call for a national strategic management group.

Both in preparation of a plan pre-disaster and post-disaster it is beneficial to include representatives from all relevant authorities (at the appropriate governance level) and stakeholders. Pre-disaster it would be beneficial for these relevant entities to meet, network, train and update the plan regularly. Having established relationships pre-event is very valuable in a response situation. Post-disaster, establishing a working group with these organisations would be useful. Typically organisations to involve will include:

- Disaster response and recovery authority representative
- Waste management operational representatives (likely local authority but it is important to include industry where applicable)
- Environmental authorities
- Health and safety authorities
- Public health authorities
- Hazardous substance authorities and industry
- Lifeline authorities (particularly with respect to demolition works)
- Marine authorities (for events with debris in marine environmental)
- Transportation authorities
- Heritage building authorities
- Non-domestic agencies (e.g. international governmental and non-governmental groups)(if any)
- Iwi
- Community representatives
It is important that a strategic management team has a person dedicated to public communication. Under current Civil Defence arrangements Public Information Management (PIM) is a separate response function. It is recommended that a PIM representative be dedicated to the demolition and debris management process.

Strategic managers / the working group will be responsible for:

- Determining policy objectives (see Section 7).
- Estimating waste volumes and composition.
- Determining operational guidelines for demolition and waste management.
- Liaising with other response / recovery managers.
- Prioritising resources to meet recovery objectives.
- Anticipating and mitigate potential problems.
- Assigning responsibility for, and oversee, post-disaster environmental and human health risk management.
- Ensuring appropriate monitoring systems are in place to enable effective strategic management and planning.
- Developing and utilising a transparent decision-making process and protocols for inter and intra-organisational collaboration.
- Developing a proactive communication strategy.
- Developing a relationship with the funding provider.
- Facilitating regulatory and legislative changes where necessary and aim to anticipate necessary legislative changes and minimise the number of legislative changes and/or avoid unnecessary legislative changes.
- Post-event response review.

The working group, should be established as soon as practicable after the disaster event. Ideally the working group should carry through the transition from response to recovery. It is important that the working group has a mandate distinct from their ‘peace-time’ mandate such that recovery objectives can be met. Normal inter- and intra-organisational relationships may need to be streamlined to facilitate this.
5. Disaster impacts

5.1 General
Disaster waste will be generated almost all natural and man-made hazards. When planning for disaster demolition and debris management before an event it is easy to get overwhelmed with the number of scenarios that are likely both across and within these hazard types. These guidelines suggest that planners concentrate on ten key factors or ‘indicators’ which are likely to alter how disaster debris can be managed. The indicators are divided into disaster impacts and disaster waste impacts. Pre-disaster these indicators will be useful when generating disaster scenarios to test / build plans. Post-disaster these indicators can be used for rapid assessment.

The indicators are described below and a semi-quantitative rating scale is suggested. Possible information sources useful for making these assessments post disaster are provided for the waste characteristic indicators.

5.2 Disaster impact indicators
The following disaster impact indicators may indirectly affect how waste can be managed.

1. The general disaster scale (e.g. the number of persons deceased, the proportion of the population affected, the proportion of buildings destroyed, the projected recovery time, the economic impact, the resources required to manage the response, lifeline disruption). In New Zealand the scale of an event may be as defined in Incident response plans or as defined by the level of a Civil Defence State of Emergency declaration.

<table>
<thead>
<tr>
<th>Low</th>
<th>Medium</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minor level of damage and disruption. Local resources only required to manage the event. Project recovery time: 1-2 years.</td>
<td>Moderate level of damage, possible loss of lives. Regional resources required. Projected recovery time: 2-5 years.</td>
<td>Significant loss of lives and damage to buildings and infrastructure. National and/or international resources required to manage the response. Projected recovery time: over 5 years.</td>
</tr>
</tbody>
</table>
In New Zealand the scale of an event may be largely determined by Civil Defence and the corresponding level of the State of Emergency (if any).

2. The number of displaced persons (who are wanting to return)

<table>
<thead>
<tr>
<th>Level</th>
<th>Low</th>
<th>Medium</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No or less than 1% of population displaced. Or with most or all of</td>
<td>1-20% population displacement in affected area, with some or all</td>
<td>Over 20% of population in affected area is displaced, with some or</td>
</tr>
<tr>
<td></td>
<td>the population intending to move permanently from the affected area.</td>
<td>intending on returning to the area.</td>
<td>all population intending on returning to the area.</td>
</tr>
</tbody>
</table>

3. The geographical extent of the impact (including effects of geographical isolation)

<table>
<thead>
<tr>
<th>Level</th>
<th>Low</th>
<th>Medium</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Area of impact confined to one or two localities, with easy access</td>
<td>Regional area of impact. Some or limited access to and from affected</td>
<td>Extensive area of impact, across multiple regions. Difficult access</td>
</tr>
<tr>
<td></td>
<td>to unaffected areas.</td>
<td>areas.</td>
<td>to and from affected area.</td>
</tr>
</tbody>
</table>

4. The hazard duration

<table>
<thead>
<tr>
<th>Level</th>
<th>Low</th>
<th>Medium</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>One off event. No recurrence of hazard event (e.g. a single strike</td>
<td>One off event with prolonged effects (e.g. prolonged presence of</td>
<td>Multiple, on-going effects of hazard (e.g. on-going severe aftershocks): for up to 1 month</td>
</tr>
<tr>
<td></td>
<td>tsunami)</td>
<td>floodwaters): up to 1 week</td>
<td>up to 1 month</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note that, related to this, is whether or not a hazard is a slow or rapid onset. In a slow onset event (such as an oil spill or potentially a flood) authorities have time to plan, pre-position supplies and people have time to put mitigation measures in place (such as move furniture above group in a flood situation).

5. Disruption to road network

<table>
<thead>
<tr>
<th>Level</th>
<th>Low</th>
<th>Medium</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Minimal damage to road network.</td>
<td>Roading networks are moderately to severely disrupted for up to one month. Authorities require minimal traffic movement.</td>
<td>Roading networks are disrupted for more than a month. Authorities require minimal traffic movement.</td>
</tr>
</tbody>
</table>

Table 5.1 shows typical ranges for disaster impacts based on different hazard types.
Table 5.1  Typical range of disaster impacts for different hazard types

<table>
<thead>
<tr>
<th>Types of Disasters</th>
<th>Disaster scale</th>
<th>Number of displaced people</th>
<th>Geographical extent</th>
<th>Hazard duration</th>
<th>Disruption to road network</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hurricanes / Typhoons</td>
<td>L-H</td>
<td>L-H</td>
<td>M-H</td>
<td>L-M</td>
<td>L</td>
</tr>
<tr>
<td>Tsunamis</td>
<td>L-H</td>
<td>L-H</td>
<td>L-H</td>
<td>L</td>
<td>L-M</td>
</tr>
<tr>
<td>Tornadoes</td>
<td>L-M</td>
<td>L</td>
<td>L-M</td>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td>Floods</td>
<td>L-H</td>
<td>L-H</td>
<td>L-M</td>
<td>L-M</td>
<td>L-H</td>
</tr>
<tr>
<td>Earthquakes</td>
<td>L-H</td>
<td>L-H</td>
<td>L-H</td>
<td>L-H</td>
<td>L-H</td>
</tr>
<tr>
<td>Wildfires</td>
<td>L-H</td>
<td>L-H</td>
<td>L-H</td>
<td>L-M</td>
<td>L</td>
</tr>
<tr>
<td>Ice storms</td>
<td>L-M</td>
<td>L</td>
<td>M-H</td>
<td>L-M</td>
<td>L-M</td>
</tr>
<tr>
<td>Volcanic eruption</td>
<td>L-H</td>
<td>L-H</td>
<td>H</td>
<td>L-H</td>
<td>H</td>
</tr>
<tr>
<td>Pandemic</td>
<td>L-H</td>
<td>L</td>
<td>H</td>
<td>M-H</td>
<td>L</td>
</tr>
<tr>
<td>Industrial disaster</td>
<td>L-H</td>
<td>L-M</td>
<td>L-M</td>
<td>L-H</td>
<td>L</td>
</tr>
</tbody>
</table>

L = low, M = medium, H = high

5.3 Waste characteristic indicators

1. Volume of waste

<table>
<thead>
<tr>
<th>Low</th>
<th>Medium</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waste generated is equivalent to 1-2 years’ worth of annual waste generation.</td>
<td>Waste generated is equivalent to 2-5 years’ worth of annual waste generation.</td>
<td>Waste generated is equivalent to more than 5 years’ worth of annual waste generation.</td>
</tr>
</tbody>
</table>

*Information sources (pre-event):* local authority building information (building dimensions, material type); land-use data; hazard models.

*Information sources (post event):* damage maps, building damage assessments; LIDAR data.

2. Human health hazard (physical (e.g. fall hazard), chemical or biological)

<table>
<thead>
<tr>
<th>Low</th>
<th>Medium</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hazard poses a weak, chronic threat</td>
<td>Hazard poses a minor acute or serious chronic threat.</td>
<td>Hazard poses a serious acute and/or serious chronic threat.</td>
</tr>
</tbody>
</table>

*Information sources (pre-event):* local authority hazardous material databases; hazard models.
Information sources (post event): air monitoring; water monitoring; expert assessments; building damage assessments.

3. Environmental health hazard

<table>
<thead>
<tr>
<th>Low</th>
<th>Medium</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hazard poses a weak, chronic threat</td>
<td>Hazard poses a minor acute or serious chronic threat.</td>
<td>Hazard poses a serious acute and/or serious chronic threat.</td>
</tr>
</tbody>
</table>

Information sources (pre-event): local authority hazardous material databases; hazard models.

Information sources (post event): air monitoring; water monitoring; expert assessments; building damage assessments.

4. Movement of waste (by hazard forces and particularly cross-property or locality boundary)

<table>
<thead>
<tr>
<th>Low</th>
<th>Medium</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>The majority of the waste remains within the property boundaries.</td>
<td>Some waste is likely to travel across property boundaries.</td>
<td>Significant waste transported across property boundaries.</td>
</tr>
</tbody>
</table>

Information sources (pre-event): hazard models

Information sources (post event): observations

5. Waste handling difficulty (e.g. specialist equipment required for demolition, waste separation or heavy material removal)

<table>
<thead>
<tr>
<th>Low</th>
<th>Medium</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Persons with little or no skill can manage waste stream. Standard household and garden tools only necessary.</td>
<td>Some basic equipment is required to manage waste. Unskilled workers could be quickly trained.</td>
<td>Waste is difficult and dangerous to manage. Specialist skill and equipment is required.</td>
</tr>
</tbody>
</table>

Information sources (pre-event): local authority building data.

Information sources (post event): observations; field trials.

Table 5.2 shows typical ranges for disaster waste impacts based on different hazard types.
Table 5.2  Typical range of disaster waste impacts for different hazard types

<table>
<thead>
<tr>
<th>Types of Disasters</th>
<th>Volume of waste</th>
<th>Human health hazard</th>
<th>Environmental health hazard</th>
<th>Movement of waste</th>
<th>Difficulty of handling waste</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hurricanes / Typhoons</td>
<td>L - M</td>
<td>L - M</td>
<td>L - M</td>
<td>M</td>
<td>L - H</td>
</tr>
<tr>
<td>Tsunamis</td>
<td>L - H</td>
<td>L - H</td>
<td>L - H</td>
<td>M - H</td>
<td>L - H</td>
</tr>
<tr>
<td>Tornadoes</td>
<td>L</td>
<td>L - M</td>
<td>L - M</td>
<td>M</td>
<td>L - H</td>
</tr>
<tr>
<td>Floods</td>
<td>L - H</td>
<td>L - H</td>
<td>L - H</td>
<td>M - H</td>
<td>L - M</td>
</tr>
<tr>
<td>Earthquakes</td>
<td>L - H</td>
<td>L - H</td>
<td>L - H</td>
<td>L</td>
<td>L - H</td>
</tr>
<tr>
<td>Wildfires</td>
<td>L - M</td>
<td>L - M</td>
<td>L - M</td>
<td>L</td>
<td>M - H</td>
</tr>
<tr>
<td>Ice storms</td>
<td>L</td>
<td>L - H</td>
<td>L - H</td>
<td>L</td>
<td>L - H</td>
</tr>
<tr>
<td>Volcanic eruption</td>
<td>L - H</td>
<td>M</td>
<td>M</td>
<td>L</td>
<td>L - H</td>
</tr>
<tr>
<td>Pandemic</td>
<td>L</td>
<td>H</td>
<td>L</td>
<td>L</td>
<td>H</td>
</tr>
<tr>
<td>Industrial disaster</td>
<td>L - M</td>
<td>L - H</td>
<td>L - H</td>
<td>L</td>
<td>L - H</td>
</tr>
</tbody>
</table>

L = low, M = medium, H = high

6. Waste description

6.1 General

After determining the general waste indicators (Section 5), prior to designing the waste management system it is necessary to make a more detailed description of the waste.

6.2 Waste sources

The first descriptive categorisation is ‘waste source’. That is, delineating the wastes depending on where or how the waste originated. A waste source categorisation is useful because the waste characteristic indicators may be different between sources and therefore are likely to be managed differently. Typically waste sources can be broken-down into the following (waste sources likely in small scale disaster events are marked with an *):

Table 5.2  Typical range of disaster waste impacts for different hazard types

<table>
<thead>
<tr>
<th>Types of Disasters</th>
<th>Volume of waste</th>
<th>Human health hazard</th>
<th>Environmental health hazard</th>
<th>Movement of waste</th>
<th>Difficulty of handling waste</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hurricanes / Typhoons</td>
<td>L - M</td>
<td>L - M</td>
<td>L - M</td>
<td>M</td>
<td>L - H</td>
</tr>
<tr>
<td>Tsunamis</td>
<td>L - H</td>
<td>L - H</td>
<td>L - H</td>
<td>M - H</td>
<td>L - H</td>
</tr>
<tr>
<td>Tornadoes</td>
<td>L</td>
<td>L - M</td>
<td>L - M</td>
<td>M</td>
<td>L - H</td>
</tr>
<tr>
<td>Floods</td>
<td>L - H</td>
<td>L - H</td>
<td>L - H</td>
<td>M - H</td>
<td>L - M</td>
</tr>
<tr>
<td>Earthquakes</td>
<td>L - H</td>
<td>L - H</td>
<td>L - H</td>
<td>L</td>
<td>L - H</td>
</tr>
<tr>
<td>Wildfires</td>
<td>L - M</td>
<td>L - M</td>
<td>L - M</td>
<td>L</td>
<td>M - H</td>
</tr>
<tr>
<td>Ice storms</td>
<td>L</td>
<td>L - H</td>
<td>L - H</td>
<td>L</td>
<td>L - H</td>
</tr>
<tr>
<td>Volcanic eruption</td>
<td>L - H</td>
<td>M</td>
<td>M</td>
<td>L</td>
<td>L - H</td>
</tr>
<tr>
<td>Pandemic</td>
<td>L</td>
<td>H</td>
<td>L</td>
<td>L</td>
<td>H</td>
</tr>
<tr>
<td>Industrial disaster</td>
<td>L - M</td>
<td>L - H</td>
<td>L - H</td>
<td>L</td>
<td>L - H</td>
</tr>
</tbody>
</table>

L = low, M = medium, H = high
Response phase (prioritised)

1. Removal of acutely hazardous substances (and other waste posing a secondary hazard e.g. waste blocking flowpaths).

* 2. Demolition to enable urban search and rescue.

3. Waste clearance for emergency / essential service operation (e.g. access way clearance, removal of damaged stock at food stores).


Recovery phase (not prioritised)

* 1. Private (residential, commercial and industrial) property detritus (non-structural material)

* 2. Public property detritus (e.g. liquefaction silt, transported waste, floodwater sediment, wind blown material, rock fall)

3. Full demolition debris

4. Major repair waste

5. Reconstruction waste

6. Horizontal infrastructure repair (e.g. roads, water, sewer, stormwater)

Within each waste source category there may be sub-categories. For example, in Christchurch following the earthquakes, private property detritus included (source 1) liquefaction silt and (source 2) household items such as broken plates, crockery, televisions and carpets. The liquefaction silt was managed differently from the household items. Each waste stream (and sub-stream) is likely to have a different (but ideally complimentary) management approach.

Note that waste may also be generated from:

- excessive unwanted donations
- large amounts of health care wastes
- emergency relief food and water packaging
- emergency welfare centres
- damaged warehouse, commercial, industrial and shop stock (liquid and non-liquid) (see Box 6.1).
Box 6.1 Food waste

One rather unanticipated waste stream following the 2010 and 2011 Canterbury earthquakes was the huge quantity of food waste resulting from damaged supermarket distribution centres. There was an urgent need to remove the waste quickly because a) the waste was a potential hazard (if it began to decompose) and b) the distribution centres needed to begin operation as soon as possible to ensure food supplies were continued. The waste was primarily managed through the municipal waste collection system; which in Christchurch consists of three transfer stations and the regional landfill. The transfer stations and landfill transporters operated 22 hours a day for approximately two weeks to clear this waste. The waste was very wet and efforts were made to dry the material before deposition at the landfill (either by mixing it with soil or by solar drying it).

Liquid food waste can also be a problem waste managers must deal with. Following a gas leak in a major gas distribution pipe in Taranaki in 2011 (affecting the operation of several dairy factories) farmers had to disposed of thousands of litres of milk which could not be collected. Farmers were advised to spray excess milk on their paddocks.

Table 6.1 shows what waste sources are expected for different hazard events. The table shows the likelihood of each stream occurring and the likely relative quantity of the particular waste stream.
### Table 6.1 Typical disaster waste sources: the likelihood of them occurring and the likely relative quantity for different hazard types

<table>
<thead>
<tr>
<th>Types of Disasters</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hurricanes / Typhoons</td>
<td>M</td>
</tr>
<tr>
<td>Tsunamis</td>
<td>M</td>
</tr>
<tr>
<td>Tornadoes</td>
<td>M</td>
</tr>
<tr>
<td>Floods</td>
<td>M</td>
</tr>
<tr>
<td>Earthquakes</td>
<td>M</td>
</tr>
<tr>
<td>Wildfires</td>
<td>M</td>
</tr>
<tr>
<td>Ice storms</td>
<td>L</td>
</tr>
<tr>
<td>Volcanic eruption</td>
<td>L</td>
</tr>
<tr>
<td>Pandemic</td>
<td>H</td>
</tr>
<tr>
<td>Industrial disaster</td>
<td>H</td>
</tr>
</tbody>
</table>

The first letter indicates the likelihood of the waste stream occurring (L=low, M=Medium, H=High probability of occurrence)

The second letter indicates the likely quantity contribution to the overall waste matrix (L=0-10%, M=10-50%, H=50-100%).

* Infected waste products possible at household level. Likely most waste will be at medical facilities.

#### 6.3 Waste streams

It is necessary to determine the waste composition within each waste source. This is to ensure the most appropriate management technique is employed and there is sufficient treatment and disposal capacity. Typically disaster waste composition is divided into nine waste streams:

- Vegetative (e.g. trees, plants)
- Construction and demolition (building materials including concrete, structural metal, timber, carpets)
- Personal property / household items (ranging from valuable personal belongings such as wallets and computers to furnishings)
- Hazardous waste (e.g. asbestos, fuel, oils, industrial chemicals)
- Household hazardous wastes (e.g. refrigerants, oils, cleaners)
- White goods (e.g. refrigerators, washing machines)
- Soil, mud and sand
- Vehicles and vessels
- Putrescent (e.g. rotten food resulting from prolonged power outages)

Table 6.2 shows typical waste streams expected for each waste source. Note that this is likely to vary significantly between hazard types. For a pandemic your waste will be almost completely infectious wastes.

### Table 6.2 Typical waste streams for each waste source: the likelihood of them occurring and the likely relative quantity

<table>
<thead>
<tr>
<th>Waste streams</th>
<th>Typical disaster waste sources</th>
<th>Response</th>
<th>Recovery</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Vegetable</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Construction and Demolition (C&amp;D)</td>
<td>M L</td>
<td>H L</td>
</tr>
<tr>
<td></td>
<td>Personal Property / Household Items</td>
<td>I L</td>
<td>L L</td>
</tr>
<tr>
<td></td>
<td>Hazardous Waste</td>
<td>H L</td>
<td>L L</td>
</tr>
<tr>
<td></td>
<td>Household Hazardous Waste (HHW)</td>
<td>H L</td>
<td>L L</td>
</tr>
<tr>
<td></td>
<td>White Goods</td>
<td>I L</td>
<td>L L</td>
</tr>
<tr>
<td></td>
<td>Soil, Mud and Sand</td>
<td>I L</td>
<td>M L</td>
</tr>
<tr>
<td></td>
<td>Vehicles and Vessels</td>
<td>M L</td>
<td>L L</td>
</tr>
<tr>
<td></td>
<td>Putrescent</td>
<td>I L</td>
<td>L L</td>
</tr>
</tbody>
</table>

The first letter indicates the likelihood of the waste stream occurring (L=low, M= Medium, H= High probability of occurrence). The second letter indicates the likely quantity contribution to the overall waste matrix (L=0-10%, M=10-50%, H=50-100%).
6.4 Waste quantification

Where possible the quantity of the above waste sources and waste streams should be calculated to ensure there are sufficient waste handling, treatment and disposal sites available.

Due to the range of disaster events and impacted building types, there are currently no established methods internationally on how to estimate disaster waste volumes. Generally waste estimation will have to be carried out post-event based on observations and available data.

Natural Material

For disaster generated wastes (vegetative, soil, etc. generated from liquefaction or landslips), data sources to assist in estimation include: hazard maps, aerial photographs, LIDAR data, and ground observations. Estimates (including composition of the waste) may need to be refined based on observations (truck capacities and weights, waste density etc.) during the initial stages of the waste management activities.

Flood and storm debris

There are currently no established waste estimation techniques for flood or storm debris in New Zealand. The Federal Emergency Management Agency (FEMA) “Debris Management Guide” 2007, includes several estimation models for storm and flood events based on observed debris volumes generated in US storm events.
Demolition

For demolition / construction and demolition waste estimation in New Zealand the following ‘rules of thumb’ could be used initially for typical residential (average 3 bedroom property):

- 80T (lightweight timber cladding, steel roof) (60% concrete, 25% wood, 5% metal, 10% other by weight), to
- 200T (brick cladding with tile roof) (90% concrete / brick / tile, 5% wood, 5% other by weight)

House construction material information is sometimes held by local authorities or could potentially be ascertained from damage reports and should be used to gather a more accurate estimate.

Typical commercial buildings can be estimated by calculating the constructed volume in m³ (V) and dividing it by 3. This will be the weight in tonnes. That is:

Weight (T) = 1/3V (in m³). At the time of writing the commercial building stock in Christchurch was generating approximately 60% concrete/brick, 10% wood, 5% metal and 25% other (by weight).

Constructed building volumes (V) could be calculated using local authority building database information or LIDAR data combined with the damaged building assessments. That is, the building volumes for all red and orange stickered buildings could be calculated and then estimate on the per cent for demolition and repair to determine the overall waste quantity.

Note that LIDAR data will only help with above ground structure volumes. It would be beneficial for local authorities to keep detailed databases of building materials and dimensions.

Repairs

Repair waste volumes can be estimated using damage assessments.

Rebuild

Building construction can generate in the order of 2 tonnes per 100 m² of new building.
Hazardous materials
Hazardous materials (including putrescent material) on properties will vary depending on the property use (e.g. residential vs commercial). Building tenants are the best source of information on likely volumes of hazardous waste. Local authorities may also have databases on building use and hazardous material presence which would be distilled.

7. Policy objectives
Before a disaster waste management plan is developed, it is important to determine the desired objectives of the plan. These should be developed in conjunction with the wider disaster recovery objectives (established by CDEM or other appointed recovery authority). Table 7.1 below lists 12 objectives which could form the disaster waste management objectives. It is important to prioritise the objectives as the objectives are not always complimentary. For example, recycling is an environmentally beneficial solution; however, if the market becomes saturated then it may increase the operational costs. The relative importance of the criteria is likely to be specific to a community and disaster event and is for authorities to determine during planning and response / recovery.

Table 7.1  12 objectives for management of disaster waste

<table>
<thead>
<tr>
<th>Objectives</th>
<th></th>
</tr>
</thead>
</table>
| Environmental | Adverse environmental effects are minimised.  
Environmentally beneficial strategies encouraged (e.g. recycling).  |
| Economic | Operational (waste handling and disposal) costs are minimised.  
Regulatory and strategic management costs are minimised.  
Local economy stimulated.  
Potential future costs from environmental remediation and adverse health effects are minimised.  |
| Social | Improves community spirit.  
Affected persons are empowered to participate in their own recovery.  
Public understands and accepts disaster waste management strategy (including a transparent and equitable process; sensitivity in handling personal property; protection of heritage buildings / items).  
Human health | Human health (both general public and workers, acute and chronic) risks are  |
Table: Recovery

<table>
<thead>
<tr>
<th>Recovery</th>
<th>The recovery is timely (including efficient use and prioritisation of human and equipment resources). The recovery facilitates a community wide recovery.</th>
</tr>
</thead>
</table>

* Direct economic costs include for waste collection, demolition, treatment and disposal and all the management / overhead costs which relate directly to management of disaster waste.

8. Waste system design

8.1 General

Once the waste sources have been identified, it is important to check the nature and capacity of the existing waste system to determine whether additional facilities are required and to determine the best management approach for each waste source. A detailed inventory of waste facilities and resources is a useful thing to establish pre-disaster.

Generally waste systems can be divided into four components:

1. Waste source
2. Waste handling
3. Waste treatment
4. Final disposal / end use

System capacities must be estimated in terms of both operational throughput (e.g. tonnes / day) and total capacity (e.g. tonnes).

A waste balance must be carried out to ensure that the waste streams from the waste sources can be managed and there are no bottlenecks in the process. Where bottlenecks are identified either waste management approaches must be altered or new waste management facilities must be considered. A system diagram may be helpful to illustrate the waste flow through the system. A simple template is shown in Figure 8-1.
Figure 8-1 Waste system template

Information management
In parallel with the system design authorities must consider how to best manage information. Information and monitoring are invaluable when planning and operating a waste management system. Information will enable the bottlenecks and potential risks and hazards to be identified. Monitoring acts as deterrence to illegal or improper practices. Clear document management systems including pro form reporting and monitoring livery, and document filing systems, are an essential part of this.

Unless debris management works from cradle to grave are managed by a single entity (which is unlikely in the privatised New Zealand disaster funding (insurance) and waste management system), it will be difficult to have visibility across the whole system (from demolition / collection through to end use / disposal). Local authorities must determine the most effective place to monitor the system to enable quality control checks.

Currently there is limited regulatory authority to obtain waste data from private demolition waste management activities. Therefore, in the absence of additional regulatory authority, it is likely to be most efficient to concentrate monitoring efforts on the 'limited' number of
disposal / end-use markets. This should enable visibility on how the waste system is coping and whether intervention is required. Reporting and monitoring requirements are discussed in the following sections. Ideally, systems for reporting and processing information from waste handling facilities should be in place pre-disaster; particularly as infrastructure (such as weighbridges and data manipulation systems) may need to be put in place. Mechanisms for identifying and mitigating inappropriate waste handling (such as illegal dumping) will also have to be in place.

Municipal waste collection

It is important that municipal waste collection continues as far as possible. The public must be notified that the collection is continuing and they must be advised of any changes in collection. Changes may occur due to road closures, chemical or physical hazards. Where no collection is possible, communities should be advised of alternative treatment measures for putrescible waste – either shallow burial or burning. As noted in Section 8.3, where there is disruption to sewage networks, nightsoil (human faeces) may also need to be included in the municipal waste.

8.2 Waste sources

8.2.1 Demolition to enable urban search and rescue

Demolition

Urban Search and Rescue (USAR) will inevitably require assistance from contractors. In particular they may need earthmoving equipment, excavators, cranes, long-reach diggers etc. There are several things that need to be carried out during this phase:

1. Appoint a contractor to coordinate resources and liaise with USAR (preferably arranged pre-event).
2. Put in place time and cost contracts for the contractors. Ensure that contractors have no salvage rights.
3. Establish a relationship with the CDEM Lifeline Utility Coordinator to ensure utility operators are able to isolate services at potential demolition sites.
4. Establish a relationship with Heritage Building authorities so that heritage assessments can be completed prior to work being carried out (where possible).
5. (as soon as possible) Appoint an independent health and safety expert to advise on potential hazards.

6. Contact building owners:
   a. As a courtesy
   b. To identify if there are any known hazards at the site (e.g. LPG or fuel tanks)
   c. To facilitate the removal of essential personal belongings
   d. So that building owners can notify their insurance company and tenants

   This is best done by local authorities as they generally hold contact information for building owners and have established systems for contacting people and record keeping.

7. Document all jobs carried out (what, why, how). It may be useful to assign a job number to each building which can be used on all documentation (e.g. dayworks sheets, disposal costs, salvaged personal property).

   It may be useful to distinguish critical buildings (buildings which may not be straightforward to deal with because of their size, complexity, degree of importance, location etc.) from other buildings at this stage.

   Generally time and cost contracts will be the most effective contract type to use during the emergency phase as the scope of works is unclear.

   Waste would not typically be separated during this stage. Waste would either be moved to the side or taken to a mixed waste storage or handling facility.

   It would be beneficial to include contractors in urban search and rescue / civil defence training exercises.

   **Health and safety**

   Emergency workers need to wear basic Personal Protective Equipment (mask, gloves, steel cap boots) before site specific hazards can be identified and the appropriate equipment (if any) determined.

   **Personal property**

   Personal property (left behind during evacuation) may need to be returned to building occupiers where the building is inaccessible (due to cordons or damage to structures). A
system should be established to return essential items (e.g. identification, keys, money, essential business items) to affected persons (see Box 8.1).

**Box 8.1  Personal property salvage**

In Christchurch, USAR teams were asked to perform a sweep of all buildings prior to demolition to gather personal belongings. This was limited to items which could be carried out by a single person. Where possible, items had been identified by the building owners / tenants. Items were placed in plastic drums labelled by building address and floor. Building owners (and where possible tenants) were notified of a location where these items could be collected. Collection was supervised by Police representatives and the items were guarded by a security firm. A parallel business access programme was established to allow business owners of yellow and green-stickered buildings inside the cordon.

**Material linked to fatalities**

During this phase, material linked to fatalities may have to be removed. Prior to any material being removed the Police Disaster Victim Identification (DVI) unit must confirm they have finished their investigation and all material with human remains has been passed to the Coroner. In the event of future investigations (for example, the 2011 Christchurch earthquake Royal Commission enquiry) the remaining building material should be loaded – unsorted, without salvage and with minimal damage to building elements – into covered trucks and taken to a secure disposal site (preferably identified pre-disaster). Once all enquiries are completed this material should be disposed of, preferably in a GPS marked location at an approved solid waste disposal facility.

It is important to liaise and consult with Iwi representatives while managing this material. Blessings should be carried out at the fatality site before waste is removed. It may also be appropriate to bless sites receiving material from buildings linked with fatalities.

**8.2.2 Waste clearance for emergency / essential service operation**

**General**

Some material may need to be removed to clear roads for essential service access. For example, removal of liquefaction silt (see Box 8.2), flood debris or landslip debris or removal
of damaged stock at food stores. In many cases the lifeline and service operators will arrange their own waste clearance activities, however, guidance must be given to ensure waste is disposed of appropriately and there is adequate disposal capacity. Road contractors may have and should have existing clauses in their contracts which require them to clear roads in an emergency. Generally time and cost contracts are best for emergency response works. It is useful to have a time or scope limit within emergency clauses in contracts. Contracts can stipulate a level above which authorities can either renegotiate rates in the contract or additional contractors can be engaged to assist with the works.

**Box 8.2  Liquefaction silt clearance**
Silt clearance after the 2010 and 2011 Christchurch earthquakes was carried out by the respective city road contractors under emergency clauses in their contracts. Residents and volunteers placed piles of silt on the kerbside for collection. The Christchurch City Council had to provide a suitable disposal site.

**Vehicle removal**
Personal vehicle (both damaged and undamaged) removal from affected areas may be necessary in the immediate aftermath of a disaster. In particular, if vehicles are:

1. blocking emergency access; or are
2. inaccessible (e.g. due to cordons, chemical or physical hazards, or access limitations for forensic purposes).

A system must be in place to remove vehicles and return to their owners as soon as practicable. Authorities should consider having standby contracts with vehicle towing companies (see Box 8.3).

**Box 8.3  Vehicle removal**
In Christchurch, Operation Vehicle was established to remove cars within the cordoned area of the central city. Prior to any vehicle removal vehicles had to be cleared by the Disaster Victim Identification team. Once clear, all damaged vehicles were taken to a nominated scrap car dealer where owners / insurers could claim their vehicle and, where necessary arrange for disposal / recycling. For driveable cars, the public were notified of the days on which certain areas would be cleared. Owners brought their keys to a location outside the cordoned areas and police officers collected the car and returned it to the vehicle owner.
8.2.3 Partial demolition / making safe building for public

Processes for partial demolition will be similar to demolition for Urban Search and Rescue above.

8.2.4 Private property detritus (non-structural material)

Removal of detritus from private property will need to be carried out by either private property owners (preferred) or by public entity. Where there are a large number of displaced persons, there is a high human health hazard, waste is difficult to handle or where insurance is low (as summarised in Table 8.1), it may be difficult to rely on private property owners removing private property detritus in a timely manner. If a public service is provided for detritus removal there are several legislative and regulatory issues regarding private property entry which will need to be addressed.

Table 8.1 Indicators for public participation

<table>
<thead>
<tr>
<th>Disaster &amp; disaster waste indicators</th>
<th>Disaster scale</th>
<th>Number of displaced persons</th>
<th>Geographic extent</th>
<th>Duration of hazard</th>
<th>Disruption to road network</th>
<th>Volume of waste</th>
<th>Human health hazard</th>
<th>Environmental health hazard</th>
<th>Movement of waste</th>
<th>Difficulty of handling waste</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private property owner participation desirable</td>
<td>-</td>
<td>L</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>L</td>
<td>-</td>
<td>-</td>
<td>L</td>
</tr>
<tr>
<td>Private property owner participation likely not feasible*</td>
<td>-</td>
<td>H-M</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>H-M</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>H-M</td>
</tr>
</tbody>
</table>

* Where a low level of insurance is combined with these indicators, public participation may be even more difficult to achieve.

Where private property owners are required to remove detritus it must be clearly indicated whose responsibility the clean-up is and where and how the waste must be handled (see Box 8.4). Generally there are two approaches:

1. Kerbside collection service

This is where residents are asked to place material cleared from their property to the kerbside (either in a pile or in bins or bags provided by the authority) for collection. A contractor or
contractors would need to be engaged to then collect the contractor waste and take it to a designated waste handling facility (see Section 8.4). This is a good approach where there is damage to road networks and minimal traffic movements are desired.

**Note** that this is best when a public funding source is available for the collection service as it would be difficult to collect a fee from individuals for this service.

2. **Provision of waste depots (free or charged)**

   This is where residents are instructed to take material cleared from their properties to a nominated location. These locations could be existing waste transfer stations or may be specifically established facilities. Facilities must be able to handle large volumes of traffic movements, record details (including waste volume / weight, type and source) and if necessary have invoicing facilities for waste deposition (see Section 8.4). Provisions for those without transportation should be considered.

   **Note** this is best under the current private funding approach (insurance) in New Zealand. However, this may not be possible if suitable location / facility cannot be found or if roads are badly damaged or property owners do not have ready access to transportation.

### Box 8.4 Private property owner responsibilities

Following a small flooding event in Auckland in February 2012, due to a burst stormwater drain) affected residents, who were largely uninsured, were reluctant to clean up as it was expected the council would carry out the clean-up. This expectation of assistance was also felt after the Queensland floods in 2011 in Australia.

In both cases authorities must determine whether they want property owners to separate material (and if so, into what categories) or whether mixed material is satisfactory. This is discussed in Section 8.6. Where source separation is expected, authorities must communicate the requirements clearly to the public. Authorities must also acknowledge the some (intentional and unintentional) mixing of waste and potential contamination is possible. Even separated waste streams will likely need to be further sorted prior to sending to the recycling / end use market.

Authorities must also decide whether collection services are open to either or both residential and commercial property owners. If the service is only available to residential property owners, some form of waste source verification will need to be in place at point of collection.
or at waste handling facilities. Limits on disposal quantity and time period may also need to be in place to deter misuse of the collection and/or disposal services and to encourage expedient waste removal. When setting time limits on this service, authorities must consider the time required for residents to liaise with insurance companies regarding the damage before removing the debris. Photos of damage may be adequate, however in some cases residents may be delayed in their clean-up.

### 8.2.5 Public property detritus

Authorities must consider who is responsible for public property detritus. Waste may be on roads and on public property. Clearance of public spaces could be (or may already be) included in municipal road and public facility maintenance contracts. If not included, contracts to cover clearance of debris in public places should be considered. A time and cost contract would be a suitable contract structure to allow for the diverse impacts which might be encountered.

### 8.2.6 Full demolition debris

**Operational organisation**

There are primarily two approaches to demolition work following a disaster event: private management (by individuals) or a central management (where works are managed collectively). There are several disaster impacts which indicate where a centralised approach may be most beneficial including the disaster scale, the number of displaced persons and where waste has moved across property boundaries. These are summarised in Table 8.2. Generally centralised management offers the following benefits:

- Helps to ensure recovery objectives are met through prioritisation of resources and works
- Greater ability to control and monitor the timeliness and quality of the works
- Reduces the demands on the impacted community
- Opportunities for economies of scale
- Allows for waste facility operation to be linked to the front end demolition process (which reduces likelihood of unnecessary and uneconomic waste facilities being established by opportunists).
- Facilitates information gathering (particularly where regulatory mechanisms are insufficient) which enables planning and monitoring.
- Potentially reduces demands on resource constrained regulatory authorities.

Note that when a central management system is imposed in a privately funded disaster recovery environment by an entity other than the funder (such as the Canterbury Earthquake Recovery Authority mobilised demolition for privately insured commercial buildings in Christchurch, see Box 8.5), consideration into cost recovery mechanisms (both regulatory and operational processes) is important. Central management will also induce overhead costs and authorities need to determine how these will be paid.

Table 8.2  Indicators for operational organisational strategy

<table>
<thead>
<tr>
<th>Disaster &amp; disaster waste indicators</th>
<th>Disaster scale</th>
<th>Number of displaced persons</th>
<th>Geographic extent</th>
<th>Duration of hazard</th>
<th>Disruption to road network</th>
<th>Volume of waste</th>
<th>Human health hazard</th>
<th>Environmental health hazard</th>
<th>Movement of waste</th>
<th>Difficulty of handling waste</th>
</tr>
</thead>
<tbody>
<tr>
<td>Centralised</td>
<td>H-M</td>
<td>H-M</td>
<td>-</td>
<td>H-M</td>
<td>-</td>
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<td>H-M</td>
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<td>H-M</td>
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</tr>
<tr>
<td>Individual</td>
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</tr>
</tbody>
</table>

Box 8.5  Central management of privately funded demolition / works
Following the 2011 Christchurch earthquake, to ensure a timely recovery, CERA established a centralised demolition service for all commercial properties and all residential properties in the residential red-zone (those in abandoned land areas). Private property owners were allowed to arrange their own demolition as long as it met the CERA timeframe and quality. Insurance companies also established centralised demolition and repair services for all of their insured properties. Overhead costs for the CERA managed system were included as a percentage cost for each building demolition. The CER Act included a cost recovery mechanism.

Prior to demolitions during the recovery phase, authorities / entities need to ensure all the appropriate approvals have been gained. The following are peace-time requirements:
- Building consent (for buildings 3 stories and above or attached buildings)
- Resource consent – heritage buildings
- Archaeological assessment / supervision

In some instances authorities may wish to waive or stream-line some of the legislative and regulatory requirements

Additional post-disaster considerations include:

**Building owner approval and agreements**
If demolition is being carried out by an entity other than the building owner, appropriate approvals, waste ownership and cost share agreements need to be made.

**Personal property salvage**
Prior to any demolition, an agreement must be reached between the property owner, insurer and contractor regarding the ownership of personal effects. Generally all personal belongings removed from buildings or uncovered during demolition should remain the property of the building owner, tenant or insurer. Best endeavours should be made to recover and return personal belongings provided it is safe to do so and security should be considered to protect belongings from theft, if necessary.

Contracts for demolition works (whether private or public, individually or centrally managed), must include waste ownership clauses. It is essential to delineate between personal property and building materials. Waste ownership clauses will differ depending on the procurement type (discussed below).

Ideally contract templates should be prepared before the disaster event.

**Waste management plan and reporting requirements**
A waste management plan is required as part of a Building Consent; however, under the Building Act, detached buildings three storeys and under do not require consent for demolition. This means that there is no visibility of what happens to waste from these buildings. Authorities may wish to consider requiring debris management information to be submitted prior to demolition to ensure suitable approaches are being taken e.g. recycling on or offsite, crushing concrete, using approved facilities etc. In addition it is useful (but not always feasible) to gather waste management reports. A sample Waste Management Plan and
Report template is included in Appendix C. If a waste management plan and report are desired, consideration must be made as to the regulatory or other means (e.g. contractual) with which these will be gathered.

It is important to consider who is suitably qualified to participate in these works. A contractor accreditation process should be considered (see Section 10).

**Contract types**

Contract types exist on a spectrum from lump sum to time & cost contracts. Generally time and cost contracts, implemented by trustworthy contractors, allow for:

- Greater quality control (environmental, health and safety, timeliness) and risk management (reduces the incentives for risky behaviour) which is particularly important where there is a human health hazard.
- Price stabilisation (unit prices can be tendered and maintained throughout, as opposed to lump sum contracts which can fluctuate)
- Lower risk for contractors
- Simplification / shortening of payment chains (e.g. disposal costs can potentially be charged direct to the Principal rather than through the contractor as per a lump sum contract)

Time and cost contracts require more monitoring and administration than lump sum contracts. However, they reduce the demands on regulatory authorities and by reducing incentives for risky behaviour, they arguably improve the quality of the outcome.

Some argue that time and cost contracts are not competitive and can contribute to price escalation. However, there are possible mitigation measures for this, such as, competitively tendering unit rates for works and allocating works based on lowest rates and appropriate expertise (see Box 8.6). It should be noted that lump sum contracts will only be lower cost (compared to time and cost contracts) if there is an over supply of contractors. This is often not the case in a post-disaster situation (where resources are stretched) and there is a danger that one or two contractors will continually bid lower than other contractors but will not have the capacity to complete the work in a timely manner.
Note that the cost for waste management/disposal is strongly linked to the method of demolition (e.g. the level of recycling, see Section 8.6). Thus contracts must include for waste in the following ways:

- time and cost contracts must include directions on the desired method of demolition and waste management
- lump sum contracts must include waste disposal (i.e. it should not be a provisional item)

It may be useful to establish a differential contract allocation strategy such as that in Christchurch, see Box 8.6.

**Box 8.6 Procurement approaches**
Following the 2011 Christchurch earthquake, the commercial building demolition programme was initiated during the emergency phase under time and cost contracts. As the process continued, unit rates were competitively submitted by contractors. Contractors were also accredited based on skill/expertise. Straightforward demolitions (less than five stories) were allocated based on the submitted unit prices and the required expertise. Buildings over five stories or buildings with special demolition requirements / unique waste streams (such as Heritage buildings) were tendered as lump sum contracts.

As mentioned above, approaches to waste ownership will differ depending on the contract type. Generally for lump sum contracts waste ownership will rest with the contractor. Thus there is potential for contractors to take personal property for their own benefit. Contract conditions will need to be prepared to minimise potential for this. For time & cost contracts waste ownership rests with the Principal until waste is deposited at the disposal site. This offers arguably more control and oversight over how personal property is managed.

**Procurement process regulation**
Authorities are generally bound by procurement processes set in legislation and regulation. Following disaster events, procurement process may not be followed (as allowed for in certain emergency legislation). In the event full procurement policies are not followed it is important to:

- Document the reasons why procurement policies were not followed
- Documents the reasons for contractor / consultant selection
Caution must be practiced when using procurement processes during the emergency phase for waste management as contracts may extend into the recovery phase. It may be prudent to limit the duration of a contract let during the emergency phase until a full contract procurement process can be carried out.

**Cashflow**

Particularly where operational works are centrally managed, it is important to ensure that cashflow is maintained to contractors and waste handling facilities. In many disaster situations contractors and waste handling facilities can work for months before they are paid, particularly where there are long payment chains. Poor cashflow may jeopardise the contractors / facilities long term viability. Payment systems must be established as quickly as possible and where the payment chain can be shortened (to minimise payments processed through contractors or other intermediaries) this will reduce the risk of contractors and facilities having to close (and thus impacting the available resources for the recovery). However, it should be noted that having payments go directly through to the Principal increases the administrative requirements.

### 8.2.7 Major repair waste

Generally debris from major repair work will have to be managed by the individuals / entities who are undertaking the repairs. In some cases this may be contractors operating under an umbrella organisation such as an insurance company.

Authorities or operations managers should consider the establishment of centralised waste facilities for contractors to bring relatively small quantities of repair waste to (ideally separated). This allows for economies of scale for contractors particularly where disposal / end use sites are a long way from the repair sites. These sites could be operated under either as private operations (contractors pay disposal fees) or where a public / central funding is available they could be operated as an integrated part of the repair process. However, this is dependent on availability of suitable sites. Disposal site operation options are discussed further in Section 8.4.5.
8.2.8 Reconstruction waste

While this volume of waste is small compared to the other waste sources this will contribute to the burden on an already stretched waste management system. As for the major repair debris, it would be useful to try to take advantage of the possible economies of scale by creating waste collection facilities.

8.2.9 Horizontal infrastructure repair

Horizontal infrastructure (e.g. roads, water, sewer, stormwater) repairs debris will likely be managed by those repairing the infrastructure. Efforts should be made to reuse on site as far as possible to reduce transportation of materials to processing / recycling / disposal sites. Contaminated material must be removed from the material. Note that some roads in New Zealand were constructed with tar and this material must be treated as hazardous.

8.3 Special Waste streams

Heritage materials

Material from heritage buildings, either being repaired or demolished, will have specific handling and/or salvage requirements. Unless under a State of Emergency or a specialist recovery legislation, ‘peace-time’ legislation requires all heritage building demolitions and repair work will require resource consents and handling requirements should be included.

Specialist storage areas for heritage materials (where building owners do not want to or cannot afford to salvage and store goods) may be needed if requested by heritage authorities, both covered and uncovered areas. Liaison with heritage specialists regarding requirements for storage areas and operations is important as heritage material must be appropriately cared for, labelled and secured. Payment for operation of the site will need to be considered.

Asbestos

Generally asbestos management regulations will not be significantly altered. The Department of Labour (DOL) may elect to reduce notification requirements to facilitate expedient removal. Also in the event that buildings are unsafe to enter or asbestos management is unduly impacting the overall recovery, DOL may relax or steam-line the requirements to adhere to the full asbestos management guidelines (such as sealing the
building and removing all asbestos prior to demolition). The DOL released a factsheet following the 2011 Christchurch earthquake and this is included in Appendix D.

All works on sites known to be or suspected of containing friable asbestos must be supervised by a contractor certified by Department of Labour to carry out restricted works.

Mitigation measures for asbestos may include:

- Appropriate personnel protective equipment.
- Personnel decontamination unit.
- Keep working area damp at all times, but avoid runoff.
- Provide a site wheel wash and vehicle decontamination.
- Allow for washing of site on completion of demolition works.
- Establish an exclusion zone around the demolition site, where possible.
- Cessation of work during high winds.
- Air monitoring during works.
- Carrying out all demolitions to completion (to avoid leaving disturbed asbestos).
- Use of adequate signage and notification for persons in the area.

Asbestos contaminated material should be separated on site from clean debris as far as possible to reduce the volume of contaminated material. However, care must be taken not to disturb the asbestos.

Note that water supply may be limited post-disaster and this may affect management options available and/or special water sources may need to be brought in. If water is available care should be taken to avoid any site runoff.

Available asbestos disposal sites should be identified, and site specific disposal requirements noted. Some disposal sites may also have transportation restrictions and contractor certification requirements (such as Kate Valley in Canterbury). The DOL asbestos guidelines indicate minimum requirements for transportation of asbestos.

All waste generated from the demolition, repair and rebuild work should be recorded, including asbestos material components.
A flowchart has been developed for a possible management approach post-disaster where buildings are unstable. This is included in Appendix E.

**Treated timber**

Efforts should be made to separate treated and untreated timber during demolition to reduce the quantities of wood that must be landfilled. Untreated timber can be used as hog fuel whereas there is currently no disposal method for treated timber other than landfill.

**Food waste**

Particularly in cases where there have been prolonged power outages, rotting food waste must be managed. Food waste from residential properties, commercial properties (supermarket warehouses, cool-stores, hospitality businesses) is possible. Both solid and liquid waste may need to be managed (see Boxes 6.1 and 8.7).

**Box 8.7 Rotting food**

Management of rotting food was also a concern in the central city cordon following the 2011 February earthquake. A special cleaning programme was initiated by Civil Defence to allow owners of green or yellow stickered buildings to enter the cordon with commercial cleaners to remove the rotting waste and clean refrigerators to reduce the public health hazard.

Following Hurricane Katrina, prolonged power outages led to significant amounts of rotting food in domestic fridges. Residents were advised to tape their fridges shut and place the entire fridge on the kerbside for collection and disposal. Authorities cleaned the fridges, removed the hazardous refrigerant chemicals and recycled the metal.

**Wastewater**

If damage has been sustained to the wastewater network (pipes or treatment facility) it is likely that there will be sewage contaminated materials to manage. Residents may be asked to use the waste collection service to dispose of faecal matter (see Box 8.8) or waste materials may be contaminated with wastewater effluent. This contamination is particularly common in liquefaction and flooding events. Public health protection in collection and disposal must be considered.
Box 8.8  Faecal material
In Christchurch many houses were left without access to sewage systems. Residents were asked to dig latrines in their backyard until portaloos and chemical toilets could be sourced. In some locations, where the ground water was particularly high, this was not possible. Residents were asked to defecate into a bag and place it in their municipal waste bin. These were collected as normal.

Mould
Mould is a common problem after flooding events. Furnishings (carpets, furniture, curtains) should be handled and disposed of appropriately.

Other hazardous wastes
Where possible, all known hazardous substances should be removed prior to demolition. If not possible, all debris from the building containing the hazardous items may have to be treated as hazardous. Liquid and solid waste must be managed by appropriately qualified hazardous waste handlers and taken to accredited treatment and disposal facilities. If the community is responsible for managing hazardous materials it is important to ensure that appropriate facilities and services are provided (see Box 8.9).

There is likely to be hazardous materials generated from residential, industrial and commercial properties. It is useful for municipalities to hold databases of premises holding hazardous wastes so that hazardous materials can be identified and removed prior to any demolition and to remove a public and environmental health hazard. The Fire Service holds some of this information already.

Box 8.9  Household hazardous waste removal
Following the 2011 Christchurch earthquake, approximately 6000 residential homes were scheduled for demolition in the areas deemed unsuitable for rebuilding. Environment Canterbury (funded by the Ministry for the Environment Waste Minimisation Fund) led a programme to reduce the risk of land contamination and illegal dumping of household hazardous waste (HHW). Property owners were first encouraged to make use of the free HHW disposal facilities at the existing transfer stations. A collection service was also provided for those unable to access the HHW disposal facilities. Last, prior to demolition specialist contractors were engaged to sweep properties to remove any HHW.
Animal carcasses
Animal carcasses are most likely in volcanic, ice storm and flooding events. There are many options for managing carcasses including:
- Burial
- Composting
- Incineration
- Rendering

8.4 Waste handling, treatment and disposal facilities

8.4.1 Pre-event
Understanding your existing waste management system and it’s vulnerabilities in a disaster event is an important step in planning for disaster waste management. Before and event it is useful to carry out a vulnerability / risk assessment of your existing waste collection system (collection, transportation, treatment and disposal). This assessment should include:
- Hazard vulnerability / risks to ALL aspects of the system (collection, transportation, treatment and disposal) for all hazards.
- Dependencies on lifelines and other services (e.g. reliance on electricity, water, wastewater, roading services etc)
- Contingency options (to cope with system failures)
- Spare capacity (to manage disaster generated wastes)

Ideally this short of assessment should be carried out during the DESIGN phase of any disaster waste management system. The use of specialised equipment and any system with low redundancy, low flexibility and high coupling is likely to be vulnerable in a disaster situation as well as providing limited options to manage increased waste streams.

Box 8.10 Municipal waste system vulnerability
The 2011 Christchurch earthquake highlighted several aspects of the municipal waste management system which both helped and hindered post-earthquake waste management. Despite damage or loss of access to two transfer stations after the February earthquake the municipal waste collection from residential houses was still able to operate due to the spare capacity in both private and public transfer stations in Christchurch. The transfer stations received higher wastes than usual due to some earthquake generated wastes. The main
bottleneck in the municipal waste management system was the transportation between the transfer stations and Kate Valley. Because of the need for specialist trucks and the long haul distance operations had to be carried out 22 hours a day for 2 weeks to clear the additional waste. Fortunately the CCC had identified the former landfill site at Burwood (10km from the city centre) as a contingency site for emergencies. Therefore mixed construction and demolition waste could be temporarily stored there rather than adding to, and potentially disrupting, the municipal waste system.

8.4.2 Waste handling

Waste handling facilities are those where waste is temporarily stored, for example, a transfer station, waste collection centre or a temporary storage area. Some sorting may be carried out but generally there is limited or no processing. These are useful facilities in a disaster waste management system as they act as buffers which allow waste to be moved out of affected areas quickly while long term waste management options (recycling and disposal facilities) are being established (see Box 8.11).

Box 8.11 Temporary storage facilities / transfer stations

In Christchurch, waste operations personnel noted that without the transfer stations the waste system in Christchurch would not have coped with the acute influx of material immediately after the September 2010 and February 2011 earthquakes. The waste system in Christchurch relies on a limited number of hook-lift trucks travelling to the regional landfill (130km return). The transfer stations and landfill were operated 24 hours a day to allow for material to be cleared.

Use of waste handling facilities inevitably increases direct costs as a result of double handling. However, they have the indirect benefits of expediting waste removal (by allowing mixed waste to be removed quickly from site rather than sorting on site) and potentially allowing the time for more environmentally beneficial waste uses to be found.

8.4.3 Waste treatment

Waste treatment facilities are where waste is physically or chemically changed in form, for example, combustion, concrete crushing and vegetation mulching. Waste handling and treatment sites are commonly combined (see Box 8.12).
Temporary staging areas

Temporary storage areas are often used in the United States following large scale disaster events, particularly by contractors managing the kerbside collection programme. The sites collect waste separated at kerbside and further separate and process the material (including mulching, incineration and concrete crushing). A sample temporary staging area is shown in Figure 8-2. Note that the sample layout reflects that the majority of disaster events in the US are weather / storm events (such as hurricanes and tornadoes). Typically the space required for a temporary staging area (including for processing areas) is 50ha per 1,000,000 cu.m of debris (FEMA, 2007, Debris Management Guide).

It is useful to identify these sites before a disaster event. Sites should be selected that are easy to access (given the expected disaster impacts) and that are unlikely to be affected by the disaster impact. It is important to ensure that the identified area has not been identified for other response and recovery activities (e.g. temporary housing, welfare centres, community events, etc.). In addition it is beneficial to establish:

- Land ownership / land-use agreements (lease and land-use consents where necessary and on-going liability for any adverse effects)
- Funding (e.g. who pays for establishment? who pays for operation? Will there be cost to dispose of at the site? Who can use the site?)
- Operational management arrangements (e.g. establish stand-by contracts)
- Operational protocols (e.g. environmental and human health standards, disposal costs (if any), information management/reporting procedures, site layout),
- Environmental baseline measurements
- Traffic management plans (both onsite and access to site)
Box 8.12 Resource Recovery Parks
Following the Christchurch earthquakes, a resource recovery park was established at Burwood landfill (the former Christchurch landfill site). The site was established to take mixed waste and a recycling facility is currently planned (at the time of writing) to process all the materials. A number of private demolition contractors also established waste handling/treatment facilities where mixed waste from their demolition sites could be taken for sorting (and processing).

Combustion
Combustion (incineration and open burning) is a treatment form often considered internationally to reduce the volume of disaster waste. However, in New Zealand, combustion on a commercial scale (i.e. incineration) is generally not considered acceptable and therefore there are limited regulatory guidelines and operational equipment and expertise. If combustion is considered a necessary post-disaster option by a community, pre-even planning is required to reduce these regulatory and operational constraints.
**Processing on site**

Note that some material processing may be carried out at the waste collection / demolition site; for example, concrete crushing. It may be useful to have a policy in place pre-disaster for onsite material processing.

### 8.4.4 Final disposal / end use

Final disposal / end use sites are where waste is either resold as a useable product (e.g. crushed concrete) or is buried with no plans for use in the immediate future (e.g. landfill).

**Recycling markets**

It is likely that the volume of disaster waste will exceed local recycling capacities and demand. This in turn will likely reduce the value of recycled materials and overall economic feasibility of recycling. It may be necessary to look at recycling markets outside the region and even outside New Zealand; however, transportation costs may be an inhibiting factor.

**Land reclamation**

In land-limited coastal locations, land reclamation may be an option for disposal of inert debris. Environmental and engineering standards should ideally be prepared pre-disaster where possible. Special consideration must be made as to how to minimise risk of contamination (resulting from high speed, high volume, debris separation and disposal) (see Box 8.13).

<table>
<thead>
<tr>
<th>Box 8.13 Lyttelton Land Reclamation</th>
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<tbody>
<tr>
<td>Following the Christchurch earthquake, Lyttelton Port of Christchurch applied for and was granted consent to accept inert earthquake debris (bricks, concrete, rocks etc.) in a land reclamation project. The reclamation offered both a low cost disposal option and allowed the Port to enlarge its wharf area to enable repairs to the damaged existing wharfs to be made.</td>
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</table>

**Disposal facilities**

Given the likely contaminants and composition of the disaster waste, under peace-time regulations waste would have to be disposed of at engineered landfills (such as those used for municipal wastes in New Zealand). Most communities in New Zealand will have access to
one or more engineered municipal landfills and construction and demolition landfills. In small scale disasters the municipal landfill is likely to have sufficient space for the waste. However, in large scale events, disaster managers need to consider alternative options. In other past disasters, disaster specific, low-engineered fills have been constructed to manage the predominantly inert waste and likely low hazard (see Box 8.14). Former landfill sites are often ideal sites to use as a contingency disposal location. It would be useful to prepare guidelines for construction of low-engineered landfill disposal facilities pre-disaster.

Box 8.14 Low-engineered disaster specific disposal facilities
In Victoria Australia, following the 2009 Bushfires, a new, low-engineered landfill cell was constructed for the bushfire waste. The cell was constructed to reduce the health and safety risk posed by trucks travelling over a dangerous stretch of road to the municipal landfills. In Christchurch a low-engineered fill was constructed at the former Christchurch landfill (Burwood). The cell was constructed to reduce the cost and carbon emissions from carting the residual waste (after the resource recovery operations) to Kate Valley landfill 120km return. At the time of writing a separate cell for timber is planned for potential mining in the future as fuel for waste to energy projects.

Another option is to use existing low-engineered landfills (e.g. construction and demolition landfills) but to increase the waste acceptance criteria (such that disaster waste residual material with likely contaminants and irregularities can be disposed there). For this option, authorities need to consider the long term liability implications of operations at that site. For example, if a private operator is accepting waste under ‘peace-time’ standards and this is changed temporarily for the disaster response, how will future liability for adverse environmental effects at the site be determined? It is recommended that waste acceptance criteria at existing facilities is not altered unless it is absolutely necessary.

8.4.5 Waste handling and treatment facility management and operation
Facility ownership / management
It is unlikely that existing facility ownership / management structures (predominantly privately owned) would be changed post disaster. It will invariably be necessary to work within these structures. However, there are opportunities for disaster specific facilities to be managed differently.
It may be beneficial that the operation risks for any new facilities, established specifically to meet a recovery need, be held entirely by public bodies or shared between public and private entities. Due to the uncertainty in a post-disaster situation, uncertainty is generally high and thus facilities hold higher operating risks. Closure of an important waste handling operation could delay the recovery process and the delays will likely have a cost to the community. It is advantageous if the commercial viability of an operation can be weighed against the cost of failure of the operation (as opposed to a private operation which is only concerned with the commercial viability). It is also likely that new facilities will be established on publically owned land and future (environmental) liability issues are simplified if the land owners and operators are the same.

Cost structure
Existing waste handling and treatment facilities generally operate on an upfront deposition charge. That is, a per tonne cost is charged corresponding to the type of waste that is received at the facility. In a post-disaster situation this can be quite a high risk cost structure as operators will receive a large quantity of material of unknown quality very rapidly, with little time to alter their cost structure. While this will be unavoidable in many event responses, there may be opportunities to operate a facility as a time and cost facility if 1) the facility is linked to the waste collection / demolition works and 2) the funding mechanism does not require specific waste management costs to be allocated to specific buildings.

Waste facility management, monitoring and reporting requirements
Ideally waste management facilities should include:

- Weighbridge or electronic volume measurement (with cameras)
- Data tracking and invoicing system including for each waste load:
  - Date, time
  - Waste source (building / site name and location)
  - Contractor (preferably demolition and transporter)
  - Material description
  - Weight / volume
- Security measures
- Contractor approval process
- Plan for management of personal property if discovered
- Environment Management Plan
- Traffic Management Plan
- Health and Safety Plan

**Contractor accreditation**

To minimise risk at the waste handling facilities it is beneficial to have some control over what waste is received at the facility. This may be in the form of a contractor accreditation system. The accreditation system could include screening for environmental, health and safety and financial credentials (as is practiced at some landfills in New Zealand). In addition it would be useful for waste facilities to know the quality of the waste likely to be received i.e. demolition material with no salvage versus residual material after recyclable removal (the former has much higher value than the latter).

### 8.5 Waste transportation

Transportation includes the movement of waste at any stage of the waste management activities.

Typically waste will be transported by contractors collecting the wastes or by those carrying out the demolitions. Certain regulatory controls / allowances may need to be made to enable efficient, effective and low risk transportation:

1. **Dust suppression:** In general covers for waste trucks is not feasible. Many trucks will not have covers (or cannot be easily fitted with covers) and placing the covers on is difficult and risky. Covers should, however, be used for any sensitive or hazardous material. Waste material should be dampened down prior to leaving the site.

2. **Weight limits:** Some roads have weight limits. These may need to be altered to improve truck movement capacity. Conversely consideration needs to be made as to how much damage waste laden trucks may do to (potentially) already compromised infrastructure (roads and subsurface infrastructure) as well as the health and safety risk posed by heavily laden trucks (e.g. increased stopping distances).

3. **Truck travel hours:** Some roads and facilities (e.g. Kate Valley in Christchurch) have regulated limits on truck travel hours. These may need to be amended to facilitate the clean-up.

4. **Dedicated truck routes:** In some cases it may be possible and useful to dedicate certain roads to truck to reduce the truck travel time and minimise disruption to other traffic.
Truck speed may need to be regulated in affected areas, particularly where there are damaged structures and the road vibrations may cause instability.

5. Cleaning trucks / wheel wash requirements.

**Waste tracking**

Operationally, it is beneficial to track the waste during transportation for transparency, accountability, and efficiency. In particular to:

1. Provide information / system to assist in billing (both truck travel and disposal costs).
2. Highlight anomalies and inefficiencies in truck behaviour (such as diversion of high value loads e.g. metal and under-filling of trucks, excessive time in traffic).

There are four main options for tracking waste:

1. Analysis of dayworks sheets / logbooks where necessary (i.e. no specific waste tracking systems)
2. A paper docket system
3. A barcode system
4. A GPS system

For options 2, 3, and 4 ideally the following information should be captured for each truck:

1. Date
2. Licence plate
3. Driver
4. Contractor
5. Waste source (exact street address)
6. Time of pick up
7. Job number (if applicable)
8. Waste quantity
9. Waste type / composition
10. Drop-off location
11. Drop-off time
12. Comments / other
GPS and Barcode systems are initially expensive to establish; however, they will reduce administrative demands and increase quality control. And by minimising opportunities for fraudulent use they may save money in the long term. However, GPS and Barcode systems generally only work where all vehicles are dedicated to the project. This may be difficult to achieve where vehicles may be being shared between different projects.

**Cost structure**

The cost structure for waste transportation system (by subcontractors) also needs to be considered. Arguably the simplest cost structure is a cost per truck trip and may be the most efficient option immediately post-event. However, this does not encourage efficient transportation (i.e. maximising load weight per trip). So payment by total weight transported is possible. From a contractor perspective, however, neither payment by trip or weight accounts for idle time in traffic. A waste tracking system would allow for a fairer cost structure to be in place (such as total drive time).

### 8.6 Recycling

#### 8.6.1 Recycling feasibility

Recycling post-disaster is driven by a number of factors:

- Lack of alternative options
- Cost (depending on context)
- Environmental objectives
- A deficit of raw materials (where recycled materials can substitute: generally reflected in the relative costs of new and recycled materials)

Recycling post-disaster is also constrained by a number of factors (over and above the ‘peace-time’ challenges to recycling), these include:

- Time constraints (desire to clear debris quickly)
- Resource availability (skilled and unskilled personnel and equipment)
- Mixed nature of waste (making separation difficult and/or costly)
- Hazards in the waste matrix
- Displaced population (unable to assist where kerbside separation by residents is requested)
• Post disaster market challenges (capacity, value, availability, disruption, space limitations, location relative to affected area)
• Availability and feasibility (relative to recycling) of other waste management options

Note that a more detailed economic and logistical analysis should be carried out at the time of the event. In addition public expectation and desire for recycling should be considered and managed. Opportunities to establish recycling operations that may not have been feasible in ‘peace-time’ should also be considered. The large volume of material may provide the economic incentives to establish plant where it was not feasible given ‘peace-time’ recycling quantities (i.e. enabling the capital to be paid of more quickly, improving the long term economics at ‘peace-time’ waste quantities). Table 8.3 shows how different disaster impacts affect the feasibility of recycling.

Also note that if recycling is desired, recycling incentives such as the waste levy and the emissions trading scheme levy should not be suspended as this may reduce the feasibility of recycling.

<table>
<thead>
<tr>
<th>Table 8.3</th>
<th>Indicators for recycling feasibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disaster &amp; disaster waste indicators</td>
<td>Disaster scale</td>
</tr>
<tr>
<td>Recycling feasible</td>
<td>-</td>
</tr>
<tr>
<td>Recycling feasibility unlikely</td>
<td>-</td>
</tr>
</tbody>
</table>

8.6.2 Recycling strategy
As in peace-time, recycling can be carried out on or offsite. If recycling is feasible, consideration needs to be made to determine how recycling should be carried out – either on or off site. Primarily offsite recycling allows for waste to be removed more quickly (which may allow others to return to their buildings more quickly) (see Box 8.15); however, it will likely increase the direct costs and will reduce the likely recycled quantity. Offsite recycling
also relies on the availability of mixed waste handling facilities with sufficient capacity and adequate transportation capacities. Offsite recycling is difficult when the waste is highly mixed or poses a human health hazard.

The ability to rely on public participation for site separation (for private property detritus), decreases as the number of displaced persons increases. However, the higher the number of displaced people, the more feasible onsite separation is for contractors as there are less space and vehicle movement constraints.

Table 8.4 summarises the disaster indicators which indicate where onsite and offsite recycling is generally more feasible. A detailed case specific analysis is suggested post-disaster.

Table 8.4 Indicators for recycling strategy

<table>
<thead>
<tr>
<th>Disaster &amp; disaster waste indicators</th>
<th>Disaster scale</th>
<th>Number of displaced persons</th>
<th>Geographic extent</th>
<th>Duration of hazard</th>
<th>Disruption to road network</th>
<th>Volume of waste</th>
<th>Human health hazard</th>
<th>Environmental health hazard</th>
<th>Movement of waste</th>
<th>Difficulty of handling waste</th>
</tr>
</thead>
<tbody>
<tr>
<td>On-site</td>
<td>-</td>
<td>H (if by contractors)</td>
<td>-</td>
<td>L-M</td>
<td>-</td>
<td>1</td>
<td>1</td>
<td>L</td>
<td>-</td>
<td>L</td>
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<tr>
<td></td>
<td>-</td>
<td>L (if by public)</td>
<td>-</td>
<td>-</td>
<td>H</td>
<td>-</td>
<td>1</td>
<td>L</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Off-site</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>H</td>
<td>M-H</td>
<td>M-H</td>
<td>M-H</td>
<td>-</td>
<td>M-H</td>
<td></td>
</tr>
</tbody>
</table>

Whatever recycling strategy is adopted, strategic management, regulatory and contractual arrangements need to reflect the desired policy.

Box 8.15 Onsite vs offsite recycling

In Christchurch, contractors favoured onsite separation as this lowered their costs (increased their profits due to the high relative cost of mixed waste disposal in Christchurch) for the lump sum contracts they had tendered for. While reducing the direct costs, this arguably slowed the demolition process.
9. Environmental and human health risk management

As mentioned in Section 2, specific legislation / regulation may be derived following a major disaster. Some of the regulation changes may include changes to ‘peace-time’ environmental and human health standards. It is important that appropriate risk management techniques are adopted as part of any legislative / regulatory change. The following principles should be considered:

1. **Accept higher risks:** Due to large scale of works, the likely speed of management and the likely lower skilled workforce (due to the resource demand post disaster) it is inevitable that the quality of the works (intentionally or unintentionally) will be lower. Therefore, regardless of the desired standards, mitigation measures need to be in place to protect people and the environment against potential negative effects.

2. **Maintain a skilled workforce for high risk work:** Where there is a demand for resources / to carry out skilled / technical work more expeditiously, authorities can either a) reduce the standards required to be met (e.g. removing the requirement to seal buildings with asbestos during asbestos removal) or b) to increase the workforce (e.g. by reducing worker certification requirements). Generally it is better to maintain a skilled workforce as these personnel have a vested interest in long term quality of their work and should be able to identify and act where additional mitigation measures are required.

3. **Avoid permitting (consenting) exemptions:** When a consenting process is deemed to be too cumbersome in a post-disaster situation authorities can either expedite the process or permit the activity (i.e. not require a consent). Generally permit exemptions should be avoided. Going through some form of consenting process will enable site specific assessments to be made. It also ensures that authorities know the activity is taking place and can maintain visibility, monitoring of activities and can intervene if necessary.

4. **Consider long term risk management:** When changing environmental and human health standards post-disaster, authorities must consider who owns the risk in the short and long term. Entities are more likely to act responsibility where they have long term ownership of the risk.

5. **Involve the community in decision-making:** The waste management system faces risk posed by community opposition. As far as possible engage the community in decision-making: both the local community (i.e. neighbours of existing and proposed waste handling facilities) and the wider community.
6. **Apply consistent standards:** Ensure that all contractors and waste handling facilities are operating the same standard. This will improve public trust in the quality of the operations.

10. **Human resourcing**

Human resources for both the strategic planning (including regulatory duties) and physical works are likely to be stretched. For this reason the following principles may be useful:

**Strategic management**

- Stream-line regulatory requirements (stream-lining processes, minimising monitoring requirements e.g. by deferring monitoring to operational programmes where possible) as far as possible.

**Operational management**

- Personnel and equipment should not be taken away from core duties (for example municipal waste collection) wherever possible.
- The work force is likely to be less skilled so operational strategies (as well as environmental and human health risk management strategies) need to account for the likely range of trained persons. Operational strategies with control functions such as centralised management and time & cost contracts should be used where possible.
- Consider implementing a contractor accreditation or pre-qualification process (this could be established pre-disaster) so that resources can be appropriately and efficiently prioritised and utilised.
- Use local labour where you can (for direct community benefit).
- Consider establishing of Memorandums of Understanding with neighbouring regions to secure additional resources.

11. **Public information**

Public information and communication is essential to any disaster plan. As discussed in Section 4, ideally there should be someone dedicated to public information in the waste team, if not the waste team must liaise with the PIM(s) officers under CDEM arrangements (or corresponding recovery personnel). Disaster waste managers must provide information on:
- Human health and safety issues (in particular information on appropriate management of hazardous waste streams and risks associated with the waste streams)
- Debris handling and disposal (for both individuals and contractors) including location of handling facilities and costs.
- Municipal waste collection arrangements (even if the service remains unchanged, communities need to be reassured of this).
- Any issues regarding waste management which may affect insurance eligibility (if applicable) (e.g. requirements to take photos of all damage before clean-up).
- Disaster waste management policy
- Any relevant rules and regulations.

In some cases, where an event is predicted (e.g. an offshore tsunami, a flood, or a wind storm) it may be necessary to disseminate public information before an event to reduce the likely volume of waste. For example, advice to place things above floor level or tie items down).

It is likely that the lead organisation for waste management (local authority, civil defence, recovery authority) will have a website with relevant information and may publish advertisements in the local newspaper. Disaster waste related information should be included.

Public information should be pro-active and a service should be provided to answer public and contractor queries.

Where possible, information should be prepared pre-disaster for ready dissemination.

**Dealing with an absent population**
In some disaster events populations are either forced to move (due to the damage) or they choose to move. They may relocate within the locality, region, country or they may move overseas. Continuing a dialogue with the displaced population is essential for many reasons including managing the waste. Before waste is removed from properties, unless there is an acute health hazard, permission from the property owners must be gained.
It is likely that other recovery management sectors (e.g. business recovery, welfare) will want to establish a register for affected persons. Waste managers should ensure that this facility can be accessed / utilised by them where necessary. Information that may need to be gained includes:

- Contact details in the event that the property must be entered / waste removed.
- Details on personal items that need salvaging (note: be careful not to promise salvage of materials as it is likely some materials may not be able to be salvaged).
- Details on any hazardous materials at the building (including where and what).

**Liaising with industry**

Due to the privatised approach to waste management and the privatised insurance system currently in New Zealand, there are likely to be a lot of independent demolition and waste management contractors operating within the disaster waste management response and recovery. It would be useful to establish a forum to share information with contractors. Initially this should take the form of physical meetings (this helps to develop relationships and trust). After that a forum for information sharing via email updates or a website would be beneficial.

**12. Assessment**

**12.1 Risk assessment**

It is important to identify any risks in the waste management system so that the risks can be treated. A simple risk register should be filled out such as the one in Table 12.1.

<table>
<thead>
<tr>
<th>Description</th>
<th>Impact (L, M, H)</th>
<th>Likelihood (L, M, H)</th>
<th>Treatment (avoid, reduce, mitigate transfer, accept)(including description)</th>
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</thead>
<tbody>
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</table>

**12.2 Effectiveness assessment**

To verify that the adopted system is appropriate and for transparency and accountability, it may be useful to apply an assessment criteria to the proposed system. A possible approach
would be to assess the process using the objectives identified in Section 7 or other disaster specific objectives and a simple effectiveness scoring system. The waste management system could be assessed as a whole or it could be assessed in parts.

The following assessment process is suggested:

1. Give each objective an importance rating or weighting, say from 0 (zero being not important) to 10 (most important).
2. Score the effectiveness of the system on meeting each objective:
   -1 has negative effect on the objective
   0 not meeting the objective (but not negative effect)
   1 meeting the objective
   2 exceeding the objective
3. Calculate the total effectiveness of the approach by multiplying the importance rating by the effectiveness score. For example, if protection of human health is the most important objective, the weighting would be 10. If the effectiveness score was judged to be ‘2’ or exceeding the objective, then the total effectiveness would be 20. Before commencing the assessment it would be useful to determine what total effectiveness scores are acceptable. An example assessment template is shown in Table 12.2.

   Table 12.2 Effectiveness assessment template

<table>
<thead>
<tr>
<th>Objectives</th>
<th>Weighting (W) (1 to 10)</th>
<th>Score (S) (-1 to 2)</th>
<th>Total effectiveness score = WxS</th>
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</thead>
<tbody>
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</table>

13. **Pre-event checklist**

Throughout the guidelines a number of pre-event tasks have been identified for local, regional and national authorities to consider to facilitate effective disaster responses. These are summarised below.
Plan

Prepare a plan. Identify the likely hazards (and subsequent impacts) and design for the likely range of scenarios. Prepare the plan collaboratively with all relevant agencies. Ensure the plan is written for roles and not individuals and that new staff are familiar with the plan. Review the plan every year.

Organisational structures

Assign responsibility for disaster waste oversight to an organisation(s); and, subsequently a role within that organisation(s). The position needs to be assigned to a role not a person (in the event of loss of life).

Develop a cross-organisational coordination structure. Ensure the structure is scalable for larger disasters and/or disasters involving different agencies.

Training

Include demolition and construction contractors in urban search and rescue and civil defence training sessions.
Pre-event contracts

☐ Establish stand-by contract for coordination of contracting resources to assist Urban Search and Rescue.

☐ Establish stand-by contract for contracting resources to assist Urban Search and Rescue (including demolition, construction and vehicle removal).

☐ Identify potential temporary waste handling and treatment areas (including for areas to store material liked to fatalities and heritage material). Where possible establish: operational management arrangements (e.g. stand-by contract) operational protocols (e.g. environmental and human health standards, payment mechanisms), environmental baseline measurements, and land use arrangements (lease and land-use consents where necessary).

☐ Develop contract templates for post-disaster demolition.

Regulation

☐ Develop a policy on post-disaster waste handling facilities (waste collection centres, temporary storage areas) including: approval criteria and process, and operational (environmental, health and safety and engineering) standards.

☐ Develop a policy on post-disaster waste treatment (combustion, onsite processing, temporary staging areas) including: approval criteria and process, and operational (environmental, health and safety and engineering) standards.

☐ Develop a policy on post-disaster waste disposal (land reclamation) including: approval criteria and process, operational (environmental, health and safety and engineering) standards), ownership and operation, payment, and liability issues.
Information / records

- Collect building data, including building dimensions, building material, hazardous materials (asbestos, LPG, etc), building use (to identify problematic waste sources e.g. putrescible waste), owner and tenant details.

- Prepare an inventory of existing demolition contracting services, waste handling facilities, resources and personnel (including for hazardous material). Identify existing databases / resources e.g. the Christchurch recycling directory www.targetsustainability.co.nz or the nationwide REBRI Recycling Directory website: http://www.branz.co.nz/cms_display.php?sn=105&st=1&pg=5410. Consider some form of accreditation or pre-approval system for contractors and waste handling facilities. Carry out a risk assessment on existing facilities.

- Establish reporting systems (including data collection and synthesis) with existing waste handling facilities. Regulatory mechanisms may be required to enable this.
Appendix A  Disaster waste management plan template
Disaster Waste Management (post-event) Plan Template

<table>
<thead>
<tr>
<th>Event:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Author:</td>
</tr>
<tr>
<td>Approval:</td>
</tr>
<tr>
<td>Next plan update:</td>
</tr>
</tbody>
</table>

DISASTER & DISASTER WASTE IMPACT INDICATORS

<table>
<thead>
<tr>
<th>Disaster scale</th>
<th>Disaster &amp; disaster waste indicators (H, M, L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of displaced persons</td>
<td></td>
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<tr>
<td>Geographic extent</td>
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<tr>
<td>Duration of hazard</td>
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<tr>
<td>Volume of waste</td>
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<tr>
<td>Human health hazard</td>
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<tr>
<td>Movement of waste</td>
<td></td>
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<tr>
<td>Waste handling difficulty</td>
<td></td>
</tr>
</tbody>
</table>

LEGISLATIVE CHANGES
(List / identify any key legislative changes impacting on disaster waste management)
FUNDING
(Identify main funds available for disaster waste management and any specific requirements stipulated by the provider)

STRATEGIC MANAGEMENT TEAM

Lead (organisation and contact)

Reporting to (organisation and contact)

Collaborators (organisation and contact person)

Meeting schedule:
# WASTE DESCRIPTION

<table>
<thead>
<tr>
<th>Approximate quantity and composition</th>
<th>Disaster &amp; disaster waste indicators (H, M, L)</th>
<th>Fund source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume of waste</td>
<td>Human health hazard</td>
<td></td>
</tr>
<tr>
<td>Movement of waste</td>
<td>Difficulty of handling waste</td>
<td></td>
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</tbody>
</table>

## Response phase

- **Demolition to enable urban search and rescue.**
  - A.
  - B.
  - C.
  - D.

- **Road clearance for emergency / welfare access.**
  - A.
  - B.
  - C.
  - D.

- **Partial demolition / making safe building for public.**
  - A.
  - B.
  - C.
  - D.

- **Waste removal to assist lifeline and essential service restoration**
  - A.
  - B.
  - C.
  - D.
<table>
<thead>
<tr>
<th>Recovery phase</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Private(^1) property detritus (non-structural material)</td>
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</tr>
<tr>
<td>A.</td>
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<td>B.</td>
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<tr>
<td>C.</td>
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<tr>
<td>D.</td>
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<tr>
<td>Public property detritus (e.g. liquefaction silt, transported waste, floodwater sediment, wind-blown material, rock fall)</td>
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<tr>
<td>A.</td>
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<td>D.</td>
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<tr>
<td>Full demolition debris</td>
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<tr>
<td>A.</td>
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<td>B.</td>
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<td>D.</td>
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<tr>
<td>Major repair debris</td>
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<td>A.</td>
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<td>B.</td>
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<td>C.</td>
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<tr>
<td>D.</td>
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<tr>
<td>Reconstruction debris</td>
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<td>A.</td>
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<td>C.</td>
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<tr>
<td>D.</td>
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<tr>
<td>Horizontal infrastructure repair (e.g. roads, water, sewer, stormwater)</td>
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<td>A.</td>
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<td>B.</td>
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<td>C.</td>
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<tr>
<td>D.</td>
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</tbody>
</table>

\(^1\) Note, that ‘property’ could be residential, commercial or industrial: each property type may be managed differently.
POLICY / PLAN OBJECTIVES

(Outline the disaster waste management objectives. Remember to align them with recovery objectives)

1.
2.
3.
4.
5. etc.
IDENTIFY EXISTING WASTE SYSTEM CAPACITY

Waste handling facilities

<table>
<thead>
<tr>
<th>Facility</th>
<th>Acceptance criteria and consent conditions</th>
<th>Operational capacity (tonnes / day)</th>
<th>Total capacity (tonnes)</th>
<th>Contact details</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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Waste treatment facilities (including hazardous)

<table>
<thead>
<tr>
<th>Facility</th>
<th>Acceptance criteria and consent conditions</th>
<th>Operational capacity (tonnes / day)</th>
<th>Total capacity (tonnes)</th>
<th>Contact details</th>
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</table>
## Final disposal / end use (including hazardous)

<table>
<thead>
<tr>
<th>Facility</th>
<th>Acceptance criteria and consent conditions</th>
<th>Operational capacity (tonnes / day)</th>
<th>Total capacity (tonnes)</th>
<th>Contact details</th>
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</table>

## Transportation

<table>
<thead>
<tr>
<th>Operator</th>
<th>Truck types</th>
<th>Number of trucks</th>
<th>Operational capacity (tonnes / truck)</th>
<th>Total capacity (tonnes)</th>
<th>Contact details</th>
</tr>
</thead>
<tbody>
<tr>
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</table>
## Demolition contractors

<table>
<thead>
<tr>
<th>Contractor</th>
<th>Capabilities / certification</th>
<th>Specialist equipment</th>
<th>Contact details</th>
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## Hazardous waste contractors

<table>
<thead>
<tr>
<th>Contractor</th>
<th>Capabilities / certification</th>
<th>Specialist equipment</th>
<th>Contact details</th>
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</tbody>
</table>
NEW FACILITIES REQUIRED
(include operational structures)

SYSTEM DESIGN
*Insert system diagram linking waste sources to waste handling facilities, for example:*

![System Diagram](image-url)
SYSTEM DESCRIPTION

RISK ASSESSMENT
(Identify potential risks)

<table>
<thead>
<tr>
<th>Description</th>
<th>Impact (L, M, H)</th>
<th>Likelihood (L, M, H)</th>
<th>Treatment (avoid, reduce, mitigate transfer, accept)</th>
</tr>
</thead>
<tbody>
<tr>
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</table>

REQUIRED / DESIRED LEGISLATIVE OR REGULATORY CHANGES
(outline possible legislative changes that may be required to facilitate the waste management)
COMMUNICATION PLAN

EFFECTIVENESS ASSESSMENT

<table>
<thead>
<tr>
<th>Objectives</th>
<th>Weighting (W) (1 to 10)</th>
<th>Score (S) (-1 to 2)</th>
<th>Total effectiveness score = WxS</th>
</tr>
</thead>
<tbody>
<tr>
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</table>
Appendix B  Emergency provisions in New Zealand Law
Biosecurity Act (BioA) 1993
The emergency provisions in the Biosecurity Act are available in the event of an outbreak (eg, foot-and-mouth disease) or occurrence of an organism with potential to cause significant economic or environmental loss, or adverse effects on human health, if it becomes established in New Zealand (s144-151). Actions under the Biosecurity Act are exempted from RMA for up to 20 days if the organism is unknown to New Zealand and has the potential to cause significant economic, social or environmental adverse effects (s7A). It is unlikely that this would be a consequence of disaster waste.

Protection from civil or criminal liability is provided for any action carried out under the Act (s163).

Building Act (BA) 2004
Powers under the Building Act provide for management (including demolition and removal) of buildings deemed as dangerous, earthquake-prone or insanitary. They provide for placing hoarding to limit people from approaching nearer than is safe. The authority can then issue a notice to require action to be taken within a specified time-frame (which is no less than 10 days) (s124). The owner of the building is liable for costs if the notice is not complied with and the territorial authority carries out the required works (s126) which may include building demolition (s127). The territorial authority is also able to carry out works to remove any immediate danger to safety of people without giving any notice. The owner is again liable for the costs and the territorial authority is not liable for issuing the warrant in good faith (s129).

Civil Defence and Emergency Management (CDEM) Act 2002
The CDEM Act is administered by the Ministry for Civil Defence and Emergency Management and is implemented by Civil Defence Emergency Management Groups established through local authorities. The purpose of the act is to improve and promote sustainable management of hazards through planning and preparation (s3).

An emergency under the CDEM Act includes any natural or other disaster which causes or may cause loss of life or injury or illness or distress or in any way endangers the safety of the public or property in New Zealand and cannot be dealt with by emergency services (s4).

Powers under the Act, under a declared state of emergency include:
• carrying out works; clearing roads and other public places; removing or disposing of, or securing dangerous structures and materials wherever they may be (s85(1)(a))
• prohibit or regulate land, air, and water traffic within the area or district (s85(1)(f))
• undertake emergency measures for the disposal of dead persons or animals (s85(1)(g))
• entry on premises where necessary for saving life, preventing injury or facilitating the relief of suffering or distress (s87(a)(b))

Under a state of emergency, designated persons (deputy, chairperson or Controller of the Group or authorised person under the Group emergency plan) may enter into a contract outside regulations stipulated in the Public Bodies Contracts Act 1959 (s94).

Any authorised person acting under the provision of the CDEM Act in a declared state of emergency has protection from liability unless the act or omission constitutes bad faith or gross negligence (s110).

The CDEM Act also cites the emergency provisions in Section 330B of the RMA.

In the recovery period, the CDEM Act allows for a Recovery Coordinator to be appointed if regional CDEM agencies are overwhelmed (s29 and 30), to direct and coordinate all recovery activities.

**Government Roading Powers Act (GRPA) 1989 No. 75**

The New Zealand Transport Agency has certain powers under this Act to construct and maintain all State Highways. Powers which will affect disaster waste include powers of entry to clear ditches / drains to drain water from State Highway (s61(4)(j)(m)). No notice to land owner is required in the event of an emergency. The emergency rules provided in this Act override the RMA (s61(10)).

**Fire Service Act (FSA) 1975**

The Act provides for emergency powers to act wherever it is necessary to save lives and property in danger (s28(3)(3A)). In the event of a HSNO event, the fire service has authority
to act under the act until a HSNO enforcement officer is in attendance. It is arguable whether actions in emergencies are exempt from the RMA\textsuperscript{2}.

Protection from liability is provided in the Act (s43).

**Hazardous Substances and New Organisms (HSNO) Act 1996**

The HSNO Act in emergencies deals with actual or imminent danger to human health or safety or danger to the environment or chattels so significant that immediate action is required to remove the danger (s135(a)(b)). Hazardous substances include substances with one or more of the following properties (either independently or in contact with air or water) (s2(1)):

i) explosiveness  
ii) flammability  
iii) a capacity to oxidise  
iv) corrosiveness  
v) toxicity\textsuperscript{3} (including chronic toxicity)  
vi) ecotoxicity, with or without bioaccumulation

Emergency powers (for unforeseen emergencies) under the Act include:

- Premise entry (s137(1)(a)(b))  
- Powers of search and seize (s137(1)(c))  
- Power to require certain action to be taken or not taken, such as stop an activity, take an action to limit emergency extent, leave an area, refrain from entering (s137(1)(d)- (g))  
- Requisition of property for use in emergency (s137(1)(h))  
- Destruction of property to limit extent of emergency (s137(1)(i))

Where disaster waste poses a significant health and safety threat due to the presence of hazardous substances, the HSNO Act may play a major role in management of the waste.


\textsuperscript{3} HSNO Act defines toxicity as capable of causing ill-health, or injury to, human beings which would include asbestos.
No action can be taken against an enforcement officer (or person acting on their behalf) under these emergency provisions (s139).

**Health Act (HA) 1956**

The Health Act is administered by the Ministry of Health and aims to protect the health and well-being of New Zealanders.

The Health Act provides emergency powers for drinking-water emergencies (s 69ZZA to 69ZZG) but does not include any provision for powers for any other public health type emergencies such as hazardous material spills (now covered by HSNO Act) or insanitary buildings (now covered by Building Act).

Under the Act, officers may remedy a situation which is considered a nuisance and may be injurious to health either directly or by harbouring disease carrying vectors without prior notice. The person responsible for the nuisance is liable for any costs incurred (s29 to 35). Poorly managed solid waste following a disaster could be covered under these provisions.

While not strictly an emergency provision, the Health Act at all times has provisions for the Governor-General by Order in Council to make regulations to fulfil the following purposes (note only those relating to solid waste management have been included here):

- the inspection, cleansing, purifying, disinfection, fumigation, and isolation of ships, aircraft, houses, buildings, yards, conveyances, drains, sewers, and things (s117(1)(c))
- the destruction of insanitary things (s117(1)(c))
- the transportation and disposal of the dead (s117(1)(f))
- the prevention of the pollution, so as to be injurious to health, of any river, stream, watercourse, or lake, whether used as a source of water supply or not (s117(1)v))
- the regulation of the handling, storage, and disposal of noxious substances or of goods that are or may become injurious to health or dangerous (s119(a)).

**Land Transport Act (LTA) 1998**

The Act has provision for the agency to make emergency rules (s162). Emergency rules may only be considered “as may be necessary to alleviate or minimise any risk of the death of or a
serious injury to a person, or of damage to property”. It is unlikely actions to assist disaster waste management in the long term would be considered under this definition.

No statement of liability or exemption from prosecution under this provision is included.

**Local Government Act (LGA) 2002**
The Act has one provision for emergency situations: the power of entry in case of emergency. This provision can be used if there is a sudden emergency causing or likely to cause – loss of life or injury to a person; or damage to property; or damage to the environment (s173). However, the extent of powers to act (e.g. removing orremedying a hazard) once on the property appears to be limited.

**Maritime Transport Act (MTA) 1994**
Emergency provisions are provided for marine oil spills (s281). For these events the MTA has precedence over the RMA provisions (s467). Protection from liability for those tending to a marine oil spill is provided for those acting in good faith (s327).

**Public Works Act (PWA) 1981**
The Public Works Act provides for right of entry in emergencies onto land where there is imminent danger to life or property, or a likelihood of serious interference with any road or public work and remedial measures need to be carried out immediately (s234). Prosecution protection is also provided by these emergency powers.

**Resource Management Act (RMA) 1991**
Under the RMA there are two types of emergency works. Those carried out in a state of emergency (by persons acting under the powers of the CDEM Act) (Section 330B) and those carried out at other times (Section 330). For both types of emergency works the provision of the following sections of the RMA do not apply:

- Section 9 – Restrictions on use of land
- Section 12 – Restrictions on use of coastal marine area
- Section 13 – Restrictions on certain uses of beds of lakes and rivers
- Section 14 – Restrictions relating to water
- Section 15 – Discharge of contaminants into the environment

In the event of a state of emergency the person exercising powers under the Civil Defence Emergency Management Act 2002 may authorise activities that “remove the cause of, or
mitigate any actual or adverse effect of the emergency”. Disaster waste may fall under this category.

Outside a state of emergency local authorities have the authority to undertake emergency works where the authority has financial responsibility for a natural and physical resource and it is affected or is likely to be affected by an adverse effect on the environment\(^4\) (s330(1)(d) and (e)) or any sudden event causing or likely to cause loss of life, injury or serious damage to property (s330(1)(f)). The emergency provision also includes authority for right of entry to private property.

In both types of emergency works the person, authority or network utility operator who authorised the emergency activity must notify the consent authority within 7 days. If an emergency activity undertaken under Section 330A(1)(2) or 330B(2)(3) requires a resource consent the standard RMA process is activated within 27 days of the activity commencing. The activity may continue until a decision has been reached on the application (s330A(3), s330B(4)). Any remedial action required would be identified and enforced (s314) via this process.

Depending on the intended activity and rules surrounding the activity this is likely to include the full public notification and submission process. However, the Minister for the Environment (or Minister of Conservation for works solely in coastal marine areas) has the power to call-in projects of national significance (Part 6AA). It is likely that waste disposal after a large scale event would fall into this category.

No person may be prosecuted for emergency works undertaken by any person exercising powers during a state of emergency (s330B(5)) or in fact acting under Section 330 of the Act (s18(2)). There is also a provision, in accordance with Section 341 that it is a defence to prosecution if the defendant proves:

---

\(^4\) It is important to note here that the definition of ‘environment’ in the RMA includes:

“(a) ecosystems and their constituent parts, including people and communities; and (b) all natural and physical resources; and (c) amenity values; and (d) the social, economic, aesthetic, and cultural conditions which affect the matters stated in paragraphs (a) to (c) of this definition or which are affected by those matters”
i) The action or event to which the prosecution relates was necessary for the purposes of saving or protecting life or health, or preventing serious damage to property or avoiding and actual or likely effect on the environment; and

ii) The conduct of the defendant was reasonable in the circumstances; and

iii) The effects of the action or event were adequately mitigated or remedied by the defendant after it occurred.

Section 11 of the RMA – subdivision of land – which may be required in the allocation of land for temporary and permanent waste management and disposal sites is not included in the provision for emergency works, however, it is included in Section 341 and is subsequently offered the same limited protected from prosecution.

**Waste Minimisation Act (WMA) 2008**

There is a provision in the Waste Minimisation Act which allows the waiver of waste disposal levy payment in ‘exceptional circumstances’ (s29).
Appendix C  Contractor waste management plan and report templates
**Waste Management Plan template**

Please note that this application will be rejected if any incorrect, missing or misleading information is found.

<table>
<thead>
<tr>
<th>Site Address</th>
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<tbody>
<tr>
<td>Contractor</td>
<td></td>
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<tr>
<td>Contact name and number</td>
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</table>

<table>
<thead>
<tr>
<th>Work hours and days</th>
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<tbody>
<tr>
<td>Estimated timeframe for demolition (including on site debris management)</td>
<td></td>
</tr>
<tr>
<td>Is the site fenced?</td>
<td>Yes / No  please circle</td>
</tr>
<tr>
<td>Is the building waste required for coronial or building inquiries?</td>
<td>Yes / No  please circle</td>
</tr>
<tr>
<td>Will building fittings and chattels be salvaged prior to demolition?</td>
<td>Full / Partial / None  please circle</td>
</tr>
<tr>
<td>Is the demolition material sorted at the site?</td>
<td>Full / Partial / None  please circle</td>
</tr>
<tr>
<td>If No, please indicate the facility where the material is going to be sorted.</td>
<td></td>
</tr>
<tr>
<td><em>(Please note that waste sorting is a waste management activity, therefore, the sorting facility requires a consent)</em></td>
<td></td>
</tr>
<tr>
<td>Please specify any material processing planned at the demolition site <em>(please attach relevant consents to this plan)</em></td>
<td></td>
</tr>
</tbody>
</table>
Please list all the waste arising from demolition, the name and address of the facilities used to dispose of or recover the waste and the waste carrier. Please ensure that these facilities have the appropriate consents to handle the waste types shown below. Should any of these facilities not have relevant consents, this management plan will be rejected.

<table>
<thead>
<tr>
<th>Material</th>
<th>Drop-off Destination (name and address)</th>
<th>Waste Carrier (transporter)</th>
<th>Estimated Quantity (please specify units)</th>
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</thead>
<tbody>
<tr>
<td>Mixed earthquake waste</td>
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<tr>
<td>Mixed cleanfill</td>
<td></td>
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<td></td>
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<tr>
<td>Concrete</td>
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<td></td>
<td></td>
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<tr>
<td>Bricks</td>
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<tr>
<td>Timber</td>
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<tr>
<td>Metal</td>
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<tr>
<td>Plasterboard</td>
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<td></td>
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<tr>
<td>Hazardous substances</td>
<td>please specify</td>
<td></td>
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</tr>
<tr>
<td>Refuse</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>please specify</td>
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<td></td>
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<tr>
<td><strong>Total</strong></td>
<td></td>
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</tbody>
</table>
# Waste Report

**Site Address:**

**Date:**

**Contractor / Owner Name:**

**Demolition contractor name:**

Were building fittings and chattels salvaged prior to demolition:  
*Yes / No  please circle*

<table>
<thead>
<tr>
<th>Material</th>
<th>Drop-off Destination</th>
<th>Quantity</th>
<th>Weight (tonnes)</th>
<th>Volume (cu.m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mixed earthquake waste</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Mixed cleanfill waste</td>
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<tr>
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<td><em>please specify</em></td>
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<td>Refuse</td>
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<td>Other</td>
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<tr>
<td></td>
<td><em>please specify</em></td>
<td></td>
<td></td>
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<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
Appendix D  Department of Labour 2011  
Christchurch earthquake factsheet
CHRISTCHURCH RECOVERY
ASBESTOS MANAGEMENT

A large proportion of buildings older than 20 years will contain some asbestos materials. When not disturbed these are normally safe as they do not release asbestos fibres.

Following the earthquake any break up of these materials can pose a risk of asbestos dust exposure.

A person moving rubble for rescue and recovery would be justified in doing so without any specific controls for managing asbestos that might be in the debris.

Dust masks should be worn wherever dust is present or likely to be generated through building movement, recovery work or demolition. Where asbestos is known or is likely to be present, these masks are compulsory.

Builders and contractors engaged to repair, demolish or remove rubble from a stable but earthquake damaged building should follow the normal asbestos management controls.

What is the acceptable risk?

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>WORK/TASK</th>
<th>SAFE PRACTICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Critical action</td>
<td>• The immediate actions required to preserve life.</td>
<td>• Wear a dust mask if one is immediately available.</td>
</tr>
<tr>
<td>[in the event of further damage]</td>
<td>• Rescuing people from rubble</td>
<td>• Bag and dispose of clothing.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Shower.</td>
</tr>
<tr>
<td>Urgent Work</td>
<td>Making structures safe</td>
<td>The testing of debris to confirm asbestos is not essential. Pragmatic decisions can be made based on the age and construction of the buildings/structures. If in doubt treat as if it contains asbestos.</td>
</tr>
<tr>
<td></td>
<td>• Demolition is needed to make a structure safe and to prevent imminent risk of harm to people in the vicinity.</td>
<td>Demolition material containing asbestos should be treated as asbestos waste and disposed of according to the Asbestos Regulations. It must not be sorted for recyclable items as other areas could then be contaminated with asbestos.</td>
</tr>
<tr>
<td></td>
<td>• The debris is unstable and susceptible to aftershocks, land subsidence or flooding.</td>
<td>Dampen down rubble before disturbing.</td>
</tr>
<tr>
<td></td>
<td>Removing rubble</td>
<td>Use the best dust mask or respirator you can get.</td>
</tr>
<tr>
<td></td>
<td>• Asbestos dust from the loose rubble created by the earthquake cannot be easily managed other than by prompt removal of the rubble from a populated area.</td>
<td>Bag dusty overalls before removing mask.</td>
</tr>
<tr>
<td></td>
<td>• Debris is obstructing essential infrastructure requiring prompt removal of the debris.</td>
<td>Shower after work.</td>
</tr>
<tr>
<td>Non-Urgent</td>
<td>Clearing sites safely</td>
<td>Full application of asbestos management guidelines is required including testing for asbestos.</td>
</tr>
<tr>
<td></td>
<td>• Damage has been created by the earthquake but the site is stable</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Debris may include asbestos but is contained on the site.</td>
<td></td>
</tr>
</tbody>
</table>

newzealand.govt.nz

The Department of Labour takes no responsibility for the results of any actions taken on the basis of this information, or for any errors or omissions. www.dol.govt.nz 0800 20 90 20
- **Disposal of debris**
  It is important that building demolition material is disposed of safely. Local councils will have designated locations for disposal and will provide advice on how product types must be separated for dumping. Always contact the council before transporting rubble and debris to the tip.

  When this waste material is being transported it must be well covered to prevent dust from getting into the air. Dampening down the material before transport can help but take care not to saturate as this may cause slurry to pour out of the container.

- **Respiratory protection**
  P1 and P2 respirator masks can be purchased at hardware stores or safety supply shops.

  People with beards will not be protected by standard masks as the facial hair will prevent a good seal between the outside of the mask and the face.

- **References**
  New Zealand Guidelines for the Management or Removal of Asbestos

  Occupational Health Tools 2009 – Department of Labour
Appendix E  Asbestos management flowchart
Asbestos management post-disaster

Demolition work approved (if applicable)

- Is the building safe to enter?
  - Yes: Carry out pre-demolition asbestos assessment (as per DOL guidelines)
  - No: What is the likelihood of asbestos?
    - Unlikely (e.g. constructed post 1990): Commence demolition – cease if asbestos
    - Likely: Appoint a certified asbestos handler
      - Prepare an alternative asbestos management plan
      - Notify Department of Labour at least 24 hours prior to works commencing
      - Carry out demolition works (remove asbestos where possible) in accordance with management plan
      - Bag / wrap and transport all asbestos contaminated wastes, to certified disposal site
      - Disposal at certified disposal site (check for any Special permitting or notification requirements)
      - Report as necessary

- Is there asbestos?
  - Yes: Commence demolition – cease if asbestos
    - Is it friable?
      - Yes: Appoint a competent asbestos handler
        - Notify Department of Labour at least 24 hours prior to works commencing as required by DOL guidelines
        - Carry out asbestos removal pre-demolition in accordance with the DOL guidelines
        - Complete demolition with asbestos mitigation measures in place
        - Asbestos contaminated material
      - No: Prepare an alternative asbestos management plan

- Notify Department of Labour at least 24 hours prior to works commencing as required by DOL guidelines

- Asbestos contaminated material

- Where asbestos separation is achieved
PART TWO: Disaster Demolition and Debris Management Policy Recommendations

Prepared for  Environment Canterbury
Ministry of Civil Defence and Emergency Management

Written by  Charlotte Brown
Date:  11 April 2012
Version:  First Draft

Forward
The following guidelines have been developed based on the experiences managing disaster waste following the February 2011 Christchurch earthquake response and the findings of Charlotte Brown’s PhD thesis entitled “Disaster Waste Management: a systems approach”. Brown’s thesis reviews the disaster waste management responses following the 2011 Christchurch earthquakes, New Zealand; 2009 Victorian Bushfires, Australia; 2009 Samoan Tsunami; 2009 L’Aquila earthquake, Italy; and 2005 Hurricane Katrina, United States.
1. Introduction

During the course of the author’s research and the author’s participation in the 2011 February earthquake, several aspects of existing institutional arrangements (governance, funding and legislation) have been identified that have or could hinder the management of disaster waste in the future. This document identifies these areas and recommends alternative approaches. The reasoning behind the recommendations here are brief. The full reasoning behind the recommendations are not included here but are outlined in full in the author’s thesis “Disaster Waste Management: a systems approach”. The thesis draft will be complete in May 2012 and the final version in late 2012. The author is happy to provide further details upon request.

2. Background

Disaster waste is a unique activity in that it bridges response and recovery. Many of the institutional structures in New Zealand are designed for emergency situations and are generally successful in that regard. However, the structures often do not consider in detail the recovery needs. They also generally do not explicitly include waste management needs.

Debris impacts on disaster response and recovery activities in the following ways:

- Emergency response: debris management to facilitate preservation of life, provision of emergency services, removing immediate public health and safety hazards such as unstable buildings and hazardous materials, etc.
- Recovery: debris management as part of lifelines restoration (critical infrastructure), building demolition, infrastructure repairs
- Rebuilding: debris management of wastes generated from and used in re-construction.

The emergency phase deals with the removal of the immediate hazards and typically corresponds to the duration of the state of emergency.

The recovery phase is where the majority of the disaster generated waste will be managed. The duration of the recovery phase for waste managers can be affected by a
number of factors outside the control of waste managers, including: police/coroner investigations (which can limit site access for public and waste contractors), slow resident return, recovery / rebuilding planning, and funding decisions (e.g. insurance payment delays). While this waste generally does not pose an immediate direct threat to lives, left unmanaged or managed too slowly, disaster waste can become a chronic problem with significant social, economic and environmental impacts.

Emergency or disaster response institutional structures (governance, funding, legislative) in New Zealand enable communities to respond efficiently and effectively to emergency situations. The mobilisation of emergency institutional structures where there is an immediate threat to lives, property or the environment is largely straightforward. However, the role of emergency provisions during the longer-term recovery operations (i.e. post state of emergency declarations) from large scale disasters, after the immediate hazards have been dealt with but extra-ordinary measures are needed to enable an efficient and effective recovery, is less clear. This was recognised in the response to the 2011 Christchurch earthquakes. Authorities were moved to develop completely new organisational and legislative structures to enable these recovery operations. In the Christchurch case, it became apparent that neither the emergency legislation nor the peace-time legislation in New Zealand was sufficient to enable an efficient and effective recovery.

This report addresses what changes to New Zealand’s institutional frameworks may be beneficial in the management of disaster waste in future disaster events.

3. Disaster impacts

3.1 General

Disaster waste will be generated almost all natural and man-made hazards. When planning for disaster demolition and debris management before an event it is easy to get overwhelmed with the number of scenarios that are likely both across and within these hazard types. This section outlines the key factors or indicators which are likely to alter how disaster debris should be managed. The indicators are divided into disaster impacts and disaster waste impacts.
The indicators are described below and a semi-quantitative rating scale is presented. The indicators are used in the remainder of this report to demonstrate the applicability and suitability of different policy approaches to disaster waste management.

### 3.2 Disaster impact indicators

The following disaster impact indicators may indirectly affect how waste can be managed.

1. The general **disaster scale** (e.g. the number of persons deceased, the proportion of the population affected, the proportion of buildings destroyed, the projected recovery time, the economic impact, the resources required to manage the response, lifeline disruption). In New Zealand the scale of an event may be as defined in Incident response plans or as defined by the level of a Civil Defence State of Emergency declaration.

<table>
<thead>
<tr>
<th>Low</th>
<th>Medium</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minor level of damage and disruption. Local resources only required to manage the event. Project recovery time: 1-2 years.</td>
<td>Moderate level of damage, possible loss of lives. Regional resources required. Projected recovery time: 2-5 years.</td>
<td>Significant loss of lives and damage to buildings and infrastructure. National and/or international resources required to manage the response. Projected recovery time: over 5 years.</td>
</tr>
</tbody>
</table>

In New Zealand the scale of an event may be largely determined by Civil Defence and the corresponding level of the State of Emergency (if any).

2. The **number of displaced persons** (who are wanting to return)

<table>
<thead>
<tr>
<th>Low</th>
<th>Medium</th>
<th>High</th>
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</thead>
<tbody>
<tr>
<td>No or less than 1% of population displaced. Or with most or all of the population intending to move permanently from the affected area.</td>
<td>1-20% population displacement in affected area, with some or all intending on returning to the area.</td>
<td>Over 20% of population in affected area is displaced, with some or all population intending on returning to the area.</td>
</tr>
</tbody>
</table>

3. The **geographical extent** of the impact (including effects of geographical isolation)

<table>
<thead>
<tr>
<th>Low</th>
<th>Medium</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area of impact confined to one or two localities, with easy access to unaffected areas.</td>
<td>Regional area of impact. Some or limited access to and from affected areas.</td>
<td>Extensive area of impact, across multiple regions. Difficult access to and from affected area.</td>
</tr>
</tbody>
</table>
4. The hazard duration

<table>
<thead>
<tr>
<th></th>
<th>Low</th>
<th>Medium</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>One off event. No</td>
<td>One off event with prolonged effects</td>
<td>Multiple, on-going effects of hazard (e.g. on-going</td>
<td>Multiple, on-going effects of hazard (e.g.</td>
</tr>
<tr>
<td>recurrence of hazard</td>
<td>(e.g. a single strike tsunami)</td>
<td>severe aftershocks): for up to 1 month</td>
<td>on-going severe aftershocks, nuclear</td>
</tr>
<tr>
<td>event (e.g. a single</td>
<td></td>
<td></td>
<td>incident): in excess of 1 month</td>
</tr>
<tr>
<td>strike tsunami)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Minimal damage to road network.</td>
<td>Roasting networks are moderately to severely disrupted</td>
<td>Roasting networks are disrupted for more</td>
</tr>
<tr>
<td></td>
<td></td>
<td>for up to one month. Authorities require minimal</td>
<td>than a month. Authorities require</td>
</tr>
<tr>
<td></td>
<td></td>
<td>traffic movement.</td>
<td>minimal traffic movement.</td>
</tr>
</tbody>
</table>

Note that, related to this, is whether or not a hazard is a slow or rapid onset. In a slow onset event (such as an oil spill or potentially a flood) authorities have time to plan, pre-position supplies and people have time to put mitigation measures in place (such as move furniture above group in a flood situation).

5. Disruption to road network

<table>
<thead>
<tr>
<th>Low</th>
<th>Medium</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimal damage to road network.</td>
<td>Roasting networks are moderately to severely disrupted</td>
<td>Roasting networks are disrupted for more</td>
</tr>
<tr>
<td></td>
<td>for up to one month. Authorities require minimal</td>
<td>than a month. Authorities require</td>
</tr>
<tr>
<td></td>
<td>traffic movement.</td>
<td>minimal traffic movement.</td>
</tr>
</tbody>
</table>

Table 5.1 shows typical ranges for disaster impacts based on different hazard types.
Table 3.1  Typical range of disaster impacts for different hazard types

<table>
<thead>
<tr>
<th>Types of Disasters</th>
<th>Disaster scale</th>
<th>Number of displaced people</th>
<th>Geographical extent</th>
<th>Hazard duration</th>
<th>Disruption to road network</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hurricanes / Typhoons</td>
<td>L-H</td>
<td>L-H</td>
<td>M-H</td>
<td>L-M</td>
<td>L</td>
</tr>
<tr>
<td>Tsunamis</td>
<td>L-H</td>
<td>L-H</td>
<td>L-H</td>
<td>L</td>
<td>L-M</td>
</tr>
<tr>
<td>Tornadoes</td>
<td>L-M</td>
<td>L</td>
<td>L-M</td>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td>Floods</td>
<td>L-H</td>
<td>L-H</td>
<td>L-M</td>
<td>L-M</td>
<td>L-H</td>
</tr>
<tr>
<td>Earthquakes</td>
<td>L-H</td>
<td>L-H</td>
<td>L-H</td>
<td>L-H</td>
<td>L-H</td>
</tr>
<tr>
<td>Wildfires</td>
<td>L-H</td>
<td>L-H</td>
<td>L-H</td>
<td>L-M</td>
<td>L</td>
</tr>
<tr>
<td>Ice storms</td>
<td>L-M</td>
<td>L</td>
<td>M-H</td>
<td>L-M</td>
<td>L-M</td>
</tr>
<tr>
<td>Volcanic eruption</td>
<td>L-H</td>
<td>L-H</td>
<td>H</td>
<td>L-H</td>
<td>H</td>
</tr>
<tr>
<td>Pandemic</td>
<td>L-H</td>
<td>L</td>
<td>H</td>
<td>M-H</td>
<td>L</td>
</tr>
<tr>
<td>Industrial disaster</td>
<td>L-H</td>
<td>L-M</td>
<td>L-M</td>
<td>L-H</td>
<td>L</td>
</tr>
</tbody>
</table>

L = low, M = medium, H = high

3.3 Waste characteristic indicators

1. Volume of waste

<table>
<thead>
<tr>
<th>Low</th>
<th>Medium</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waste generated is equivalent to 1-2 years’ worth of annual waste generation.</td>
<td>Waste generated is equivalent to 2-5 years’ worth of annual waste generation.</td>
<td>Waste generated is equivalent of more than 5 years’ worth of annual waste generation.</td>
</tr>
</tbody>
</table>

2. Human health hazard (physical (e.g. fall hazard), chemical or biological)

<table>
<thead>
<tr>
<th>Low</th>
<th>Medium</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hazard poses a weak, chronic threat</td>
<td>Hazard poses a minor acute or serious chronic threat.</td>
<td>Hazard poses a serious acute and/or serious chronic threat.</td>
</tr>
</tbody>
</table>

3. Environmental health hazard

<table>
<thead>
<tr>
<th>Low</th>
<th>Medium</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hazard poses a weak, chronic threat</td>
<td>Hazard poses a minor acute or serious chronic threat.</td>
<td>Hazard poses a serious acute and/or serious chronic threat.</td>
</tr>
</tbody>
</table>
4. **Movement of waste** (by hazard forces and particularly cross-property or locality boundary)

<table>
<thead>
<tr>
<th>Low</th>
<th>Medium</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>The majority of the waste remains within the property boundaries.</td>
<td>Some waste is likely to travel across property boundaries.</td>
<td>Significant waste transported across property boundaries.</td>
</tr>
</tbody>
</table>

5. **Waste handling difficulty** (e.g. specialist equipment required for demolition, waste separation or heavy material removal)

<table>
<thead>
<tr>
<th>Low</th>
<th>Medium</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Persons with little or no skill can manage waste stream. Standard household and garden tools only necessary.</td>
<td>Some basic equipment is required to manage waste. Unskilled workers could be quickly trained.</td>
<td>Waste is difficult and dangerous to manage. Specialist skill and equipment is required.</td>
</tr>
</tbody>
</table>

Table 3.2 shows typical ranges for disaster waste impacts based on different hazard types.

Table 3.2 **Typical range of disaster waste impacts for different hazard types**

<table>
<thead>
<tr>
<th>Types of Disasters</th>
<th>Volume of waste</th>
<th>Human health hazard</th>
<th>Environmental health hazard</th>
<th>Movement of waste</th>
<th>Difficulty of handling waste</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hurricanes / Typhoons</td>
<td>L - M</td>
<td>L - M</td>
<td>L - M</td>
<td>M</td>
<td>L - H</td>
</tr>
<tr>
<td>Tsunamis</td>
<td>L - H</td>
<td>L - H</td>
<td>L - H</td>
<td>M - H</td>
<td>L - H</td>
</tr>
<tr>
<td>Tornadoes</td>
<td>L</td>
<td>L - M</td>
<td>L - M</td>
<td>M</td>
<td>L - H</td>
</tr>
<tr>
<td>Floods</td>
<td>L - H</td>
<td>L - H</td>
<td>L - H</td>
<td>M - H</td>
<td>L - M</td>
</tr>
<tr>
<td>Earthquakes</td>
<td>L - H</td>
<td>L - H</td>
<td>L - H</td>
<td>L</td>
<td>L - H</td>
</tr>
<tr>
<td>Wildfires</td>
<td>L - M</td>
<td>L - M</td>
<td>L - M</td>
<td>L</td>
<td>M - H</td>
</tr>
<tr>
<td>Ice storms</td>
<td>L</td>
<td>L - H</td>
<td>L - H</td>
<td>L</td>
<td>L - H</td>
</tr>
<tr>
<td>Volcanic eruption</td>
<td>L-H</td>
<td>M</td>
<td>M</td>
<td>H</td>
<td>L-H</td>
</tr>
<tr>
<td>Pandemic</td>
<td>L</td>
<td>H</td>
<td>L</td>
<td>-</td>
<td>H</td>
</tr>
<tr>
<td>Industrial disaster</td>
<td>L-M</td>
<td>L-H</td>
<td>L-H</td>
<td>L</td>
<td>L-H</td>
</tr>
</tbody>
</table>

L = low, M = medium, H = high
4. Governance

Generally disaster waste is not explicitly included in existing Civil Defence governance arrangements for emergency response. And recovery arrangements, the period where most of the waste will be managed, in general are weakly defined for all recovery activities.

Prior to any disaster, responsibility for strategic management of disaster waste needs to be assigned to relevant organisations; and, subsequently a role within those organisations. This needs to fit under the civil defence group structure. There should be designated organisations / positions at each level of government to ensure that the appropriate resources and coordination can be carried out appropriate to the scale of the disaster and overall recovery management. Note that within each organisation the responsibility should be assigned to a role and not a person to ensure continuity and in the event of loss of life in a disaster event.

A lead authority will need to be appointed and this is likely to change for different disaster scales and impacts. It is likely that this lead authority will correspond to the level of disaster event i.e. if it is a local emergency, the lead agency will be local; if the emergency is regional, the lead will be regional etc. Determination of which organisation at local, regional and national would be appropriate to lead the strategic management of the waste needs to be agreed between authorities and may differ between regions. The appropriate lead may also differ depending on the disaster impact. Table 4.1 indicates which organisation (both level of government and waste or emergency authorities) would be most appropriate to manage disasters with different impacts. As the table shows, the level of governance is in general determined by the disaster scale and geographical spread of impact. The type of organisation is determined by the number of displaced persons, level of road disruption and the human health hazard in the waste as this increases the urgency to clean-up and increases the interconnectedness between waste management activities and other recovery activities.
Table 4.1  Indicators for determining the strategic lead

<table>
<thead>
<tr>
<th>Disaster &amp; disaster waste indicators</th>
<th>Disaster scale</th>
<th>Number of displaced persons</th>
<th>Geographic extent</th>
<th>Duration of hazard</th>
<th>Disruption to road network</th>
<th>Volume of waste</th>
<th>Human health hazard</th>
<th>Environmental health hazard</th>
<th>Movement of waste</th>
<th>Difficulty of handling waste</th>
</tr>
</thead>
<tbody>
<tr>
<td>National</td>
<td>H</td>
<td>-</td>
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<tr>
<td>Regional</td>
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<tr>
<td>Local</td>
<td>L</td>
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<td>L</td>
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<table>
<thead>
<tr>
<th>Level of Governance</th>
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<tbody>
<tr>
<td>National</td>
<td>H</td>
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<td>H</td>
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<td>-</td>
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<td>-</td>
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<tr>
<td>Regional</td>
<td>M</td>
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<td>-</td>
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<tr>
<td>Local</td>
<td>L</td>
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<table>
<thead>
<tr>
<th>Authority type</th>
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</thead>
<tbody>
<tr>
<td>Emergency / recovery</td>
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<td></td>
</tr>
<tr>
<td>Waste / Environmental</td>
<td>/</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

It is recommended that the lead agency be delegated responsibility / mandate to lead the waste management activities. Preferably this would be in the form of legislative authority requiring collaboration with relevant agencies as well as power to direct authorities to act and facilitate legislative and regulatory changes where required. A strategic management approach, distinct from ‘peace-time’ structures is generally required to meet recovery objectives. This is to ensure that personnel are somewhat removed from their peace-time roles, mentalities (e.g. silos), relationships and other constraints and are able to think within a disaster recovery context. Following significant disaster events there are many situations which require extra-ordinary measures to be taken. While it is important to realise the ‘peace-time’ relevance and implications of any actions, responders should not be limited to peace-time approaches.

It is important that whatever structure is set up for strategic management for waste should, as far as possible, bridge between emergency and recovery structures for continuity. Different approaches and decision-making processes will be required during the emergency phase, however, much of the systems and infrastructure required during the longer term waste management activities will be initiated during the emergency phase.
Typical organisations which need to be included in a strategic waste management organisational structure / collaborative working group would include:

- Disaster recovery authority representative
- Waste management operational representatives (likely local authority but it is important to include industry where applicable)
- Environmental authorities
- Health and safety authorities
- Public health authorities
- Hazardous substance authorities
- Lifeline authorities (particularly with respect to demolition works)
- Marine authorities (for events with debris in marine environmental)
- Transportation authorities
- Heritage building authorities
- Non-domestic agencies (e.g. international governmental and non-governmental groups) (if any)
- Iwi
- Community representatives

In that group it is vital that the strategic management structure has strong links with those with vested interest and long-term responsibility for and knowledge of waste management facilities and operations. Some existing inter and intra-organisational communication protocols may need to be stream-lined to improve coordination efficiencies.

To improve the effectiveness of collaboration efforts, it is highly beneficial to establish relationships pre-disaster. This group would ideally (at respective levels of government):

- Collaboratively develop a disaster waste management plan
- Periodically meet to discuss disaster waste preparedness and hold training exercises.

It is important that a strategic management team has a person dedicated to public communication. Under current Civil Defence arrangements Public Information
Management (PIM) is a separate response function. It is recommended that a PIM representative be dedicated to the demolition and debris management process.

Strategic managers / the working group will be responsible for:

- Determining policy objectives.
- Estimating waste volumes and composition.
- Determining operational guidelines for demolition and waste management.
- Liaising with other response / recovery managers.
- Prioritising resources to meet recovery objectives.
- Anticipating and mitigate potential problems.
- Assigning responsibility for, and oversee, post-disaster environmental and human health risk management.
- Ensuring appropriate monitoring systems are in place to enable effective strategic management and planning.
- Developing and utilising a transparent decision-making process and protocols for inter and intra-organisational collaboration.
- Developing a proactive communication strategy.
- Developing a relationship with the funding provider.
- Facilitating regulatory and legislative changes where necessary and aim to anticipate necessary legislative changes and minimise the number of legislative changes and/or avoid unnecessary legislative changes.
- Post-event response review.

Training

Ideally a demolition and waste management function should be included under the Civil Defence system and therefore incorporated in Civil Defence exercises. Subsequently it may be beneficial to delegate strategic management lead for waste management activities to personnel within the civil defence arrangements.

Demolition crews should also be included in Urban Search and Rescue training and planning. Standing contracts for demolition crews and specialist training is recommended.
In addition, it is recommended that waste management be included in the Lifeline planning groups that are in existence around New Zealand. The author has identified some interdependencies between waste and other lifelines and it is believed benefit would be gained by including waste organisations in lifelines groups. Refer to:

5. Funding

5.1 General
Disaster recovery activities are significantly affected by funding availability. The timeliness and quality of recovery activities are not only impacted by the extent of the funding but also the mechanisms with which funding is delivered. As demolition and debris management activities are on the critical path to recovery, it is essential that they are effectively funded to minimise disruption to the recovery and rebuilding process.

This section discusses the effectiveness of existing funding arrangements in enabling disaster waste to be effectively managed and is divided into four sections:

- Funding source
- Funding delivery
- Funding valuation
- Funding policies

5.2 Funding source
In New Zealand, there is generally an expectation that financial preparedness for a disaster event (including management of debris generated) is a private responsibility (individuals, households or businesses). The alternative approach to a private approach is to have funds managed as a public fund and to distribute the funds as necessary after the event. Thus funding sources will be divided in this discussion into Public or Private sources.
New Zealand does have some public funds which can be accessed during a state of emergency. However, it is unclear what waste activities would be covered.

Private funding has some disadvantages in terms of management of waste (and recovery activities in general). Private funding essentially means that individuals are in control of their own works: in terms of timeliness and quality. Unless some form of central control is provided (e.g. the CER Act following the 2011 Christchurch earthquake), the community wide recovery relies on individual actions. In terms of waste, in particular, the likelihood of inappropriate waste handling (potentially contributing to environmental and human health hazards) is far greater.

In addition, there are a number of situations where, in the authors opinion, public funding will almost certainly be required and authorities should plan for these eventualities (summarised in Table 5.1):

- If there are a high number of displaced persons wanting to return, (and waste removal would encourage people to return to the area) public funding may be beneficial.
- Where there is a high human health hazard (and property owners are slow to clean-up)
- Where the disaster action (e.g. flood or tsunami) moves waste across property boundaries, it is inevitable that public funding will be required as waste ownership (and so responsibility for clean-up) will be difficult to ascertain.

Table 5.1  Indicators for funding source

<table>
<thead>
<tr>
<th>Disaster &amp; disaster waste indicators</th>
<th>Disaster scale</th>
<th>Number of displaced persons</th>
<th>Geographic extent</th>
<th>Duration of hazard</th>
<th>Disruption to road network</th>
<th>Volume of waste</th>
<th>Human health hazard</th>
<th>Environmental health hazard</th>
<th>Movement of waste</th>
<th>Difficulty of handling waste</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public</td>
<td>-</td>
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Generally public funding offers many benefits including:

- Enabling more effective strategic management (due to reduced organisational complexities and autonomy over fund management)
- Ensure that a community wide recovery is enabled and the recovery is not delayed / impacted by private funding issues.
- Ensure that the available funds are prioritised to activities which benefit the wider community most.

If an individual funding system is preferred (or unavoidable) there must be facility to enable centralised management of works should it be required (to enable improved quality control and resource prioritisation).

Private funding systems can be manipulated such that the potential negative impacts can be mitigated. For example:

1. Individuals not acting in a timely matter: legislative or regulatory authority can be granted that enables authorities to direct individuals to act for the benefit of the recovery, such as the approach enabled by Section 38 of the CERA Act. Cost recovery mechanisms would be an important consideration where authorities are forced to act on behalf of individuals.

2. Inappropriate waste handling: Where there are funding gaps or entities wish to save on waste management costs authorities would have to put in place systems which encourage appropriate behaviour (e.g. offering free disposal sites, incentive schemes for disposing of hazardous waste appropriately, increased monitoring requirements)

For small scale events, private funding approaches (where waste and repair / rebuilding are by the same entity) offer more opportunities for site level material reuse.

Based on the above it would be beneficial to develop a (flexible) funding strategy that establishes funding responsibility for different disaster impacts to aid decision-makers make timely decisions post disaster.
5.3 Funding delivery

The method in which financial assistance is distributed to the affected population varies. The primary mechanisms for disaster recovery funding are:

1. Directly facilitated (delegated organisation carries out the works collectively).
2. Reimbursement (individuals facilitate the work and present receipts for reimbursement).
3. Lump sum (value of recovery works is estimated and paid as a lump sum to the affected person – who is, in turn, responsible for facilitating the necessary works).

Generally, as for funding source, the greater control the funding authority has on the funds, the better quality outcome will be achieved. Direct facilitation offers greatest opportunity for control, followed by Reimbursement and Lump Sum respectively. Individuals charged with lump sum payments / contracts are potentially likely to ‘cut-corners’ to save money. If works are directly facilitated through a publically engaged organisation, the risk of adverse effects from illegal dumping, unsafe health and safety practices, slow waste management etc. will be minimised. This has been observed in several international case studies investigated including in Christchurch. Greater control is particularly beneficial where there is a significant human health hazard. For example, following the 2011 Christchurch earthquake, the decision by contractors to enter unsafe buildings to strip recyclables despite being instructed not to enter the building.

Direct facilitation is also beneficial from a waste management perspective. Post-disaster, disaster specific waste management facilities, particular resource recovery facilities, will operate under extreme uncertainty. Generally waste management facilities would have to operate as an independent operation to the demolition works / waste collection works. Facility operators must estimate a unit cost to handle an unknown quantity and quality of material. Given the speed of the operations they have very little time to respond and adjust their price structure should their initial estimates be incorrect. This level of risk means these facilities are vulnerable to failure either during the recovery process (which may mean closure of the facility) or after the event (which may mean a legacy issues for authorities to manage). Direct facilitation allows for waste management facilities to be married to the front end waste management process and for actual costs (through a time and cost), rather than estimated costs, to be reflected.
Price escalation is a commonly observed phenomenon following disaster events. From an end user perspective (i.e. the community) direct facilitation and cost reimbursement offer more security over the cost of the works as the actual cost to complete works is covered, rather than an estimated value. Lump sum payments mean that communities may be vulnerable to price fluctuations: sums that might be calculated to be sufficient to complete a work scope may no longer be sufficient two years later when the works are actually carried out. From a funder perspective, lump sum structures offers more security over the total cost.

5.4 Funding valuation

Authorities must ensure that, whether private or public, sufficient funds are available for demolition and debris management activities and that there are no funding gaps or double-ups.

It is preferable if demolition and debris management is a separate item from rebuilding funds. This is to ensure that money is not inappropriately diverted from demolition and/or debris management (e.g. by using inappropriate waste handling approaches to reduce costs) to increase funds available for rebuilding.

Estimates for post disaster demolition and debris management costs need to:

- Be updated regularly (to reflect changing waste and contracting markets)
- Be priced to match the local market (as there are large variations in waste management markets across New Zealand)
- Include a post-disaster premium (due to time and/or resource constraints and recycling market changes which inevitably increase waste management costs)\(^5\)

There are also a number of management costs that need to be included in funding structures:

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\(^5\) Note that where there is a completely privatised waste management market with competitors (for example in Auckland), prices may be driven lower in a disaster situation. However, in general, a cost increase is predicted.
• Management overheads for structures where private funding systems are managed centrally (such as in Christchurch 2011)
• Management costs for facilities such as heritage storage facilities (where authorities have taken custodianship of heritage materials not claimed by owners).

5.5 Funding mechanism principles

In addition to the above, several principles for designing effective funding policies (public or private) are suggested:

• Funding mechanisms need to be scalable / adjustable to match the disaster scale and impact type.

• Funding mechanism policies need some flexibility to allow for effective and efficient waste management options. In particular, ideally funding policies should not only consider direct costs, but also environmental, social and economic effects (as sometimes lowest cost options lead to perverse outcomes).

• Where there are ineffective legislative mechanisms for information gathering, funding mechanisms would be a good way of ensuring data is gathered to enable strategic planning.

• Where possible, policy exclusions which may affect implementation, or have significant environmental and human health effects, should be avoided (e.g. asbestos).

• Funding mechanisms and operational organisational strategies should be designed together to ensure systems can be effectively implemented and there are no funding gaps. For example, if a centrally managed operations programme is desired, public funding mechanisms can significantly reduce administrative demands and can improve operational efficiencies.

• Funding providers need to consider the potential for liability due to adverse effects resulting from the disaster response.
6. Legislative and regulatory frameworks

6.1 General

In a review of the New Zealand legal framework to manage disaster waste Brown et al. (2010)\(^6\) summarised that solid waste, in New Zealand, is managed under a complex legislative framework comprising seventeen regulations and a multitude of regulatory authorities. Emergency provisions exist in some of the governing legislation but not all. Generally, current emergency laws enable immediate threats from acutely hazardous waste, unsafe structures, blocked access ways and putrescible wastes to be managed effectively. However, beyond that in the recovery phase (where most of the waste is managed and when waste poses a chronic rather than an acute threat to community recovery (e.g. by preventing business operation, rebuilding activities)) the suitability of New Zealand law is less clear. In particular while there does appear to be quite a bit of regulatory flexibility, the complexity of responsibilities, stakeholders and unclear statutory precedence may result in slow or ineffectual decision-making.

The following section outlines the areas within New Zealand law that may need further investigation. This section includes:

- Existing emergency legislation and regulation
- Strategic management
- Funding mechanisms
- Operational management
- Environmental and human health risk management
- General principles

6.2 Existing emergency law in New Zealand

During a State of Emergency the Civil Defence and Emergency Management (CDEM) Act 2002 provides full powers to act to protect the public and property. Powers under the CDEM Act, under a declared state of emergency include:

• carrying out works; clearing roads and other public places; removing or disposing of, or securing dangerous structures and materials wherever they may be (S85(1)(a))
• prohibit or regulate land, air, and water traffic within the area or district (S85(1)(f))
• undertake emergency measures for the disposal of dead persons or animals (s85(1)(g))
• entry on premises where necessary for saving life, preventing injury or facilitating the relief of suffering or distress (S87(a)(b))

The CDEM Act and its applicability to disaster waste management is explained in further details below.

In New Zealand, generally, outside a state of emergency, ‘peace-time’ laws must be adhered to. New Zealand laws currently have several emergency provisions which may be applicable to management of disaster waste. The provisions are summarised in Table 6.1. Generally these provisions can only be used when there is a direct threat to public health and safety and therefore may not be suitable to facilitate long term disaster waste management. The major piece of legislation related to disaster waste management is the Resource Management Act and this is discussed in detail below.

<table>
<thead>
<tr>
<th>Act or Rule</th>
<th>Emergency powers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biosecurity Act 1993</td>
<td>Full powers to remove any biosecurity threat</td>
</tr>
<tr>
<td>Building Act 2004</td>
<td>Powers to remediate or demolish dangerous or insanitary buildings.</td>
</tr>
<tr>
<td>Fire Service Act 1975</td>
<td>Full powers to act to save lives and property</td>
</tr>
<tr>
<td>Government Roading Powers Act 1989 No. 75</td>
<td>Powers to clear state highways and associated drainage (including private property access)</td>
</tr>
<tr>
<td>Hazardous Substances and New Organisms Act 1996</td>
<td>Powers to remove hazard in any emergency</td>
</tr>
<tr>
<td>Health Act 1956</td>
<td>Provision for Governor General to make regulations to protect health at any time by order in council.</td>
</tr>
<tr>
<td>Land Transport Act 1998</td>
<td>Some emergency powers but unlikely to be activated in relation to waste management</td>
</tr>
<tr>
<td>Act</td>
<td>Power Description</td>
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<td>-----------------------------------------------</td>
<td>----------------------------------------------------------------------------------</td>
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<tr>
<td>Local Government Act 2002</td>
<td>Emergency right of entry powers</td>
</tr>
<tr>
<td>Maritime Transport Act 1994</td>
<td>Emergency powers to respond to oil spills only</td>
</tr>
<tr>
<td>Public Works Act 1981</td>
<td>Right of entry and power to act where there is imminent danger to life or property or serious interference with any public work.</td>
</tr>
<tr>
<td>Resource Management Act 1991</td>
<td>Power to take emergency actions to protect life, property and/or the environment.</td>
</tr>
<tr>
<td>Waste Minimisation Act 2008</td>
<td>Power to waive waste levy</td>
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</table>

**Civil Defence and Emergency Management Act**

The CDEM Act gives extensive powers during a State of Emergency. It describes coordination structures, authority delegation, and powers to act outside other pieces of legislation. CDEM agencies, however, are reportedly reluctant to direct activities using powers under the Act (during a State of Emergency) as they would become responsible for the oversight and management of activities that they do not necessarily have the skills or resources for. They see their role as more of a coordination role with other authorities.

In terms of waste it is also unclear as to what waste management activities would be included in the Civil Defence mandate. Following the 2011 February Christchurch earthquake there was confusion both internally and externally as to whether Civil Defence had authority to approve disposal of materials in a land reclamation at Lyttelton Port, particularly when there were other disposal options available. (Note that to date the use of CDEM powers has not been tested in a court of law in New Zealand.)

In a recovery situation, when it is likely most of the disaster waste management activities would be carried out, the CDEM Act provides for directive and coordination possibilities with the appointment of a Recovery Coordinator (S29) when Group Controller’s

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capacities are overwhelmed. Recovery activities (S4) which the Coordinator is responsible for include:

   a. the assessment of the needs of a community affected by the emergency; and
   b. the coordination of resources made available to the community; and
   c. actions relating to community rehabilitation and restoration; and
   d. new measures to reduce hazards and risks.

While the Recovery Coordinator has the authority to coordinate and direct all the above activities, they must work within existing laws. The Recovery Coordinator may “suggest special policies” when existing policy provisions are insufficient (MCDEM 2009). However, any changes to existing laws necessary to manage the waste effectively (as examples, use of land reclamation as a disposal option, or modification of asbestos handling rules) would have to be implemented via peace time legislative processes. This seems to limit the directive powers of the Recovery Coordinator. Following the 2011 February Christchurch earthquake, this structure and authority was evidently deemed to be insufficient with the passing of the Canterbury Earthquake Recovery Act and the Canterbury Earthquake Recovery Authority.

Resource Management Act
The Resource Management Act (RMA) has several mechanisms with which extraordinary measures (both in and outside a state of emergency) for management of disaster waste could be approved. Primarily:

- The 330 and 330B emergency provisions
- The use of discretion
- Ministerial call-ins.

Under the RMA there are two types of emergency works. Those carried out in a state of emergency (by persons acting under the powers of the CDEM Act) (Section 330B) and those carried out at other times (Section 330). For both types of emergency works the provision of the following sections of the RMA do not apply:

- Section 9 – Restrictions on use of land
• Section 12 – Restrictions on use of coastal marine area
• Section 13 – Restriction on certain uses of beds of lakes and rivers
• Section 14 – Restrictions relating to water
• Section 15 – Discharge of contaminants into the environment

In the event of a state of emergency the person exercising powers under the Civil Defence Emergency Management Act 2002 may authorise activities that “remove the cause of, or mitigate any actual or adverse effect of, the emergency”. Disaster waste may or may not fall under this category.

Following the 2004 Manawatu floods (largely coordinated through the Manawatu-Wanganui Regional Council CDEM group) there was some initial frustration over the use of emergency procedures under the RMA – in particular determining what activities could be carried out without going through formal procedures. The Regional CDEM Recovery task group and the Regional Council eventually prepared a guidance note together to outline procedures to be followed.

Outside a state of emergency local authorities have the authority to undertake emergency works where the authority has financial responsibility for a natural and physical resource and it is affected or is likely to be affected by an adverse effect on the environment (s330(1)(d)(e)) or any sudden event causing or likely to cause loss of life, injury or serious damage to property (s330(1)(f)). The emergency provision also includes authority for right of entry to private property. Given that the definition of ‘environment’ in the RMA includes:

“(a) ecosystems and their constituent parts, including people and communities; and (b) all natural and physical resources; and (c) amenity values; and (d) the social, economic, aesthetic, and cultural conditions which affect the matters stated in paragraphs (a) to (c) of this definition or which are affected by those matters”

It is possible (but unlikely in the author’s opinion) that this clause could be used for both acute environmental and human health threats as well the chronic social and economic threats caused by the presence of disaster waste.

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In both types of emergency works the person, authority or network utility operator who authorised the emergency activity must notify the consent authority within 7 days and the standard RMA consent process is activated within 27 days of the activity commencing (if required) (S330A(1)(2), S330B(2)(3)). The activity may continue until a decision has been reached on the application (S330A(3), S330B(4)). Depending on the intended activity and rules surrounding the activity this is likely to include the full public notification and submission process.

To expedite the process, Ministerial ‘call-in’ for projects of national significance could be utilised. Management of disaster waste could be considered under this provision in large events. The main advantage of the Ministerial call-in is the ability for consents to by-pass local authority processes and go straight to the Environment Court to facilitate a faster consent process. It is intended that the application assessment process and outcome would be the same through both mechanisms but in a faster time; however, a Ministerial call-in would undoubtedly increase the level of political influence on the decision.

The RMA allows for discretion. However, the author raises concern over discretion being used post-disaster without clear post-disaster decision-making protocols / procedures being in place to justify decisions. Decision-makers are open to criticism and potentially liability. Discretion must be used with caution.

Despite these mechanisms, several factors may add to uncertainty in decision-making under the RMA. First, decision-makers will be under significant time pressures in a post-disaster situation. Without time to gather adequate information and carry out a full effects assessment, decision-makers may feel unsupported in their decision-making which may come under scrutiny during the subsequent consent process (including consultation). Second, there is uncertainty as to what assessment criteria will be used in an emergency situation when a resource consent application is being assessed, and decision-makers may be reluctant to act if resource consent is not guaranteed. How will assessors address the overall impact of the action on community recovery from a disaster? This uncertainty will add to the decision-makers’ quandary.
6.3 Disaster waste management legislative requirements

6.3.1 Strategic management

In general, the CDEM Act is an effective tool for emergency response. The emergency powers are effective for removal of immediate threats during a state of emergency, however, the institutional unwillingness to use the powers needs to be addressed. The coordination structures provided for both during a state of emergency and during a recovery period are clear. However, the key legislative decisions that may need to be made to manage disaster waste lie outside the scope of powers under the CDEM Act. Any regulatory changes which may be required to carry out recovery activities must be made by the relevant authority.

The success of the Recovery Coordinator will be dependent on how well they can manage the large numbers of waste management stakeholders and how willing the various stakeholders are to work together and meet recovery objectives. The complexity of the New Zealand legal provisions (and associated regulatory bodies) may hinder decision-makers in a disaster recovery situation. There is the potential for ten to twelve regulatory authorities to be involved in various aspects of the waste management process. This number of authorities is potentially cumbersome when trying to conduct a collective decision-making process in a time-pressured situation and could potentially lead to complicated implementation processes (monitoring, approvals, certification etc). Stakeholders may also have conflicting goals and agendas for the recovery process. It would be beneficial to have a pre-determined disaster organisational structure, including roles and responsibilities, specifically for disaster waste management stakeholders. This structure could work under the direction of the overall CDEM recovery structure. Establishing relationships with stakeholders before the event is also an important step.

Strategic managers are likely to be different between regions. The following are some desirable legislative features to enable effective strategic management:

- The appointed disaster waste lead organisation should be granted regulatory authority and clear mandate for management of disaster waste and make or request corresponding regulatory and legislative changes.
- Legislative or regulatory arrangements should also specify collaboration requirements with relevant agencies (for quality control) (stream-lining peace-time arrangement where possible).
Disaster Demolition and Debris Management Policy Recommendations

- Authority to gather data to enable risk monitoring and strategic planning.

6.3.2 Funding mechanisms

If New Zealand chooses to maintain a private funding approach to disaster waste management then several legislative / regulatory measures are recommended to ensure recovery objectives are met:

1. Legislative powers will be required to ensure private funds can be directed strategically toward the recovery objectives.

Following the 2011 Christchurch earthquake, essentially Section 38 of the CER Act allowed for this control of the recovery by incorporating a ‘time’ provision which allowed CERA to intervene when individuals did not act in a timely manner. CERA was limited to intervention on ‘dangerous buildings’ only (i.e. the provision did not extend to sites which were an aesthetic nuisance or were attracting criminal behaviour such as the abandoned homes in the residential red-zone). It is possible that provisions in the Building Act or other ‘peace-time’ provisions could have been used in these cases; however it would be simpler (from an organisational perspective) to include these non-dangerous buildings under the same recovery legislation and the notification period and processes in the Building Act could be streamlined in disaster specific legislation.

2. Where central management is desired in a privately funded environment, legislative provisions need to include for cost recovery.

Centralised management has many benefits, including:

- Opportunities to ensure recovery objectives are met by prioritising resources and works.
- Reducing the demands on the impacted community.
- Improving quality control of the works in terms of time and environmental and human health.
- Macro (community level) cost control can be better achieved through centralised recovery works.
• Macro (community level) costs are generally reduced through central management.
• Waste management systems designed and planned on a macro (community) scale.
• Mitigating risks associated with establishing post-disaster waste handling facilities (such as operational and financial viability) by linking them with centralised waste management processes.
• Facilitating information gathering, which enables planning and monitoring.

Another important aspect of the CER Act was the inclusion of cost recovery for works carried out on behalf of property owners. Most importantly it included for cost recovery whether property owners agreed or not (in the event of disagreements or absent / non-responsive buildings owners). It is responsible however, to include a notification period prior to taking action where possible.

3. Ensure the funding policy does not depend on ‘peace-time’ legislation or regulation that might not apply post-disaster. Some funding policies internationally (and nationally) include clauses which require certain legislative / regulatory requirements to be met. It is important to ensure legislative changes would both exclude essential waste management activities from funding.

4. Consider liability implications for funding providers (as liability concerns may restrict waste management options).

6.3.3 Operational management

There are several operational management aspects that would benefit from supportive legislative / regulatory measures. Having appropriate legislative measures will allow flexibility to allow effective disaster waste management systems to be established for a range of disaster events.

Demolition

Property entry for debris management / demolition

Currently, the Building Act and Civil Defence Act cover removal of public health and safety risks, however, the powers under these Acts do not cover demolition or waste removal for aesthetic purposes or for purposes of community-wide recovery / rebuilding. Powers to act in this situation need to be considered in any recovery
Disaster Demolition and Debris Management Policy Recommendations

legislation, as they were in the CER Act. Considerations include: processes for property owner notification and processes for where the owner is not contactable and payment responsibilities. Liability protection would be beneficial.

Property debris / waste ownership
Where owners are contactable and cooperative, contractual agreements between building owner / insurer and contractor can establish ownership of materials (building materials and personal items) salvaged from the site and any revenues generated in the resale of these items. Legislative provisions assigning ownership of waste materials where it is not possible to gain owner approval (e.g. for absent property owner), however, need to be developed.

Legislative frameworks also need to consider ownership of materials where waste has been moved by disaster forces. Movement could be across jurisdictional boundaries also (an extreme example of this is the 2011 Japanese tsunami where tonnes of debris were sent across the Pacific to the US). As above, it is likely that building materials and items of personal significance would need to be treated separately. Note that private funding organisations (e.g. insurers) often claim ownership of materials, therefore it is likely that the funding source needs to be considered when preparing the legislative provisions.

Prohibition of dangerous building entry
Legislative authority is also needed to instruct contractors whether or not buildings are safe to enter. Contractors may wish to enter buildings to perform ‘soft-strip’ or remove asbestos or other hazards. Authorities need to consider their role and responsibility in controlling entry to these buildings and if desired, legislative authority assigned.

Waste Handling and Transportation
Waste handling

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10 ‘Soft-strip’ is where buildings furnishing and fittings are removed to enable greater waste separation (for recycling and reuse).
Generally health and safety regulations will remain unchanged. However, some health and safety processes (such as asbestos handling and other hazardous wastes) may need to be streamlined to increase efficiency of operations. Asbestos handling procedures are time consuming and resource intensive. They are also difficult to comply with when buildings are unsound (as this may put contractors in danger). It is recommended that stream-lined processes are considered, designed and regulated pre-event. Liability issues under stream-lined processes need to be considered (for both workers and the public).

In general it is recommended:

- Minimum hazardous material handling, transportation, disposal or temporary storage standards in a large scale disaster including the possibility of emergency arrangements under the Basel Convention for ‘export’ of waste products are identified.
- Pre-identify and regulate potential disposal / treatment options which are currently outside our standard waste management options (eg land reclamation and waste incineration).

**Transportation**

Large volumes of trucks may be travelling within the city. In some cases dedicated routes may be established to improve traffic flow. Existing legislation may inhibit truck travel (due to weight or operational restrictions / hours).

- Greater flexibility in transportation regulations in recovery would be beneficial (i.e. in situations that do not threaten life and/or property as is currently provided for).
- Consider responsibility and liability for damaged roads, potential health and safety incidents and for damage to infrastructure under roads if ‘peace-time’ standards are altered.

**Waste handling facilities (Processing, treatment and disposal)**

**Repairing existing facilities**

There is a possibility that existing facilities will get damaged during a disaster event. This may mean that operators need to make emergency repairs either to minimise adverse environmental or human health effects, or to ensure they are operational for accepting
disaster waste. If for the former reason, these repairs could be carried out, with direction / permission from the regulatory authority under S330 or S330B (with or without state of emergency), however there is no provision for emergency repairs to be made purely to restore operations. One option would be to classify Waste as a lifeline utility under the CDEM Act so that waste operators are both obligated to and entitled to make emergencies repairs to restore function in an emergency event. This is particularly relevant to municipal waste and hazardous waste facilities / service providers.

Temporary or new waste management sites (including disposal)
While some temporary or new sites may be established during an emergency (likely under RMA S330) they are likely to be required into the recovery period, thus under current arrangements consents would be required. As discussed in the previous section, the RMA has flexibility to allow new facilities to be approved; however, there is considerable uncertainty in this process and the potential that facilities might be established and then disestablished following the consent process – costing money and causing delays to the recovery process. If the RMA is to remain as the primary mechanism for consenting sites post-emergency then clear assessment criteria (different to peace-time assessment criteria) needs to be defined to ensure sites can be confidently established.

The establishment of an assessment criteria for post-disaster situations would aid and support decision-makers. The definition of environment in the RMA includes for social and community as well as the physical environment. In a disaster recovery situation there is often a greater emphasis on social / community impact than in peace-time situations. With a heightened emphasis on social factors (such as speed of waste management) it is possible that peace-time environmental impact acceptance standards will in turn be lowered to meet these different objectives. Developing and transparent assessment process on how this social-environmental trade-off will be assessed in the consent process would help to support decision makers when establishing their waste management strategy.

It is important to note that Section 330 / 330B of the RMA does not apply to Section 11 of the RMA – subdivision of land. Subdivision of land could potentially be required when establishing new waste handling and disposal facilities. It would be beneficial to
include Section 11 in Section 330 to allow in the event that land subdivision would be required.

Alteration to existing consented sites
Alteration to existing facility consent conditions should generally be avoided if possible due to future liability issues (specifically where the facility is not owned and operated by the regulatory authority). If alterations are made (e.g. to waste acceptance criteria) then arrangements around ongoing liability would need to be made.

Human resourcing
Legislation or regulations may need to be altered to increase the available labour resources such as processes for expedient certification of waste handlers (hazardous goods etc) and transporters. However, is should be noted that where possible high risk work (e.g. asbestos management, high rise demolition) should be carried out by skilled personnel.

Liability implications of volunteer or community participation needs to be considered. Some disaster waste management options include a requirement / expectation of community participation (for example removing detritus from private property). Provisions determining or absolving liability need to be included in emergency and recovery legislation.

Procurement
Under a state of emergency, designated persons (deputy, chairperson or Controller of the Group or authorised person under the Group emergency plan), Under the CDEM Act may enter into a contract outside regulations stipulated in the Public Bodies Contracts Act 1959\(^\text{11}\).

However, as discussed earlier, disaster waste management is unique in that activities often commence during the emergency phase and extend into the recovery phase. This

\(^{11}\) CDEM Act, s 94
can create regulatory difficulties around procurement. Regulatory processes around this need to be developed.

Procurement regulations during the recovery phase need to account for the uncertainty likely in the recovery works as the full extent of damage may not be known for some time.

**Recycling**

Recycling, in the same manner and level as peace-time may not be possible due to the scale of disaster and nature of the waste. Specifically:

- Time constraints
- Resource availability
- Mixed nature of waste
- Hazards in the waste matrix.
- Displaced population
- Post disaster market challenges (capacity, availability, disruption, space limitations, location relative to affected area)

Existing legislation governing recycling volumes / targets / processes need to be reviewed to ensure unrealistic recycling targets are not imposed during a disaster response.

Conversely if recycling is a desirable approach, ‘peace-time’ recycling incentives (such as the Waste Levy and the Emissions Trading Scheme levy) should be retained. Removing levies is common reaction to reduce the economic burden of the recovery. If recycling is needed due to limited landfill space etc, removing the levy could have significant indirect costs.

One solution to this may be including disaster clauses in peace-time recycling legislation and regulation. In New Zealand this is likely to impact the Waste Minimisation Act and any local / regional bylaws such as the Christchurch City Cleanfill Bylaw.
6.3.4 Environmental and human health risk

Generally post-disaster waste management risk management decisions can be categorised as:

Environmental:

- Hazards within the disaster waste matrix (e.g. waste classification)
- Waste treatment (e.g. incineration, open burning)
- Temporary staging and recycling facility establishment (e.g. mulching, concrete crushing)
- New disposal facility establishment

Human Health:

- Hazardous material handling (e.g. asbestos)
- Demolition processes (e.g. fall hazards)
- Hazardous material disposal

Peace-time approaches to management (as discussed above) may be too cumbersome or generally unfeasible post-disaster when balancing all the environmental, economic and social factors. Specific legislation / regulation and new risk management approaches may be required. It is important that appropriate risk management techniques are adopted as part of any legislative / regulatory change. The following principles should be considered:

1. **Accept higher risks:** Due to large scale of works, the likely speed of management and the likely lower skilled workforce (due to the resource demand post disaster) it is inevitable that the quality of the works (intentionally or unintentionally) will be lower. Therefore, regardless of the desired standards, mitigation measures need to be in place to protect people and the environment against potential negative effects.

2. **Maintain a skilled workforce for high risk work:** Where there is a demand for resources / to carry out skilled / technical work more expediently, authorities can either a) reduce the standards required to be met (e.g. removing the requirement to seal buildings with asbestos during asbestos removal) or b) to increase the workforce (e.g. by reducing worker certification requirements). Generally it is better to maintain a skilled workforce as these personnel have a vested interest in long term quality of
their work and should be able to identify and act where additional mitigation measures are required.

3. **Avoid permitting (consenting) exemptions:** When a consenting process is deemed to be too cumbersome in a post-disaster situation authorities can either expedite the process or permit the activity (i.e. not require a consent). Generally permit exemptions should be avoided. Going through some form of consenting process will enable site specific assessments to be made. It also ensures that authorities know the activity is taking place and can maintain visibility, monitoring of activities and can intervene in emergent risks if necessary.

4. **Consider long term risk management:** When changing environmental and human health standards post-disaster, authorities must consider who owns the risk in the short and long term. Entities are more likely to act responsibly where they have long term ownership of the risk.

5. **Involve community in decision-making:** It is important to involve community in risk management decisions as much as possible and particularly where the operations will be medium to long term operations. However, as mentioned previously, consultation requirements may need to be stream-lined to allow for efficient and effective decision-making.

6. **Apply consistent standards:** To improve public perception and trust in a risk management approach, consistent standards should be applied across the recovery effort.

### 6.3.5 General principles

In general, disaster waste management laws need to: allow for flexibility for adaptation to any situation; be bounded enough to provide support and confidence in outcomes for decision-makers; allow for timely decision-making and action; be collaborative; and focus on responsibility, not accountability.

In particular the following general recommendations are made

- Emergency laws are not always applicable to recovery. Recovery specific legislation is recommended and a clear distinction between decisions made to enable emergency response and to enable recovery.
• Recovery legislation and regulation changes need to be clearly delineated from 'peace-time' laws.

• Clear disaster waste management decisions making processes (not just outcomes) need to be officially established, such as establishment of minimum acceptable standards, or transparent risk / decision assessment processes. The process should include environmental, economic, social and recovery objectives.

• Liability for long term adverse effects resulting from emergency provisions needs to be considered.

• Liability protection within recovery legislation may empower decision-makers to make timely decisions.

No person may be prosecuted for emergency works undertaken by any person exercising powers during a state of emergency\textsuperscript{12} or in fact acting under Section 330 of the Act\textsuperscript{13}. There is also a provision, in accordance with Section 341 that it is a defence to prosecution if the defendant proves:

\begin{itemize}
  \item [i)] The action or event to which the prosecution relates was necessary for the purposes of saving or protecting life or health, or preventing serious damage to property or avoiding and actual or likely effect on the environment; and
  \item [ii)] The conduct of the defendant was reasonable in the circumstances; and
  \item [iii)] The effects of the action or event were adequately mitigated or remedied by the defendant after it occurred.
\end{itemize}

• If alteration of interpretation of peace-time standards is practiced, liability implications should be considered.

• Changes to legislation or regulation during response and recovery should be minimised and a realistic duration for changes should be assigned (such that waste managers can develop long term strategic plans with certainty).

• Disaster waste management requirements should be considered when developing peace-time waste strategies and regulations such that disaster waste managers are restricted by strict peace-time regulations.

• Legal implications on, and conflicts with, peace-time legislation and regulation needs to be considered when developing recovery legislation (regulation at local, regional and national level).

\textsuperscript{12} RMA s 330B(5)
\textsuperscript{13} RMA s 18(2)
• Flexibility around notification periods allow for necessary programme flexibility. Short notification periods are desirable.

• Consultation periods / requirements should be designed to balance consultation and timely decision-making (e.g. time limited, targeted consultation with existing representative groups rather than community wide)