A study of the role of rainwater tanks as an emergency water source for the Wellington region following a major earthquake on the Wellington Fault

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ABSTRACT

The Wellington region is highly vulnerable to large earthquakes because it is bisected by large active faults. It is also at risk of being isolated due to the disruption of supply lifelines. In particular, the bulk water supply pipelines cross the Wellington Fault at several different locations, implying that severe disruptions to reticulated water provision to households are highly likely as a consequence of an earthquake on this fault. This is particularly the case for Wellington City because of its high population and isolation from local sources of water. The purpose of this study was to explore the role of rainwater tanks in providing an alternative source of water to households in Wellington City in the event of a large earthquake.

KEYWORDS

Earthquake hazards, Wellington City, emergency management, water supplies, rainwater tanks

1.0 INTRODUCTION

Urban water infrastructure services include water supply, wastewater and stormwater drainage facilities. While coping with too much water during some months of the year and too little during others is not an uncommon problem for New Zealand communities, a further pressing issue for urban areas is preserving supply lifelines in the wake of earthquake damage to water infrastructure.

The Wellington region is uniquely vulnerable to large earthquakes, as not only is it bisected by large active faults, it is also highly isolated and reliant on a small number of lifelines which are themselves vulnerable to earthquake damage (Cousins et al., 2010).

Cousins et al. (2010) predicted pipeline damage to bulk water supply mains from a rupture of the Wellington Fault, and estimated times for restoration of the bulk supply to the main delivery points throughout the region. Wellington City was identified as being particularly vulnerable due to its physical isolation east of the Wellington Fault, concentration of population, and lack of access to alternative supplies. The shortest time to restore even a limited bulk water supply to Wellington City was estimated to be in the range of 35 to 55 days. This study also considered the reduction in restoration times that would result from the construction of a new dam at Whakatikei, located 25 km northwest of Upper Hutt and on the western side of the Wellington Fault. This new source would require only one crossing of the Wellington Fault to deliver bulk water to the Karori supply point, compared to three crossings for the existing Kaitoke to Karori system. The study concluded that the construction of a dam at Whakatikei would lead to a 15-20 day reduction in time needed to restore water supply to central Wellington. A related study by Beban et al. (2011) identified a range of substantial social benefits expected to accrue from the construction of an additional water source for the Wellington Region, which would lead to the earlier return of a reticulated water supply to the region.

Nonetheless, it is clear that even if the construction of the Whakatikei Dam proceeds, urgent consideration needs to be given to the provision of other sources of emergency water for the Wellington Region, particularly Wellington City. Options include public and private rainwater tanks, the use of non-potable (non-drinkable) water, desalination plants and the provision of emergency tankers. The purpose of this study was to explore the role of rainwater tanks in providing an alternative source of water to households in Wellington City in the event of a large earthquake. Specific objectives were:

- To explore the benefits of installing rainwater tanks for emergency water supplies following natural disasters.
- To identify technical, operational and compliance issues associated with the installation of emergency rainwater tanks.

2.0 RAINWATER HARVESTING

Rainwater harvesting to augment water supplies is practiced successfully in many regions of the world (UNEP, 2009; refer to publications on the website of the International Rainwater Catchment Systems Association www.ircsa.org). The South Pacific Applied Geoscience Commission (SOPAC) has published a comprehensive guide to rainwater harvesting ('*Harvesting the heavens*') in the Pacific which can be downloaded from its website at http://www.pacificwater.org/pages.cfm/water-services/rainwater-harvesting. The SOPAC report notes that rainwater harvesting has often been regarded as a technology of last resort but in fact has distinct advantages, particularly in areas such as the Pacific where there is generally abundant rainfall and there can be problems with alternative supplies (e.g. saltwater intrusions into freshwater lenses).

Rainwater harvesting has also been successfully utilised as part of the emergency management response to natural disasters. Rainwater tanks were installed and used in relief camps following the October 2005 earthquake in Northern Pakistan (Amin and Han, 2009; Mahmood et al., 2011) and also as an alternative water supply in Banda Aceh following the December 2004 Indian Ocean tsunami (Han, 2007; Song et al., 2008). Similarly, following the September 2009 Samoa earthquake and tsunami, the Samoa Red Cross Society played an important role in water, hygiene and sanitation promotion by providing 1000 jerry cans and containers; 69 communal water tanks and 350 5000-litre household rainwater harvesting tanks. The Red Cross also distributed 1.8 million litres of safe drinking water in tankers, and has supported the Samoa Water Authority by contributing to a new water supply pipeline for relocated affected communities. For the household rainwater tanks, the Samoa Red Cross Society provided support and advice for their installation and safe operation.

A study by Beban et al (2013 in preparation) has explored the quantity of water that would be required by residents in Wellington following a large earthquake. This report identifies a minimum survival level of 6 L per person per day is required, with 20 L per person per day being more appropriate (however 20L per person per day will still result in elevated health risks see Table 1). The Beban et al (2013 in preparation) report also explores the social implications arising from a loss of piped water in the context of Wellington, and presents a decision tree based on the supply of water and whether residents will stay at their homes or evacuate to an emergency shelter or alternative accommodation.

A report was commissioned by Greater Wellington Regional Council to investigate the role of rainwater tanks in the four cities of the Wellington region, in reducing water usage (Harrison and Grierson, 2011). Models were run for a range of parameters: two, three and four-person households; roof areas of 100m^2, 150m^2 and 200m^2; storage tank volumes of 5000L and 10,000L; and both a dry and an average summer. Rainfall data supplied by Greater Wellington was used as the basis for the analysis. Savings per household through water charges reductions were also calculated, and compared to the capital costs of installation of rainwater tank systems for outdoor usage and toilet flushing only. The study found that for Wellington City, savings are expected to be very low in comparison with the capital costs, and tank systems will never pay for themselves through reduced water charges. The average cost for installing 5000L and 10,000L tank systems for 25% of properties in Wellington City is $153 million; the average total savings over a five year period achieved by installing these tanks would be $10.7 million.

This study did note that rainwater tanks ‘can provide an effective emergency supply in the event of a civil defence emergency.’ However it also noted that a major issue in urban environments is space, and that while tanks may be installed under existing decks or below ground, installations are likely to be considerably more difficult and expensive.

A companion report investigating the potential contribution made by rainwater tanks to reducing water demand during dry summers was also prepared (Harrison and Grierson, 2010). The assumptions specified for the study were that the analysis be performed for a two person household with a roof area of 100 m^2 and a 5,000 L tank. Findings were that the volume of water contributed by rainfall during a very dry summer would meet approximately 17% of the demand for each household, and therefore if it is assumed that 25% of households were to have rainwater tanks installed, this would equate to a 4.25% reduction in water demand for Wellington City.

Studies by Abbot (Abbot et al 2007, 2011, 2012; Abbot, 2008, 2010) have explored the effectiveness of rainwater harvesting in a New Zealand urban environment. These studies concluded that roof-collected rainwater can contribute significantly to a sustainable water strategy during disasters although no specific water demand scenarios were modelled and no cost-benefit analyses were carried out.

2.1 NEW ZEALAND-SPECIFIC RESOURCES ON RAINWATER HARVESTING

New Zealand-specific official information resources on rainwater harvesting include a site administered by the Building Research Association of New Zealand (BRANZ). This site (www.level.org.nz) aims to provide authoritative advice on sustainable buildings, and includes comprehensive advice on the installation of rainwater tanks. This site describes three categories of tank installations based on intended use:

- Rainwater storage for all household purposes
- Rainwater storage for irrigation and non-potable uses such as toilet flushing
- A simple rainwater storage tank for garden irrigation.

Recommended design features align with proposed uses; for example, the simple storage tank for garden irrigation has no first flush diverter, leaf guard or inspection cover, and has only a limited capacity tank. For rainwater intended for consumption, a range of contamination prevention measures are necessary, and roofing, guttering and pipe materials as well as roof paint must comply with the relevant standard - ASNZ 4020.

3.0 ACCESS CONSIDERATIONS FOR EMERGENCY WATER SUPPLIES

A review carried out under the auspices of the World Health Organisation (Howard and Bartram, 2003) investigated the quantity of domestic water required to promote good health. The paper derived acceptable minimum quantities of water necessary to meet the needs both for consumption (hydration and food preparation) and basic hygiene. The main findings of this report are summarised in Table 1. A significant finding is that the volume of water required is less important than the level of accessibility to water supplies, although these two parameters are related.

This table indicates the likely quantity of water that will be collected or available at each level of service. The authors note that "*the public health gains derived from increased volumes of water typically occur in two major increments. The first relates to overcoming a lack of basic access, where the distances and time involved in water collection result in use of volumes inadequate to support basic personal hygiene and may be marginally adequate for human consumption. Further significant health gains occur largely when water is available at household level*".

Table 1 Summary of requirement for water provision to promote health (after Howard and Bartram, 2003).

Service level	**Access measure**	**Needs met**	**Risks to health**
No access (quantity collected <5 L/c/d*)	More than 1 km to source, or >30 minutes collection time	Consumption – not guaranteed Hygiene not possible (unless practiced at source)	Very high
Basic access (quantity unlikely to exceed 20 L/c/d)	100-1000 m to source, or 5-30 minutes collection time	Consumption should be assured. Basic hygiene (handwashing and food preparation) should be possible but laundry and bathing difficult to assure.	High
Intermediate access (50 L/c/d available)	Water delivered through one tap on site (or within 100 m or 5 minutes collection time)	Consumption should be assured. Personal hygiene and food preparation hygiene assured; laundry and bathing should be possible.	Low
Optimal access (>100 L/c/d available)	Water supplied continuously through multiple taps	All consumption and hygiene needs should be met	Very low

*litres per person per day

This study has implications for the siting of rainwater tanks for emergency use. Individual household tanks can play a valuable role in supplementing water available to individual households in the event of loss of the reticulated water supply. However, it is probably unrealistic to regard large water tanks (which are typically located at schools and other community venues such as churches or marae) as being a viable source of emergency water to households in the Wellington region, other than in the very short term, due to access considerations (Beban et al., 2011). Large rainwater tanks at community venues may, however, play an extremely valuable role in the event of these locations being used as Welfare Accommodation Centres.

The remainder of this report will be concerned only with the role of emergency rainwater tanks to contribute to post-disaster water requirements at the individual household level.

4.0 COMPLIANCE REQUIREMENTS

4.1 BUILDING CODE REQUIREMENTS

Any rainwater system must meet relevant Building Code requirements (http://www.level.org.nz/water/water-supply/mains-or-rainwater/). This includes a requirement for adequate potable (drinkable) water to be provided for consumption, oral hygiene, utensil washing and food preparation. This potable water supply must be protected from contamination, and must not contaminate the water supply system or source.

The Building Code also requires adequate water supply to any sanitary fixture (such as toilets, baths, showers, sinks etc.). The sanitary plumbing system must be set up to minimise any risk of illness or injury.

A building consent is required if collected rainwater is piped into a house and/or connected to a mains supply system.

Rainwater storage tanks (whether plumbed to the house or not) also require a building consent where they: exceed 2,000L capacity and are supported not more than 2m above the ground; or exceed 500L capacity and are supported not more than 4m above the ground.

Any rainwater system that is connected to a mains water supply must be designed to minimise the risk of contamination of the mains water supply by including an air gap or backflow prevention device. The system must also be designed to minimise the risk of contamination to rainwater intended for household use.

4.2 RESOURCE MANAGEMENT REQUIREMENTS

Section 31 of the Resource Management Act 1991 states *'Every territorial authority shall have the following functions for the purpose of giving effect to this Act in its district:*

(a) the establishment, implementation, and review of objectives, policies, and methods to achieve integrated management of the effects of the use, development, or protection of land and associated natural and physical resources of the district:

(b) the control of any actual or potential effects of the use, development, or protection of land, including for the purpose of—

- *(i) the avoidance or mitigation of natural hazards; and*
- *(ii) the prevention or mitigation of any adverse effects of the storage, use, disposal, or transportation of hazardous substances; and*
- *(iia) the prevention or mitigation of any adverse effects of the development, subdivision, or use of contaminated land;*
- *(iii) the maintenance of indigenous biological diversity.'*

To comply with s.31, territorial authorities have developed district plans, which manage development within their jurisdictional boundaries. To manage this development, each district plan has its own set of objectives, policies and rules. Often, these objectives, policies and rules are specific to the district, which means there is no nationally or even regionally consistent approach to how development (including rainwater tanks) is dealt with under the RMA and the associated land-use planning regime.

In the Wellington region there are five territorial authorities:

- Wellington City Council;
- Lower Hutt City Council;
- Upper Hutt City Council;
- Porirua City Council; and
- Kapiti District Council.

Under each of these councils' district plans there are differing approaches for determining whether the installation of a rainwater tank on a typical residential property requires resource consent. To determine whether a rainwater tank requires resource consent, it first needs to be determined whether rainwater tanks are considered to be a building or structure under the relevant district plan. Table 2 summaries the definitions (including any exemptions) of buildings for the various district plans in the Wellington region.

Table 2 The definitions (including any exemptions) of buildings in the various district plans in the Wellington region and the planning implications for a 1000L rainwater tank (Hutt City Council 2004, Kapiti Coast District Council 1999, Porirua City Council 1999, Upper Hutt City Council 2004, and Wellington City Council 2000).

Council	**Definition of a building**	**Implications for a 1000L rainwater tank**
Lower Hutt City Council	Any structure or part of a structure, whether temporary or permanent, movable or immovable, but for the purposes of this Plan excludes: (e) all structures less than 1.2 metres in height;	If the rainwater tank was over 1.2m in height it would be considered to be a building.
Upper Hutt City Council	Any structure whether temporary or permanent, movable or immovable, which, in addition to its ordinary and usual meaning, includes the following: Any tank or pool, and any structural support - Which has a capacity of not less than 25,000 litres and is supported directly by the ground Which has a capacity of 2,000 litres or more and is supported at a height of more than 2.0 metres from the base of its structure. Which has a capacity of 500 litres or more and is supported at a height of more than 4.0 metres from the base of its supporting structure.	A rainwater tank with a capacity of between 500L and 1999L would have to be over 4m in height to be considered a building. A rainwater tank with a capacity of between 2000L and 25,000L would have to have to be over 2m in height to be considered a building.
Porirua City Council	Includes any "dwelling" (see definition for dwelling), structure or part of a structure, whether temporary or permanent, movable or immovable, but does not include: Structures less than 5m2 in area and less than 1.5m in height. Handrails that form part of a deck or patio, are excluded from this calculation for height.	The rainwater tank would have to have an area greater than 5m2 and be over 1.5m in height to be considered a building
Wellington City Council	Structure definition – means any equipment, device, or other facility made by people and is fixed to the land; and includes fences and walls.	All rainwater tanks would be considered to be structures
Kapiti Coast District Council	Includes any dwelling (see definition for dwelling), structure or part of a structure, whether temporary or permanent,	The rainwater tank would have to have an area greater than 8m2 and be over 2.4m in height

Council	Definition of a building	Implications for a 1000L rainwater tank
	movable or immovable, but does not include: Detached structures (including temporary structures) less than 2.4 metres in height and less than 8m2 in floor area where they are located at least 1 metre from any adjoining property boundary. Water tanks are classed as detached structures.	to be considered a building. Furthermore, the water tank (regardless of size) needs to be more than 1m from the boundary of the property.

If a rainwater tank is exempt from being considered a building or structure under the district plan, it can be constructed without the need for a resource consent. If the rainwater tank is considered to be a building or structure, it can still be constructed without the need for a resource consent, providing it complies with the relevant rules of the planning zone for the property upon which it is to be installed. If the rainwater tank is considered to be a building or structure and does not comply with the relevant rules of the zone, a resource consent is required. This process can take between 20 working days (non-notified consent) to 4 months (notified consent).

Out of the five district plans in the Wellington region, only two actively encourage the installation of rainwater tanks with new residential development. The Kapiti Coast District Plan requires all new dwellings to have a rainwater tank with a minimum capacity of 4000L. Under the Hutt City District Plan, multi-unit residential developments (being three or more dwellings on a site) are encouraged to include rainwater storage as part of the design of these buildings.

4.3 NON-STATUTORY TOOLS

In the Wellington region, the Hutt City and Kapiti District Councils provide non-statutory financial tools to encourage the installation of rainwater tanks. The Hutt City Council waivers all fees on building consents for rainwater tanks (Hutt City Council, 2012). The Kapiti Coast District Council funds a retrofit scheme where homeowners can apply for up to $5000 in funding to install a rainfall tank on their site. This funding is then recovered through the properties rates for the proceeding 10 years (Kapiti Coast District Council, 2013).

5.0 VOLUME CALCULATIONS

5.1 ESTIMATED VOLUMES AVAILABLE

For an individual dwelling, the potential volume of water that can be harvested from a roof can be calculated by the following formula (UNEP, 2009):

Supply (litres per year) = rainfall (mm/year) x catchment area (m^2) x runoff coefficient

Greater Wellington Regional Council maintains rainfall recording stations at a range of locations throughout the Wellington region[1]. Summary data are available for each site, from 2001 onwards, for annual totals and maximum daily rainfall for each year.

The UNEP (2009) handbook on rainwater harvesting in the Caribbean provides a guide for calculating the amount of water that can be captured from a given roof. The catchment area can be determined from inspecting a plan view of the roof then noting which catchments drain to gutters and can be captured for storage. As an example, the house and garage shown in Figure 1 have a combined roof plan area of 176m^2, but only about half of this area (i.e. ~90m^2) drains to the storage tank.

According to the website of Quotable Value New Zealand[2], the average house size for Wellington City is 159m^2.

The runoff coefficient is a measure of the efficiency of capture and storage of incoming rainfall. Losses can occur due to evaporation, overflow from blocked gutters, and the roof surface, with more impervious materials such as corrugated metal sheets being associated with higher runoff coefficients. Runoff coefficients for different surfaces vary from 0.6-0.8 for concrete; 0.7-0.9 for corrugated metal sheets, and 0.8 to 0.9 for tiles (UNEP, 2009).

Figure 1 Household rainwater collection and storage system (M. Rosenberg photo).

1 http://graphs.gw.govt.nz/rainfall-2/

2 http://www.qv.co.nz/propertyinformation/KnowledgeCentre/Averagehousesizebyarea12042011.htm

As an indicative calculation for an 'average house' in Wellington City, annual rainfall at Greater Wellington's recording site in Newtown ranged (over the period 2001 to 2011) from the lowest value of 592.3mm in 2009 to 1203.2mm in 2010. Assuming that half of the roof area of this 'average house' is available for rainwater collection and storage (~80m^2), the following supply would be expected:

Lowest-rainfall year: Supply = 592.3mm/year x 80 m^2 *x 0.8 = 37,907 litres/year*

Highest-rainfall year: Supply = 1203.2mm/year x 80 m^2 *x 0.8 = 77,005 litres/year*

Further losses can also be expected if a first flush diverter system is used. These devices are recommended as, after a period of dry weather, the first rains will wash off material that may have accumulated on the roof or in the gutters, such as bird droppings, leaf litter, dust and incomplete combustion products from domestic woodburners. A first flush diverter is a simple installation (example shown in Figure 2) that is part of the downpipe, configured to remove the initial wash from the roof so it does not enter the storage tank.

To calculate the volume that should be diverted, the UNEP (2009) report notes that it is generally assumed that 0.5mm rainfall is required to wash off accumulated contaminants. Thus, for the 'average house in Wellington City' discussed above, the volume of diverted water (and hence the volume of the diverting device) is 80m^2 x 0.5mm = 40 litres. This volume would be lost at the start of every new rainfall event.

Figure 2 Rainwater tank (1000 litre) with first flush diverter system (grey length of pipe with removable cap for cleaning) (S. Abbott photo).

5.2 ESTIMATED DEMAND

The current advice from Civil Defence[3] is that each household should store three litres of drinking water per person per day, for three days. They also strongly advise that greater quantities be stored for purposes of food preparation and hygiene. Greater Wellington Regional Council[4] recommends having 20 litres per person per day for as long as the mains water supply is not operational. It should be noted that this level of water provision (20 L/person/day) was considered by Howard and Bartram (2003) to be associated with high risks to public health, and they recommended a level of 50 L/person/day to meet hygiene and sanitation requirements.

Making the worst-case assumption that a prolonged dry period coincides with a major earthquake on the Wellington Fault, the following times (numbers of days' water supply) can be calculated for different household sizes and commonly-available rainwater tank volumes (Table 3), for usage rates of both 20 and 50 L/person/day. This table illustrates the value of having a larger tank for emergency water storage.

Table 3 Number of days' water supply available from rainwater tanks of different sizes, for different household sizes and rates of water usage.

Tank size	**Number of days that a full rainwater tank would provide 20 litres per person per day in a period with no rainfall**		
	Household occupants		
	2	3	4
200 L	5 days	3.3 days	2.5 days
500 L	12.5 days	8.3 days	6.25 days
1000 L (see Figure 2)	25 days	16.7 days	12.5 days
2000 L	50 days	33.3 days	25 days
5000 L	125 days	83 days	62.5 days
	Number of days that a full rainwater tank would provide 50 litres per person per day in a period with no rainfall		
	Household occupants		
	2	3	4
200 L	2 days	1.3 days	1 day
500 L	5 days	3.3 days	2.5 days
1000 L	10 days	6.7 days	5 days
2000 L	20 days	13.3 days	10 days
5000 L	50 days	33 days	25 days

3 http://www.civildefence.govt.nz/memwebsite.nsf/wpg_url/for-the-cdem-sector-public-education-draft-articles?opendocument

4 http://www.gw.govt.nz/rainwater-tanks/

6.0 WATER QUALITY ISSUES

The Guidelines for Drinking-Water Quality Management for New Zealand (Ministry of Health, 2005) include a comprehensive review of microbiological and chemical contamination issues associated with rainwater harvesting. These guidelines also provide advice on minimising contamination of roof-catchment systems, advice for cleaning storage tanks and advice on appropriate treatment methods to minimise risks to the health of consumers.

6.1 MICROBIOLOGICAL CONTAMINATION

Rainwater collected via roof catchment systems and stored in domestic tanks will contain a range of micro-organisms, of which some may be pathogenic. There are numerous examples of microbiological contamination of roof-collected rainwater in the literature. For example, a study by Sedouch (1999) on 100 roof-collected rainwater samples from the lower North Island found that only 18% of samples complied with *E. coli* standards set by the Drinking-Water Standards for New Zealand (1995) and 40% of samples failed badly, with very high *E. Coli* counts. Similarly, a study by Simmons et al. (2001) found that of 125 roof-collected rainwater samples from rural Auckland districts between 1996 and 1998, 56% had faecal coliform levels that would have exceeded the 1993 WHO drinking water guidelines.

Specific pathogens have been reported in roof water samples. Savill et al. (2001) reported the presence of *Campylobacter* in five percent of roof water samples collected from rural households in the North Island. Eberhart-Phillips et al. (1997) found that consumption of roof-collected rainwater was associated with a threefold greater risk of campylobacteriosis relative to consumers on town supply.

6.2 CHEMICAL CONTAMINATION

Chemical contamination of rainwater can originate from a range of different sources. In urban areas, prior to removal of lead additives to petrol, rainwater samples commonly contained levels of lead in excess of its Maximum Allowable Value of 0.01 mg/L (DWSNZ, 2008). For example, Stevenson (1980) reported lead levels in Christchurch rainwater ranging from 0.005-0.031 mg/L, compared to a background level of 0.002 mg/L. A study conducted in Auckland (ARC, 2004) concluded that roofs within 100 metres of busy roads are likely to have an increased contaminant burden from vehicle emissions. Other vehicle-associated contaminants include zinc, cadmium and benzene.

Rainwater quality may also be affected by contact with roof, guttering and tank construction materials. The effect of roofing materials is thought to be minor for sloped roofs as the water is in contact with roofing materials for such a short time, with a possible exception being new, unpainted galvanised steel roofs, which may leach zinc for several months (MOH, 2005). The presence of lead in roof tank waters is thought to be due to sources such as lead head nails, lead flashings, solder and alloys used in plumbing fittings.

Smoke from domestic woodburners or open fires may contaminate roof-collected water supplies with arsenic and boron from the burning of coal or treated timber. A recent study (Mitchell, 2012) reported levels of arsenic in particulate matter (PM_{10}) in Wainuiomata, Wellington, as having an annual average of 7.1 ng/m^3, in excess of the national air quality guideline to protect public health of 5.5 ng/m^3. Deposition of fine particulate matter onto roofs may increase the concentration of this contaminant in rainwater tanks. Other contaminants associated with combustion are polyaromatic hydrocarbons (PAHs); ARC (2004) reported that median levels of the PAHs fluoranthene and benzo[a]pyrene exceeded their maximum allowable values.

An important point to note is that Maximum Allowable Values (MAVs) for chemical contaminants of health significance are set on the basis of a lifetime exposure. Thus, short-term exceedences of the MAVs in a situation of emergency consumption may not necessarily represent a health risk. In the short term, that water is microbiologically safe to drink is considered a more urgent concern.

6.3 PALATABILITY ISSUES

The DWSNZ (2008) lists Guideline Values for a range of parameters which do not pose a direct health threat to consumers, but which can affect the palatability of the water due to changes to its appearance, taste or odour, or cause operational problems such as scale deposition. These parameters include metals such as iron and zinc, which may impart a metallic taste to water at levels exceeding the Guideline Values; and a range of organic compounds.

Specific problems that have been associated with roof-collected rainwater systems include high levels of zinc leached from new unpainted galvanised iron roofs; organic compounds leaching out of fibreglass storage tanks; and leaves that collect in gutters lowering the pH of the rainwater which can in turn cause corrosion from metallic pipes and fittings (e.g. copper pipes) (MOH, 2005).

7.0 SUMMARY AND FURTHER CONSIDERATIONS

Wellington City has identified as being particularly vulnerable to disruptions to critical lifeline services, including household water supplies, due to its physical isolation east of the Wellington Fault, concentration of population, and lack of access to alternative supplies. The shortest time to restore even a limited bulk water supply to Wellington City was estimated to be in the range of 35 to 55 days. The purpose of this report is to investigate the potential role that rainwater tanks could play in providing access to emergency water supplies in the event of a major earthquake.

Rainwater harvesting systems are used in many parts of the world. In Zealand, over ten percent of New Zealand households, in areas not served by municipal town supplies, rely on roof-collected rainwater systems. However, studies commissioned by Greater Wellington Regional Council indicate that installation of rainwater tanks for non-potable uses (toilet flushing and outdoor usage) would be unlikely to make a significant contribution to reducing water demand in Wellington City during dry summers; and furthermore would be difficult to justify on economic grounds as installation costs greatly outweigh savings in water charges. An important issue is that space is typically very limited in urban areas, thus installation of sizeable (5,000L or 10,000L) water tanks may be difficult and expensive for many properties. However, these studies do acknowledge that rainwater tanks may be an effective emergency supply.

An important point to note is that large tanks would be needed to provide emergency water storage benefits following a disaster; however the installation of larger tanks is likely to be considerably more difficult and expensive in urban areas.

According to a comprehensive study conducted by the World Health Organisation, in the absence of a reticulated, treated supply, it is better to have supplies available at the household level, because there is a direct relationship between the level of access to water supplies and the volume available for meeting basic drinking, hygiene and sanitation needs. While large (25,000L) community tanks may be very valuable in supplying emergency accommodation centres, they are unlikely to provide an adequate supply to households.

Roof-collected rainwater systems are, in general, vulnerable to both microbiological and chemical contamination, particularly in urban areas. A comprehensive range of advice on installation, preventive maintenance and treatment is available from the Ministry of Health for these systems.

There is also no consistent approach to how rainwater tanks are treated in land use planning documents across the Wellington region. There are five different district plans in the region, with each having a different approach to the management of rainwater tanks. It is therefore important that parties intending to install a rainwater tanks on their property to check with their local territorial authority to see whether a resource consent will be required, prior to installation. Two councils however, (Hutt City and Kapiti District Councils) provide non-statutory financial tools to encourage the installation of rainwater tanks.

In summary, roof-collected rainwater systems are probably best seen as one of a range of options for provision of water supplies to households following a large earthquake in the Wellington Region. The 2010-2011 Canterbury earthquakes provide a valuable opportunity to harvest lessons on the range of options used by authorities to provide water at the household and neighbourhood level and to welfare centres.

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