Water, Sanitation and Hygiene (WASH) Emergency Guidelines – literature review

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EXECUTIVE SUMMARY

Water, sanitation, and hygiene (WASH) guidance in an emergency provides critical advice to communities to ensure that risks to public health are minimised. Internationally the Sphere Association and WHO emergency WASH guidelines hold the most comprehensive and referenced documents that inform other organisations and countries that have developed WASH guidance in emergencies. International guidance stated the importance of including WASH emergency guidance within drinking water safety plans.

In New Zealand, national organisations and ministries, as well as most regional civil defence units, contain consistent emergency WASH guidance messaging, such as:

- Storing a minimum of 3 L of water per person per day, for at least 7 - 9 days supply.
- Treatment of drinking water by adding 5 drops of bleach per 1 litre of water or half a teaspoon of bleach per 10 litres of water.
- Construction of an emergency toilet using a large (15 – 20 L) plastic bucket with a secure lid.

Some regions within New Zealand provide good examples of a multi-agency approach (i.e., WREMO/Wellington Water and Health New Zealand – Te Whatu Ora and the sharing of emergency WASH guidance documents (i.e., Wellington/WREMO and Auckland/AEM) so as not to duplicate efforts. Very few regions made attempts to address tikanga Māori perspectives with regards to emergency WASH planning. Other regions which had experienced significant emergency WASH challenges (i.e., Christchurch and Kaikōura earthquakes) showed little evidence of lessons learned to improve public health outcomes within their region in the event of another emergency. There was also very little WASH guidance available for the establishment of emergency shelters/welfare centres, in particular advice for a marae context.

There was, however, sparse guidance at a national and regional level with regard to the long-term management of human faecal waste and drinking water supplies, particularly if there was a need to implement emergency WASH practices and behaviours for an extended period of time during a recovery phase. There was also inconsistent messaging at a national level with regard to how to manage emergency toilet waste. NEMA and Health New Zealand – Te Whatu Ora guidance suggested that a small amount of regular household disinfectant (such as chlorine bleach) could be added to the emergency toilet bucket each time the toilet is used. The guidance, however, did not give any advice on managing the risk associated with residual chlorine reacting with nitrogenous substances and organic matter, which produces halogenated compounds some of which (e.g., trihalomethanes) are considered carcinogenic.

There were no nationally consistent infographics were identified to assist communities with potential WASH options in an emergency. There was limited WASH advice available through multimedia channels to promote public health during an emergency and little effort to address tikanga Māori perspectives.

While New Zealand has an active civil defence programme, effort is required to ensure that nationally consistent language and messaging are used alongside nationally consistent infographics and multimedia resources to assist communities in minimising the public health risks associated with emergencies.

1. INTRODUCTION

1.1 PURPOSE AND SCOPE

This report provides a literature review of water, sanitation and hygiene (WASH) guidance available in New Zealand and internationally in the event of an emergency. Currently, New Zealand does not have a single national guidance document for WASH in emergency situations. The purpose of the review is to identify those guidelines that could aid in the development of New Zealand WASH guidelines for emergencies in the future. The review focuses on safe drinking water, sanitation and hygiene in emergency situations, which are crucial to human health and well-being.

The literature review does not include wider environmental health issues in an emergency, such as nutrition, and indoor and ambient air quality. While the literature review does not include domestic dwelling shelters (i.e., private homes) it does include emergency WASH guidance for Civil Defence emergency welfare centres/shelters. In addition, the literature review does not include emergencies that involve transport incidents, hazardous substances, terrorism, and conflict in war zones, as it is proposed that during these events WASH practices within the general population can either be maintained or the emergency is not considered relevant to a New Zealand context.

1.2 BACKGROUND

In emergency situations, appropriate water, sanitation and hygiene (WASH) guidance is vital to protecting public health and maintaining dignity and social resilience (Smith, 2009; Yates et al., 2018). Depending on the nature of the emergency event, the vulnerability of the affected population, the capacity of the local and natural systems to respond alongside the deterioration in environmental conditions often results in a dramatic increase in WASH related disease (World Health Organization, 2002). New Zealand, communities are at risk from a broad range of hazards that may impact WASH, such as severe weather, floods, earthquakes, tsunamis, pandemics, landslides, fires, volcanic activity, utility failures and droughts (Wellington Region Emergency Management Office, 2024). Of particular note, scientific research indicates that there is a 75% probability of an Alpine Fault earthquake greater than magnitude 7 happening in the next 50 years, and there is a 4 out of 5 chance that it will be a magnitude 8+ event (National Emergency Management Agency, 2024). An emergency of this magnitude would not only require a national response but also international assistance (National Emergency Management Agency, 2024). Furthermore, New Zealand is experiencing now and into the future an increased frequency and intensity of extreme weather events that may result in emergencies that impact WASH and public health outcomes for those populations affected (Ministry for the Environment, 2024). There is an increasing risk globally of multiple disasters/emergencies occurring at once, resulting in significantly increased impacts on public health (Leppold et al., 2022).

The distinguishing factors between natural and human-made disasters are now difficult to differentiate, given the current incidence of disasters globally (Marshall et al., 2020). This is largely due to human choices in architecture, fire risk and natural resource management, which can cause and worsen natural disasters (Kelman, 2020; Peduzzi, 2019). It is impossible to eliminate hazards as a result of an emergency or disaster, but the public health impact on a population in terms of WASH can be lessened with adequate preparation before

an event and appropriate response measures during and in the recovery phase of an emergency (Khan et al., 2018).

For the purposes of this literature review, ‘emergency’ is used in preference to ‘disaster’ when referring to WASH guidelines within a New Zealand context. This terminology complements New Zealand’s National Emergency Management Agency (NEMA) and legislation (Civil Defence Emergency Management Act, 2002).

According to Wisner and Adams (2002) emergencies can be divided into three stages that may require varied WASH responses:

- **Before**: preparedness, mitigation and resilience building
- **During**: emergency response
- **After**: post emergency recovery

During the preparedness and resilience building phase, public health is often optimal and provides the best opportunity for communities to build capability in the event of an emergency. In contrast, the initial emergency response phase is where public health is most likely to be compromised, and the highest level of support is needed (Parkinson, 2009; Shackelford et al., 2020). The post-emergency recovery phase can result in a settling of routines and methods to maintain public health but can also result in prolonged exposure to public health risks especially if multiple disasters occur (Leppold et al., 2022).

This literature review is based on international, regional and national WASH guidance documents, standards, peer reviewed literature and case studies. Web-based searches between 1990 – 2024 were completed using the following search engines: ScienceDirect, Web of Science, PubMed, ProQuest Public Health, Google Scholar and Google. The following search terms were used to collate the sources of information for the literature review:

Water, sanitation and hygiene in emergencies and/or disasters	Public health WASH outcomes in emergencies and/or disaster
WASH guidance in emergencies and/or disasters	Health protection in emergencies and/or disasters
WASH guidance in emergencies and/or disasters	Sanitation and emergencies and/or disasters
WASH international guidelines and/or standards	Drinking water and emergencies and/or disasters
WASH national guidelines and/or standards	Hygiene and emergencies and/or disasters
International WASH guidelines and/or standards	Global WASH standards and/or guidelines
Public health response in emergencies and/or disaster	

1.3 REPORT FORMAT

Section 2 details WASH public risks during an emergency, cross-cutting themes and reviews from selected international and domestic literature, and resources related to emergency WASH guidance. Section 3 discusses key insights from New Zealand and international literature followed by the conclusions in Section 4.

2. LITERATURE REVIEW

International and national WASH guidance documents and standards have been selected alongside relevant peer-reviewed articles and grey literature. The following sections define WASH and provide a description of international WASH guideline documents and current New Zealand national and regional WASH guidance.

2.1 WASH PUBLIC HEALTH RISKS DURING AN EMERGENCY

During an emergency, people are more susceptible to illness and death from disease, particularly diarrhoeal and infectious diseases (Sphere Association, 2018). These diseases are strongly correlated to inadequate sanitation and water supplies and poor hygiene (World Health Organization, 2013a). The main pathways for pathogens to infect humans are faeces, fluids, fingers, flies and food (Figure 1) (Lauffer & Walter, 2020). WASH interventions aim to prevent and control the transmission routes of bacteria (e.g., Shigella, *E. coli*), viruses (e.g., norovirus, cholera, hepatitis A and E), and protozoa (e.g., Cryptosporidium) and helminths (World Health Organization, 2022). The main objective of WASH programmes and guidelines in an emergency response is to reduce public health risks by creating barriers along transmission pathways (Sphere Association, 2018). According to the Sphere Association (2018) WASH activities include:

- Promoting good hygiene practices
- Providing safe drinking water
- Providing appropriate sanitation facilities
- Reducing environmental health risks
- Ensuring conditions that allow people to live with good health, dignity, comfort and safety

The Sphere Association (2018) also states that it is important for WASH programmes to:

- Manage the entire water chain: water sourcing, treatment, distribution, collection, household storage and consumption;
- manage the entire sanitation chain in an integrated manner;
- enable positive healthy behaviours; and
- ensure access to hygiene items.

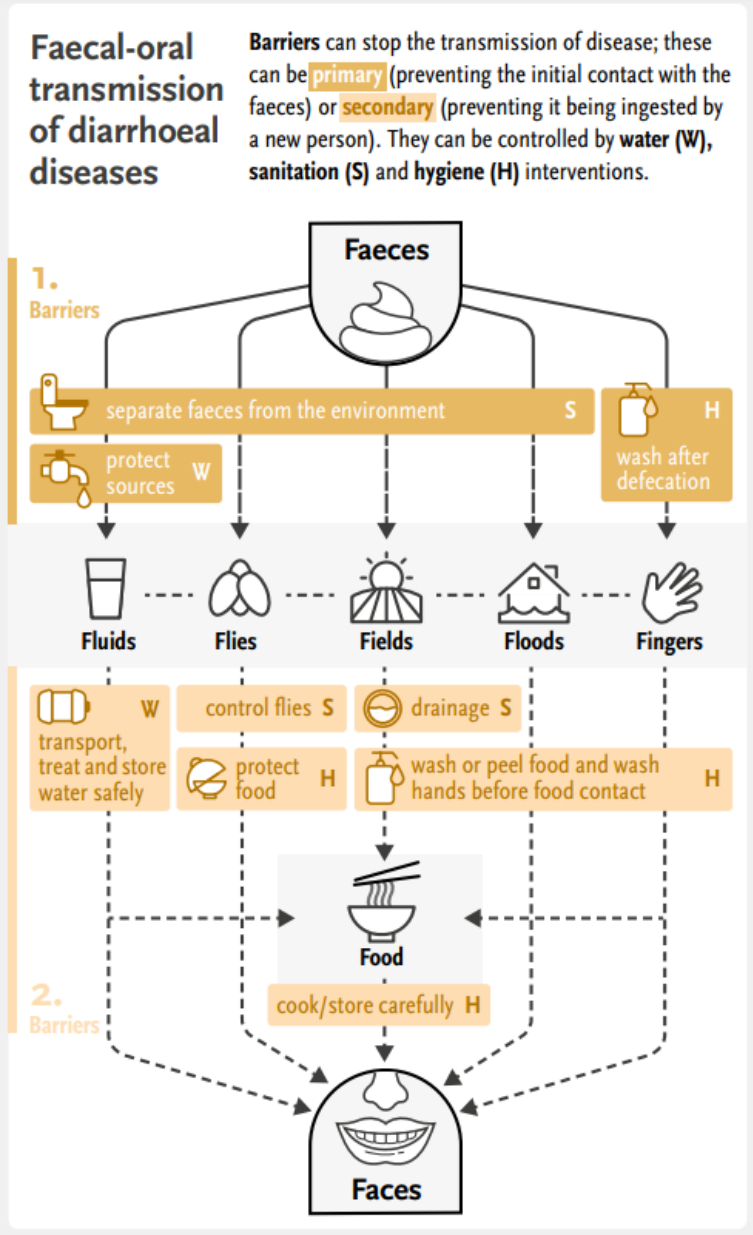

Figure 1. Illustration of transmission of diarrhoeal diseases and the potential barriers to prevent transmission (Lauffer & Walter, 2020).

2.2 CROSS-CUTTING THEMES

Cross-cutting themes or topics that intersect WASH have an impact on public health outcomes during an emergency. These topics should be integrated and considered during all stages of emergency WASH planning and implementation (before, during and after). Examples of cross cutting themes (also referred to as horizonal themes) are issues that touch on general principles such as equality, sustainability and good governance. Communities are the primary change agents in emergencies and should be the most influential decision-makers before, during and after an emergency. At every phase of an emergency, communities should be listened to, with the needs and rights of all individuals at the core of all decisions (Sphere Association, 2018). Consideration of cross-cutting themes is of particular importance if WASH solutions are to be practiced and sustained for a long

period of time and, in some cases, years (e.g., emergency toilet use after the Christchurch earthquakes) (Nicholas et al., 2017).

Consideration of gender, equity and inclusion are vitally important in any attempt to meet the WASH needs of a community during an emergency. This may include consideration of menstrual needs (Royo et al., 2024), those with disabilities and WASH initiatives that are accessible and suitable for the very old or young (Wilbur et al., 2022). Also, the language and cultural needs of communities need to be considered to ensure accessibility of messaging and to maintain social resilience (Nicholas et al., 2017).

WASH outcomes can be influenced by the geographic location of the communities that are impacted by an emergency. Populations located on steep topography (i.e., Wellington) may experience a limited ability of emergency services to reach and respond alongside access to support and resources in the event of a long recovery (Mowll et al. (2022). In contrast, flat plains and valleys may be vulnerable to liquefaction (Dellow et al., 2018). Urban and rural populations may have access to different resources, which could impact WASH outcomes. Those who reside in apartment buildings will require WASH solutions which are appropriate for multi-story access with no or limited access to open land in contrast to those who live in stand-alone houses with backyards (Mowll et al. (2022). Community engagement on WASH issues may be harder in urban areas, where the population density is higher and at-risk groups are less visible (Sphere Association, 2018). Coastal communities may have greater access to WASH assistance via coastal transport networks than inland communities (Public Inquiry into the Earthquake Commission, 2020). Also, climatic conditions may result in the persistence of different WASH related diseases in an emergency, alongside the spread of disease within communities that are forced to live in close proximity and share facilities (Watson et al., 2007)

2.3 INTERNATIONAL EMERGENCY WASH GUIDELINES

There are many key organisations and clusters that contribute to the creation and improvement of WASH guidelines. The key organisations at the forefront of WASH in emergency settings are the Sphere Association (2018), the World Health Organization (Wisner & Adams, 2002; World Health Organization, 2013b), the United Nations High Commissioner for Refugees (UNHCR) (United Nations High Commissioner for Refugees, 2022), and United Nations International Children's Emergency Fund (UNICEF) (United Nations International Children's Emergency Fund Sudan, 2017). While these are different organisations that provide separate guidelines, these organisations tend to collaborate and share resources. In some cases, these organisations will either host these resources or provide WASH guidelines to specific countries. An example is UNICEF creating country specific WASH emergency handbooks and technical guidelines for the Pacific and Sudan (Table 1). From this review, developing countries tend to have specific emergency WASH guidelines due to infrastructure, resources, and response constraints, along with higher rates of disease that are often not present in developed countries.

Many countries around the world apply international WASH guidelines from organisations and resources produced by the WHO and the Sphere Association, among others. Due to the nature of these guidelines, it is not always possible to determine which documents and organisations' resources are being used to create the specific country's guidelines. However, what can be said is developed countries typically do not have specific emergency WASH response plans due to the complex and centralised nature of their infrastructure and government. Response plans are fragmented due to the inter-organisational nature of the response to emergencies in these countries. The United States system is an example of this (Figure 2), where national emergency responses are coordinated by the Federal Emergency Management Agency (FEMA) using the National Response Framework (NSF). In this case,

issues related to WASH could include Public Works & Engineering, which is responsible for infrastructure and emergency water supply; Department of Health and Human Services, which provides public health information and sanitation standards; and the Environmental Protection Agency (EPA), who may lead water contamination responses. Although these three groups by no means exhaust the list of organisations involved in responses related to WASH in the NSF (Federal Emergency Management Agency, 2024).

The scale of the emergency is also critical in determining which organisation is coordinating the emergency response. Initially, in most cases but specifically in the United States, local emergency responders provide assistance, however, this may grow into a state-wide response. Once local and state emergency response is overwhelmed, it becomes a concern at the federal level, and FEMA takes on responsibility for the emergency. The National Incident Management System (NIMS) is a standardised approach that is used from local to federal (Federal Emergency Management Agency, 2024).

Table 1. International emergency WASH guideline examples.

International organisation/Country	WASH guideline name/guideline mention	Published or updated	Link
Sphere Association (cluster)	The Sphere Handbook	2018	https://handbook.spherestandards.org/en/sphere/#ch006
Emergency WASH Knowledge Portal (cluster)	Portal containing extensive resources to deal with WASH in emergencies	2024	https://www.emergency-wash.org/
WHO	Environmental health in emergencies and disasters	2002	https://iris.who.int/bitstream/handle/10665/42561/9241545410_eng.pdf?sequence=1
WHO	WHO technical Notes on WASH in Emergencies	2013	https://www.who.int/teams/environment-climate-change-and-health/water-sanitation-and-health/environmental-health-in-emergencies/technical-notes-on-wash-in-emergencies
WHO	Guidelines for Drinking Water Quality 4th edition	2024	https://www.who.int/publications/i/item/9789241549950
UNHCR	UNHCR WASH Manual: Practical guidance for Refugee settings (Cites SPHERE Handbook)	2020	https://emergency.unhcr.org/sites/default/files/UNHCR%20WASH%20Manual%20-%207th%20Edition%20%28UNHCR%2C%202020%29%20%281%29_1.pdf
UNICEF Pacific	Pacific WASH in Emergencies Coordination Handbook	2014	https://www.unicef.org/pacificislands/media/721/file/Pacific-WASH-Handbook.pdf
UNICEF Sudan	Emergency Technical Guidelines for Sudan	2017	https://www.unicef.org/sudan/media/1031/file/Emergency-Technical-Guidelines-2017.pdf
International Federation of Red Cross and Red Crescent Societies (IFRC)	WASH Guidelines for hygiene promotion in emergency operations. Targets Health promotion and specifically mentions SPHERE	2017	https://www.rcrc-resilience-southeastasia.org/wp-content/uploads/2019/04/1319400-IFRC-WASH-guidelines-for-hygiene-promotion-in-emergency-operations_final.pdf
WEDC	Emergency sanitation: assessment and programme design	2002	https://wedc-knowledge.lboro.ac.uk/resources/books/Emergency_Sanitation_-_Complete.pdf
WASH Global Cluster (led by UNICEF)	UNICEF has not written its own guidelines; however, it has been involved, relying on Global Cluster resources and other organisations' (see below).		
UNDRR	Because this falls under the UN and UNICEF is the first call to action for disasters, applying guidelines from other UN organisations. They may be involved in organising guidelines, however, it will be similar to UNICEF Pacific and Sudan		
UNOPS	Mentions IFRC and other country specific Red Cross organisations		

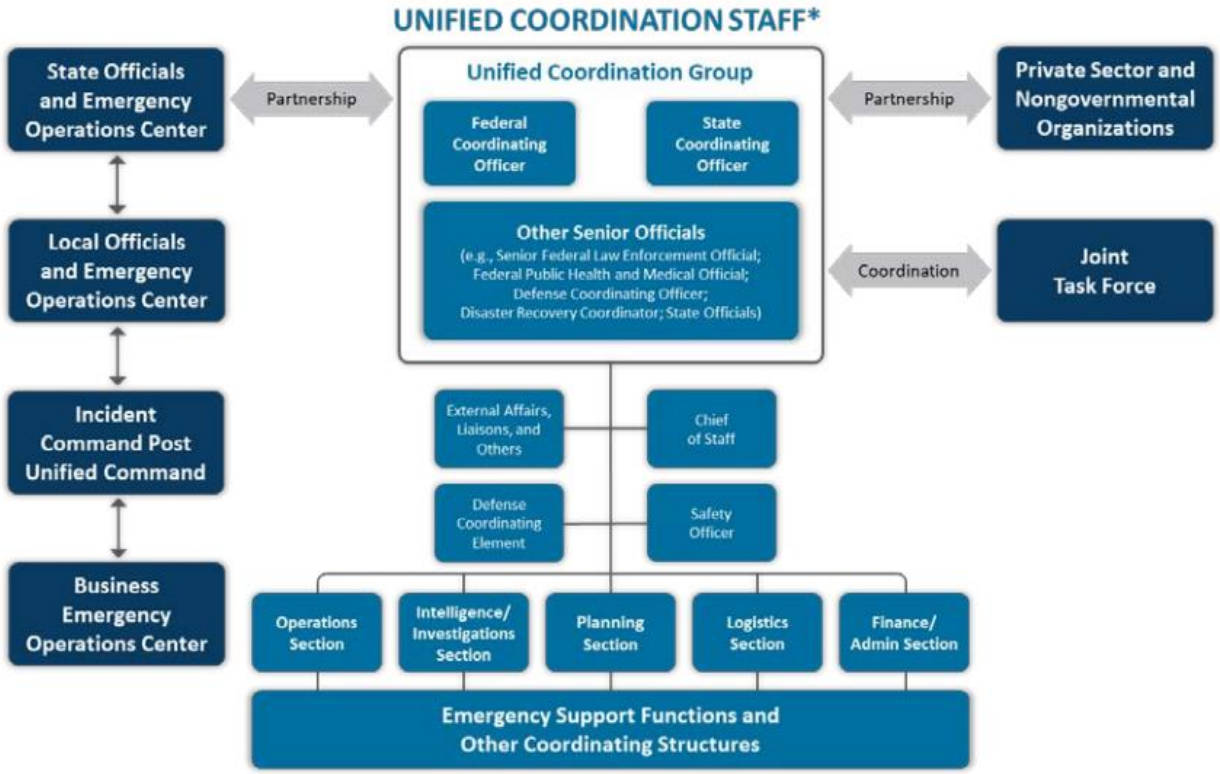

Figure 2. Unified coordination of organisations during an emergency (FEMA, 2019). When a disaster is declared, the leadership of agencies with relevant functional authorities may join together in a team effort to respond, forming a Unified Coordination Group/staff* (UCG)

2.3.1 International WASH guideline examples

Sphere Association (2018): The Sphere Handbook

The Sphere Association is a humanitarian organisation that contains multiple member organisations and was initially developed by a number of non-government organisations (NGOs), including the Red Cross and Red Crescent. Through humanitarian aid, it aims to uphold the rights and dignities of people affected by emergencies and disasters. The Sphere Association has produced standards and guidelines for a plethora of government and non-government, private sector organisations and volunteers.

The Sphere Handbook: “Humanitarian Charter and Minimum Standards in Humanitarian Response”, available in multiple languages, is one of the most widely recognised references for WASH standards internationally, providing a comprehensive guide for all components of WASH and humanitarian response. The Sphere handbook is a primary material source and has been used during the establishment of the WHO WASH technical notes and guidelines (World Health Organization, 2013b). It contains guidelines which state specific quantities and concentrations of standards and limits, minimum number of toilets per person in several different contexts, and minimum water quality standards. The guidelines state key actions under each standard as well as key indicators, such as minimum quantity of essential hygiene items. It also includes guidance notes, some of which include adapting to the culture and context of the country and population and understanding that there are at-risk groups that require more care than others. For the purposes of this report, only the section “Water supply, Sanitation, and Hygiene protection” within the Sphere handbook (2018) was reviewed. The handbook provides extensive information in the appendix and figures to illustrate important components of WASH, such as graphs that show the faecal oral transmission routes (fluids, fingers, flies, fields and floods) (Sphere Association, 2018). While the Sphere guidelines focus on WASH, consideration is also given to cross-cutting issues such as food security and nutrition, and health.

Other charts and tables covering WASH related information in the Sphere Handbook include:

- Minimum water quantities for survival
- minimum number of toilets for distinct circumstances
- categorised water and sanitation diseases
- Household water treatment and storage decision tree

Shelter is a critical determinant for survival in the initial stages of a disaster. The functions that shelter provides include protection from weather, security, dignity, and enhanced resistance to ill health and disease. In terms of shelter the Sphere handbook prioritises first the return to private dwellings, secondly the option of being hosted by family or an unaffected community and finally as the third and last option sheltering in a collective settlement (an emergency welfare centre or shelter) is recommended. The handbook recommends that emergency welfare shelters should avoid locations that are directly impacted by the emergency itself, the emergency shelter site should have the ability to be accessed by large vehicles for the delivery of essentials such as food and the centre should have resources and the ability to provide adequate water, sanitation and hygiene facilities. The handbook also recommends a minimum surface area of $45m^2$ for each person within the emergency shelter. It also recommends that emergency shelter living quarters should

consider vulnerable people such as the elderly, disabled, unaccompanied minors and those with compromised health.

World Health Organisation: Environmental health in emergencies and disasters – A practical guide (2002)

In 2002, the WHO published an extensive practical guide: "*Environmental health in emergencies and disasters*", which is an aggregation of many of their previous resources into a single document to address emergency response. Although this resource was published over 20 years ago, it provides a comprehensive guide on emergency response, covering many areas such as the nature of emergencies and disasters and an early version of the three stage WASH response, namely:

1. Pre-disaster activities
2. Emergency response
3. Recovery and sustainable development

The document also provides technical components of response, which includes water supply, sanitation, and while not specifically mentioned, covers many parts of hygiene. Other sections of the book (also covered in the Sphere Handbook) include shelter and emergency settlement, chemical incidents, and training. This guide serves as a foundational resource alongside others like the Sphere handbook and still contains much of the useful information seen in other resources (Wisner & Adams, 2002).

The topic of emergency shelters is discussed at length by Wisner and Adams (2002) some of the key points that are discussed include self-sheltering, the different types of shelters available, site selection, building and construction, and community engagement. The guidelines state that self-sheltering is almost always more beneficial as it lowers the stress put on organisations and allows people who really need emergency shelter to be accommodated. The guide is geared toward individuals in developing countries and is less detailed when it comes to formal organisations stepping in to help the population experiencing an emergency.

World Health Organisation: WHO technical notes on WASH in emergencies (2013)

The World Health Organization (2013b) published 15 technical notes on WASH in emergencies, which contains information on washing hands correctly, cleaning and disinfecting water supplies, rehabilitating treatment, waste management, and minimum requirements for water chlorination. The goal of these technical notes is to achieve the lowest possible burden of water and sanitation-related disease through primary prevention. Technical documents are suitable for field technicians, engineers, and staff assisting in emergency situations. They primarily focus on the technical aspects of dealing with disasters, making some reference to other guidelines and the WHO Drinking Water Standards. A summary of the technical notes are detailed in Appendix B.

World Health Organisation: Guidelines for drinking water quality (2017) (4th edition)

The WHO guidelines for drinking water quality (GDWQ) (*4th edition)* are used extensively by governments and NGOs. Originally published in 1971, it was intended to replace international and European guidelines. The GDWQ has several sections which specifically note water quality and treatment in emergency responses, which can be different to water quality under normal conditions. The GDWQ states that one of the primary waterborne risks

to public health stems from faecal contamination into drinking water. The document provides extensive information on pathogens as well as treatment options related to microbial risks. It should be noted that the GDWQ also covers extensive information on chemical and radiological contamination; however, it is less likely to be an issue in emergencies where infrastructure is damaged. The document underpins the WHO technical notes and has been referenced by many WASH resources, as seen in Table 1 (World Health Organization, 2017). It also states that emergency responses should be written into water safety plans.

United Nations High Commissioner for Refugees (UNHCR) WASH manual (2019) (6th edition)

The UNHCR WASH manual “Practical Guidance for refugee settings”, serves as a manual for WASH with the specific focus of responding to emergencies where refugees are involved. Although aligned with Sphere, the UNHCR manual is focused on refugees and people who are displaced. Displacement is considerate of cultural norms, beliefs, and diverse groups in mind. The manual also covers the assistance of refugee women and girls with respect to their dignity and health (Principle 3: Protection, safety, and privacy and Principle 4: Menstrual hygiene). UNHCR has a refugee focus, and as such, long-term displacement is taken into consideration and states this displacement may last for decades. Within the manual, emergency phases are defined as:

1. Emergency phase (0-6 months)
2. Transition phase (up to 2 years)
3. Post-emergency and protraction phase (2-20+ years)

A summary of WASH indicators and standards, which includes water quality, sanitation, waste (excreta, wastewater, and solid waste) management, and hygiene, can be found on the UNHCR website (United Nations High Commissioner for Refugees, 2022). The UNHCR also maintains a dashboard with sites considered in emergency status, with report cards stating indicators and guidelines used (United Nations High Commissioner for Refugees, 2024).

While emergency welfare centres and shelters are not extensively discussed, the guidance does highlight that adequate space for managing WASH needs is important, particularly for the management of menstrual hygiene. This also includes woman and girls being included in the discussion of WASH facility requirements.

Other Notable Resources

Many clusters and portals exist which provide resources to respond to WASH in emergencies, while these may not specifically be guidelines, they do contain useful material. Some examples are provided below.

WASH Global Cluster (led by UNICEF)

The Global Wash Cluster (GWC) is a collaborative group that has 93 members from over 30 countries. Among these members are Sphere, WHO, Red Cross International, UNICEF, UNHCR, CDC. Simply put, the GWC is a humanitarian coordination system that aims to improve the response to WASH in a way that will benefit all people who are affected by disasters and emergencies. The GWC supports national coordination platforms (NCPs) to deliver the 6+1 functions. These functions include:

- Support service delivery
- Informing strategic decision-making
- Planning and strategy development
- Monitoring and reporting
- Contingency planning/preparedness/capacity building
- Advocacy

As the Cluster Lead Agency, UNICEF has the responsibility of operational support, setting standards and policies, and building response capacity (Global WASH Cluster, 2024).

The Cluster system is present across the world at the local government level, such as in the Kingdom of Tonga (Tonga). In Tonga there are 11 clusters such as the emergency telecommunication cluster, reconstruction cluster and the health and nutrition, water sanitation and hygiene ("Disaster Risk Management Act 2021," 2021). This cluster system is legislated under the Disaster Management Risk 2021 Act. The Health, Nutrition and WASH cluster aims to reduce avoidable mortality, morbidity and disability, and restore the delivery of, and equitable access to, preventive and curative health and nutrition services as fast as possible and in a sustainable way. It plays a role in coordination and mobilisation of stakeholders in disaster management preparedness, response and recovery in the WASH sector. During or after an event e.g. a cyclone the cluster will typically be activated within 24-48 hours by the lead agency, the Ministry of Health.

Emergency WASH Knowledge Portal

The Emergency WASH Knowledge Portal is a collaborative platform which contains practical resources for emergency water, sanitation, and hygiene information set out by the Emergency WASH Compendium. This is separated by sanitation technologies, water supply technologies, and hygiene promotion in emergencies, which are all open source.

Australian Disaster Resilience Handbook Collection: Health and disaster management (2019)

The Australian Disaster Resilience Hub hosts several disaster response handbooks, which provides trustworthy knowledge about disaster resilience and aligns with the National Disaster Risk Reduction Framework used by NEMA Australia. The collection promotes good practice in building resilience in Australia, builds smooth inter-organisational operations by setting out consistent principles, and language used by all parties involved in disaster response. One of the handbooks present in the collection is the Health and Disaster Management handbook (Australian institute for disaster resilience, 2019). Safety of first responders, air quality, water quality considerations, food safety, insect, vectors, and vermin control, sanitation issues, and hygiene and health promotion (SAWFISH) is used instead of WASH, although WASH is still encapsulated in this more comprehensive acronym.

The following is covered when focusing on the WASH related content:

Water quality considerations

- Identifies microbial and chemical contaminants as potential issues.
- Highlights minimum water requirements for a person.
- States community resilience can be enhanced through disaster warnings, and provision of bottled water.

Sanitation and waste issues

- Highlights solid waste collection and disposal as problems to consider, stating contingency plans need to be set out allowing excess waste to be dumped.
- States it is necessary to safely dispose of human waste as this is a primary pathway for the spread of communicable diseases. It is mentioned that if wastewater infrastructure is damaged, short-term plans are required and may include a bucket and spade to bury waste, while a medium-term provision such as portable toilets, latrines or septic tanks may be an option.
- Disposal of dead stock and hazardous waste are also mentioned, although these issues are passed to the Environmental Protection Authority and noted in the Australian Veterinary Emergency Plan.

Hygiene and health promotion

- Channels for public health promotion are identified and may include brochures, posters, print media, television, radio, websites, community groups and social media.
- Although mentioned here, a separate handbook titled Public Information and Warnings (2021) (Australian institute for disaster resilience, 2021) has been created. This comprehensively breaks down each channel of communication to the essentials of message construction.
- The Australian Disaster Resilience Knowledge Hub

The Health and Disaster Management Handbook is comprehensive, further listing information in a public health context about the disaster approach (prevent, prepare, planning, response), health emergency arrangements, community inclusion, ethics, law, communication, disaster types, and the health system. While specifics around how tasks such as deploying portable toilets are not described in the handbook, the Health and Disaster Management Handbook references the handbook put forward by the Sphere Association (2018) with respect to water quantity and quality.

According to the Australian Institute for Disaster Resilience (2019), it may be necessary to evacuate homes and go to a shelter prior to, during, or in the aftermath of an emergency. The handbook states that the purpose of emergency shelters are for short-term use where individuals are provided information, water supply, sanitation, waste management, shelter, and food. While the handbook does not provide more detail on this topic, another handbook by the Australian Institute for Disaster Resilience (2017) titled “Evacuation Planning” does. The handbook states that a lead organisation with authority is responsible for the management of shelters. The lead organisation will depend on the state and legislation, emergency management plans, and prior documented emergency management arrangements. In many cases, these plans are given to local authorities, however this may change with the severity of the emergency. The handbook states that while emergency shelters should be able to sufficiently handle a large number of occupants, self-shelter options are encouraged and the handbook promotes self-organised shelter away from the disaster impacted area. The handbook states that shelter preparedness should be part of household emergency preparedness campaigns. The handbook recognises that private domestic dwelling shelters are not possible for everyone and that assisted accommodation options such as evacuation centres, commercial accommodation, and specialist facilities should be made available and organised by the lead organisation. A list of requirements to ensure evacuation centres are fit-for-purpose can be found in this handbook. It recognises that some individuals may require additional support for example seniors, parents with

infants, LGBTIQIA+ members and the disabled. This extra support may include psychological support, physical support due to disability, and baby formula for infants.

The handbook states that health, safety, and security is important to consider when planning emergency shelters. The handbook notes that training and induction of staff into the facilities being used is important, alongside environmental health issues such as food, waste and hygiene management, fire safety, and site security, which may include support from police. Management of the emergency shelters is highlighted as important within the handbook to ensure that adequate resources are distributed to people living in close proximity. The handbook states other considerations such as uniting families together and communication sub plans for evacuation sites to keep individuals informed. Animal welfare and management is also included in the handbook and it is stated that at least one emergency shelter site should allow for pets to be present, while assistance animals should not be denied at any centre. Lastly, contingency plans for when shelter is compromised or when capacity has exceeded is noted in the handbook. The handbook states that there should be plans in place to allow some individuals to transition to other facilities if needed.

Hillsborough County (Florida) comprehensive management plan

Like all other counties in the United States, the Comprehensive Emergency Management Plan (CEMP) is the foundational document for Hillsborough County in their response to emergencies, which is not specifically focused on WASH emergency response but does include elements of it. Like the Florida state CEMP and the NSF (Federal Emergency Management Agency, 2019; State Emergency Response Team, 2024), the Hillsborough Country CEMP is split into emergency support functions (ESFs), which separates the response and recovery into different categories. In each ESF, the purpose of the ESF, support organisations, and the procedures to follow, are identified.

The ESFs and their relevance to WASH include:

- **ESF 3 Technical engineering advice:** Undertakes damage assessment and restoration of utilities such as water supply and wastewater infrastructure. Also undertaken is the removal of debris to prevent development and spread of vector-based epidemiological agents.
- **ESF 6 Mass care and medical services:** Provision of temporary sanitation facilities, ensuring minimum of 3 days supply of food, water, and sanitation facilities are available for designated public-school shelters. Also included are “comfort stations” for responders which provides sufficient water, food, and sanitation facilities.
- **ESF 7 Resource support:** Procurement of required resources, which may include food, water, and other necessary supplies.
- **ESF 8 Health and medical:** Coordinate with appropriate agencies and municipalities to inspect and advise on general sanitation matters.
- **ESF 11 Food and water:** Provides plans and procedures for food, water, and other necessities supplied.

The CEMP also provides several examples of events which activated the emergency operations centre during the last plan update. This provides information such as major affected infrastructure, damage cost estimates, and number of individuals seeking refuge in emergency sheltering. This information is likely directly relevant for future planning and cost estimates for damage.

Florida state has taken a proactive response to emergency management due to the state being in a high-risk area. A number of resources on disaster preparedness, such as the Hillsborough County Disaster Preparedness Guide (annually updated), are available (Hillsborough County, 2024). This includes a disaster kit, which details food, water, and personal hygiene materials. Each county contains detailed information on established emergency shelters, which consider the general population, pet-friendly emergency shelters, and special needs shelters. The necessary items to bring to these shelters are detailed on each county's websites (Hillsborough County Public Schools, 2024).

As Florida is located in a high-risk area, state departments have provided precautionary boil water notices at the start of the hurricane season, although it is noted that the emergency could be any other unforeseen event. The notice also includes instructions on how to treat water and under what circumstances you should use disinfectants. Along with this, are a number of links that include information on Hurricane preparation for drinking water systems, a water tracking database that allows facilities to update their operational status, and an inter-agency bulk water transport guidance document to ensure safe drinking water (Health, 2023).

Once the Hillsborough county resources and services are unable to cope with the emergency response, the state of Florida will begin to provide resources and support to counties requiring it. Like the country CEMP, the state CEMP contains ESFs which are similar to local ESFs. This allows each increase in emergency response requirements to be smooth, where roles and responsibilities are well identified. As identified in the previous section, developed countries are often able to provide the public with greater quantities of resources, such as bottled water for drinking and hygiene, while other WASH guidelines created for developing countries provide foundational information which covers basic themes of WASH such as ensuring water supply is not contaminated. This highlights the great disparity between developed and developing countries.

While WASH is critical during emergencies, the Hillsborough CEMP mentions emergency shelters, which also provide another layer of general protection when private domestic housing may not be available or adequate. In the case of Hillsborough country, Florida, an area notorious for extreme weather events, emergency shelters are available in the event of an emergency. Emergency shelters typically open during the announcement of an emergency. In Florida the most common building designated as an emergency shelter are public schools, while other locations such as churches also serve as public emergency shelter locations. Within the Hillsborough CEMP a list of the emergency shelters is updated annually and made available on the county's website. Designated emergency shelters also required a minimum amount of food, water, and sanitation facilities to be stored onsite at all times. Maintaining this emergency stock is a joint responsibility between the school board, the Office of Emergency Management, and social services. The Hillsborough CEMP also makes provisions for special needs shelters, which are dedicated to individuals who require special medical or physical support. These can be pre-registered to allow the county to understand how many special needs individuals there are that may require support. Additional emergency shelters are available that are not required to keep resources onsite and provide short term accommodation that is better than a private car. The planning detailed in the Hillsborough CEMP for emergency shelters is not dissimilar in other counties and states in the US, which use the same system to respond to emergencies (Hillsborough County Public Schools, 2024; Office of Emergency Management, 2019).

Centers for Disease Control and Prevention (CDC)

While the CDC is not the main point of contact for WASH during emergencies, they do provide some guidelines and graphics that inform the public about what to do during and post-emergency. These recommendations include “How to Make Water Safe in an Emergency”, which details boiling, disinfecting, and filtering water prior to use (Centers for infectious disease control and prevention, 2024b). Another resource is their “Guidelines for Personal Hygiene During an Emergency”, which details the steps involved in order to properly clean hands, and following local guidance put forward by the county where the emergency is occurring (Centers for infectious disease control and prevention, 2024a).

Key findings: The structure and clarity of emergency response plans varies by country. Key humanitarian organisations such as UNICEF, Sphere Standards, WHO, and UNHCR are focused on providing specific foundational documentation on WASH guidelines. These guidelines include details such as water requirements for drinking and washing, treatment protocols for water disinfection, and minimum toilet-to-people ratios. While these details are important for developed countries, these documents tend to target developing countries, particularly UN organisations. This is contrasted by developed countries, which have a complex ecosystem of disaster response plans due to better infrastructure and greater access to resources, for example the provision of emergency shelters/welfare centres. The focus for developed countries is on coordination and communication of disaster response holistically, with WASH being just a small portion of the response plan. This is particularly true at the national and regional/state level. Greater detail on WASH guidelines can be found at the local level, however, it is still the case that most response plans are centred around coordination of organisations and resource delivery. What has been highlighted as important in several of the case studies is that each scale (local, regional, national) should use a unifying system (i.e., NIMS) to ensure coordination is seamless and consistent across each of these scales

2.4 NEW ZEALAND EMERGENCY WASH GUIDANCE

The National Emergency Management Agency (NEMA) provides emergency guidance in New Zealand. Established in 2019, it replaced the Ministry of Civil Defence and Emergency Management. NEMA is an autonomous departmental agency hosted by the Department of the Prime Minister and Cabinet and provides support to regional civil defence units throughout New Zealand before, during, and after an emergency.

There is recognition that emergency WASH guidance may evolve over time within initial efforts focusing on utilising globally accepted standards and guidelines (i.e., Sphere Association, 2018). However, as countries (such as New Zealand) engage with emergency WASH issues, there may be a movement towards national WASH guidance that are country-specific and fit for purpose. These take into account the specific emergency risks in that country and considers culturally and geographically appropriate WASH solutions (International Organisation for Migration, 2022).

2.4.1 National WASH guidance

There are national documents that include various WASH guidance in an emergency. It is important to note, however, that there is currently no national WASH emergency guidance document available for a New Zealand context that encompasses all aspects of WASH in an emergency.

National Emergency Management Agency (NEMA)

National Emergency Management Agency (NEMA) manages New Zealand's central government's response and recovery functions for national emergencies and supports the management of local and regional emergencies. NEMA's Get Ready website provides communication documents in various languages (approximately 19) alongside audio, large print and braille options. NEMA provides national leadership throughout emergency management phases defined for a New Zealand context that includes readiness, reduction, response and recovery.

NEMA provides specific emergency WASH specific guidance that includes:

- Consistent messages for Civil Defence Emergency Management (CDEM) (Nov 2024) was a document developed to support the development of tailored communications during the four phases of emergency management: readiness, reduction, response and recovery. The document includes nationally agreed, consistent messages for all civil defence emergency management units and emergency services to use. Specific WASH guidance is given for storing and treating drinking water alongside making an emergency toilet.
- A focus on preparing specific locations such as work, home and community (i.e. work ready, home ready, and community ready) in the event of an emergency.
- Storing water: how much water to store per person and suitable water storage container options. The guidance recommends that households should have at least three litres of drinking water per person per day for at least three days. This messaging was found to be consistent with Health New Zealand – Te Whatu Ora guidance.
- Work out what supplies you need: e.g. For an emergency toilet a sturdy, watertight container that can hold approximately 15 – 20 litres is advised with a snug fitting

cover. The guidance suggests that a small amount of regular household disinfectant (such as chlorine bleach) can be added to the container each time the toilet is used. The guidance, however, did not give any advice on managing the risk associated with residual chlorine reacting with nitrogenous substances and organic matter, which produces halogenated compounds some of which (e.g., trihalomethanes) are considered carcinogenic. This messaging was found to be consistent with Health New Zealand – Te Whatu Ora guidance but inconsistent with international acceptable practices used to minimise the public health risk associated with producing halogenated compounds.

The Water Services Authority - Taumata Arowai: Declaring a drinking water emergency

The Water Services Authority - Taumata Arowai is the water services regulator for New Zealand and ensures that all communities have access to safe drinking water. They also have a role in regulating the environmental performance of wastewater networks throughout New Zealand. Taumata Arowai can only declare a drinking water emergency after consultation with public health experts (including the relevant medical officer of health) and the Minister of Local Government according to the Water Services Act 2021 (s 59). Taumata Arowai provides WASH guidance in the event of an emergency:

How to make water safe to drink under a boil water notice, which includes advice on drinking water, personal hygiene, washing dishes and food preparation (including babies fed with formula). Drinking water treatment guidance recommends a rolling boil for 1 minute or disinfecting the water with household bleach (5 drops of bleach to 1 litre of water or half a teaspoon to 10 litres of water), which was found to be consistent with Te Whatu Ora/Health NZ guidance.

Other resources that The Water Services Authority – Taumata Arowai provide include:

- Drinking water supplies following a flood event
- Advice for drinking water suppliers following a flood event – bore water
- Advice for drinking water suppliers following a flood event - rainwater

Ministry for Primary Industries (MPI): Food safety in natural disasters and emergencies

The Ministry for Primary Industries provides advice on food hygiene during natural disasters and emergencies. They also provide specific guidance on treating water using household bleach for drinking purposes, hygiene practices and cooking. The MPI advice for treating household drinking water (5 drops of household bleach per litre of water or half a teaspoon for 10 litres) is consistent with Te Whatu Ora/Health NZ guidance.

Te Puni Kōkiri: Civil defence marae emergency preparedness plan

Te Puni Kōkiri is the New Zealand government's principal policy advisor on Māori wellbeing and development. In 2018 Te Puni Kōkiri provided a Marae Emergency Preparedness Plan template to ensure that marae, Māori and the wider community are ready in the event of a disaster or emergency (Te Puni Kōkiri, 2018). While not specifically mentioning WASH, the template encourages marae communities to think about their service providers (i.e. septic tank company, plumber, electrician, builder and water tanker) along with identifying what

infrastructure they have (i.e., water, power, sewerage, toilets/showers, cooking, dining and rubbish facilities).

Health New Zealand – Te Whatu Ora

Health New Zealand – Te Whatu Ora is responsible for improving services and outcomes across the New Zealand health system. Health New Zealand's website provides written guidance on how to protect public health in the phases of preparation, during and after an emergency and includes guidance on:

- Using water safely during an emergency,
- waste management during an emergency, including guidance on how to make a temporary toilet and a long drop toilet. This website information is complimented by a factsheet on sewage disposal.
- guidance for DHB emergency management staff: Infant feeding in an emergency for babies aged 0 – 12 months (2015) The plan was developed to help emergency planning and response staff of district health boards to respond to infant feeding needs during an emergency, This guidance is currently being updated (as of Dec 2024).
- Protecting Your Health in an Emergency (2015) This guidance document is currently being updated (as of Dec 2024) and include key information about water, disposing of sewage, looking after yourself, accommodation, getting rid of rubbish and food safety.
- Public health response to the February 22 Christchurch earthquake: progress report (30 March 2011) authored by the Canterbury Public Health Medicine Registrar and the Medical Officer of Health Incident Controller[1]. This report provided a public health update during the initial emergency response that included an update on the water quality technical advice, welfare centre management and outbreak control.

Ministry for Ethnic Communities

The Ministry for Ethnic Communities is the New Zealand government's chief advisor on ethnic diversity and the inclusion of ethnic communities in wider society. The Ministry provides ethnic communities in New Zealand with information, advice and services and administers funds to support community development and social cohesion.

- What you will need in an emergency: The Ministry for Ethnic Communities has prepared a YouTube clip (in 19 different languages) detailing what to do to prepare for different disasters and emergencies and how to respond when they happen. The YouTube clip recommends preparing WASH supplies in advance such as 9 L of water per person for at least 3 days, toilet paper, hand sanitiser and large plastic buckets for an emergency toilet, which was found to be consistent with Te Whatu Ora/Health NZ guidance.

Joint Centre for Disaster Research, Massey University

The Joint Centre for Disaster Research (JCDR) at Massey University is an international centre for research and teaching in disaster risk and emergency management. The JCDR

[1] Report available through Health New Zealand – Te Whatu Ora

covers a broad range of topics across emergency management that tackle real-world situations and solutions. In partnership with Massey University and the Earthquake commission (EQC) the Te Toi Whakaruruhau o Aotearoa (Māori Disaster Risk Reduction Centre) was established in July 2020. No emergency WASH related research or resources were found that dealt with Māori values and matauranga Māori to inform and facilitate the health and well-being of Māori.

2.4.2 Regional WASH guidance

In New Zealand local authorities are responsible for the formation of Civil Defence Emergency Management (CDEM) units within their area. There are 16[2] different civil defence emergency management units throughout New Zealand coordinating efforts before, during and after an emergency. Each CDEM can be made up of a consortium of local authorities, emergency services, lifeline utilities, welfare organisations, government departments and non-government organisations. Examples of WASH related documents, resources and messaging are included in the following sections.

Hawke's Bay Civil Defence Emergency Management Group

An independent review following Cyclone Gabrielle (Feb 2023) was conducted:

- Hawke's Bay Civil Defence and Emergency Management group response to Cyclone Gabrielle (March 2024)

This report reveals severity of the emergency event and how civil defence staff and the community were simply overwhelmed due to the lack of operation detail in their emergency plans. While not specifically mentioning WASH the report give valuable recommendations for improving the enabling environment in terms of the response to an emergency event. The report states that engagement with the regional public health unit and Health New Zealand – Te Whatu Ora was poor at the beginning of the response but improved later.

In relation to the establishment of welfare centres the report recommended improvements at local and regional levels alongside investment and enhanced national coordination. The report revealed that *"At the operational level, Māori agencies and marae felt that their proven abilities to deliver welfare services at scale were either ignored or hampered by bureaucratic decision making"* (page 6). The report recommended to: "*Utilise marae as distribution and welfare hubs throughout the region and ensure they are supplied with current sitreps and action plans. Ensure that their role in the CDEM* (Civil Defence Emergency Management*) system is both appropriately resourced and clearly communicated to local communities"* (page 16).

Auckland Emergency Management (AEM)

Auckland Emergency Management (AEM) works in partnership with emergency services and communities to prepare for and coordinate an effective response and recovery in the event of an emergency within the Auckland region. AEM provides some WASH related emergency guidance, such as:

- Work out what supplies you need in an emergency: Includes advice on at least 3 days supply of water with at least 9 L of water per person for drinking and basic

[2] Civil defence emergency management (CDEM) units throughout New Zealand: Northland, Auckland, Waikato, Bay of Plenty, Tairawhiti, Taranaki, Manawatū-Whanganui, Hawke's Bay, Wellington, Nelson-Tasman, Marlborough, West Coast, Canterbury, Otago and Southland.

hygiene as well as being prepared with large plastic buckets for an emergency toilet which was found to be consistent with Te Whatu Ora/Health NZ guidance.

- No water: This resource provides guidance on what to do for drinking water, cooking and washing if there is no water in an emergency.
- Helping you cope during a power outage This pamphlet provides advice for septic tank owners who can no long use their onsite wastewater system and maintaining hygiene standards by washing hands.
- Lifestyle block emergency preparedness handbook Auckland Section 3 of this document contains advice on how to manage water on your property in the event of an emergency (i.e., water tanks, septic system and water drainage).

Wellington Region Emergency Management Office (WREMO)

The Wellington Region Emergency Management Office (WREMO) works in partnership with emergency services and other organisations to prepare for and coordinate an effective response and recovery to emergency events in the Wellington region. They provide various documents that include WASH advice and guidance in emergencies:

- Don't flush infographic (Figure 3): gives emergency toilet options for a variety of household situations.
- High-rise buildings: gives advice for those who live or work in high-rise buildings following an earthquake especially for sewage disposal.
- Water storage infographic: Includes advice to store emergency water with a minimum amount of 3 L per person per day and recommends storing enough water for 7 days (21 L per person). This minimum amount is only enough for drinking, cooking and very basic hygiene and was found to be consistent with Te Whatu Ora/Health NZ guidance.
- Lifestyle block emergency preparedness handbook Wellington region WREMO duplicated the Auckland lifestyle block guidance handbook for a Wellington context.

Figure 3. Wellington Region Emergency Management Office (WREMO) Infographic: "After a large earthquake don't flush".

Mowll et al. (2022) created a post-earthquake emergency sanitation plan for the Wellington region. The plan recognised that in the event of the Wellington fault rupturing outages of wastewater collection could last 3 months but may exceed 2 years within the Wellington metropolitan area (Mowll et al., 2022). Co-authors of the plan included: Wellington Region Emergency Management Office (WREMO), Massey University, Green Earth Development Ltd, Regional Public Health and Wellington Water. The plan states that households will need to manage their own toilet waste within their property for at least a week. Beyond the first week after an earthquake the plan allows end-users to choose their preferred sanitation option catering for a range of ages, behaviours, cultures and capacities. The high-level goal for the emergency sanitation plan was to minimize gastrointestinal outbreaks from occurring, following an emergency event. This resulted in the "Don't flush" campaign, which promoted several options for the public to use should the infrastructure be compromised. The options took into account local topography and weather conditions, as these, in particular, changed the viable options.

Mowll et al. (2022) recommended that the next steps include:

1) Sanitation in emergencies public education that includes:
    - why the sanitation options were chosen and why some sanitation options were not recommended for a Wellington context (i.e., portable and chemical toilets)
    - the items that can be purchased pre-event to enable good sanitation practices in an emergency
    - suggestions on how to build a functional long-drop toilet
2) Procurement and marketing via a public-private partnership
    - In 2012, WREMO established a public-private partnership to enable people to purchase a 200 L emergency water tank at an affordable price of $100 (a saving of $165). This initiative has generated sales of more than 24,000 tanks so far (2021) and resulted in 5 million litres of water storage capability throughout the region.
    - To improve people's access to sanitation in an emergency, WREMO and Wellington Water have worked to promote a local Wellington company who supplies a two-bucket emergency toilet kit. Alongside the promotion of this company's emergency toilets, WREMO has scheduled an annual campaign from 2023 to help people understand how to manage waste through a range of options. These range from digging a long-drop toilet and using two buckets to modifying their existing toilet for people with physical challenges.

Brenin et al. (2021) published findings from a workshop that addressed the emergency sanitation challenges and opportunities following a large Wellington Fault earthquake scenario. The workshop included presentations from WREMO, Wellington Regional Public Health, Wellington Water and the Joint Centre for Disaster Research (Massey University). The workshop provided a summary of the discussions regarding engaging communities and marginalised groups that ranged from tikanga Māori perspectives to the sanitation challenges faced by those with lesser capacity (Figure 4).

Summary of Discussion on Engaging Communities and Marginalised Groups

Prompt question	Responses
What key information needs to be part of a pre-disaster conversation?	- Projected wastewater service outage durations when toilets cannot be flushed. - Consequences of flushing toilets when the wastewater network is damaged; waste will be discharged into some residences, onto residential land, and overland in streets or to waterways. - Serious nature of diseases transmitted by the faecal-oral pathway. - Options for emergency sanitation (may be location dependent). - Probability that some homes may be uninhabitable following the scenario earthquake or disasters with similar wastewater consequences.
What are the main challenges for the pre-disaster conversation?	- Agencies engaging with community groups need better information on options and context to help with conversations and planning. - How do we even define communities? Who are they and what challenges might they face in their particular situation? For example: students or those in apartments, people living with a disability, migrants and refugees, and those for whom English is a second language. There is a diversity of community groups with differing needs and abilities to access and maintain sanitation facilities. - To reach different communities, start with approaching key people/influencers. - Consider pre-planning messaging and assistance for those who will most need help.
What socially and culturally awkward norms do we need to consider when coming up with solutions?	- Environmental, social, and cultural standards may be temporarily compromised following an event. - There is social awkwardness and squeamishness around bodily functions, with reference to Rosenquist (2005). However, for emergency preparedness communications, use of euphemisms such as "human waste" may not be helpful. Participants agreed on the need for consistent terminology and suggested that the terms "wee" and "poo" be adopted as they are direct and unambiguous, if informal.
What will those who have lesser capacity do?	- Groups representing the disabled find it difficult to prioritise emergency preparedness in general, as their finite resources are occupied with day-to-day issues such as transport and access. - The disabled are more likely to favour emergency sanitation solutions based on their regular toilet arrangements (e.g., bag inside toilet) due to ease of use. - It is incumbent on all community members to support those with reduced capacity.
What are some of the tikanga Māori perspectives and plans for sanitation in disasters?	- Marae around the Wellington region are well set up to cope in a disaster, although many urban marae may lack the appropriate space for the separation of sanitation facilities from other areas (due to overall space limitations). - Marae are likely to source portable toilets where appropriate and able to do so, with long drops also identified as an option. The larger marae have pre-identified places where long drop toilets may be located. Pre-digging of long drops has been put forward as an appropriate action. - All plans should align with the Treaty of Waitangi principles and articles.
Who is best to lead work on engaging communities and marginalised groups in the conversation about emergency sanitation?	- WREMO are the appropriate lead as they have the regulatory authority under the Local Government Act. - Other stakeholders must be engaged, and collaboration is essential. - WREMO should be a public voice but in partnership and with input from other key partners such as Regional Public Health and Wellington Water. - All advice should be evidence based.

Figure 4. Summary of discussion on engaging communities and marginalised groups (Brenin et al., 2021, pg. 48)

Emergency Management Canterbury (EMC)

The Emergency Management Canterbury (EMC) works in partnership with emergency services and other organisations to prepare for and coordinate an effective response and recovery to emergency events in the Canterbury region. On their website they provide various documents that include WASH advice and guidance in emergencies:

- Storing bottled water in preparation for an emergency alongside the recommendations with regard to the amount of water to store (Figure 5). To treat drinking water, it was advised to add five drops of unscented household bleach per litre of water (or half a teaspoon for 10 litres), which was found to be consistent with Te Whatu Ora/Health NZ guidance.
- Waste management: Guidance suggests using a portable toilet or bucket and digging a deep hole in a household garden to dispose of the human waste. It also suggests using a pit latrine to dispose of waste within a property boundary.

No documents or key messages were found that detailed the emergency WASH lessons learned from the Canterbury (2010/2011) and Kaikōura (2016) earthquakes.

Figure 5. Guidance on the amount of water to store per person for either a bare minimum and survival upgrades (source: Emergency Management Canterbury (EMC) Infographic)

Selwyn District Council

Selwyn District Council distributed to homeowners physical copies of Are you ready?: A guide to emergency preparedness in Selwyn (Selwyn District Council, 2024). As shown in Figure 6 the booklet gave brief guidance on drinking water (for 3 days or more have at least 9 L of water per person and half a teaspoon of household bleach to every 10 L of water), sanitation options (i.e. bucket emergency toilet) and hygiene. This guidance was found to be consistent with Te Whatu Ora/Health NZ guidance.

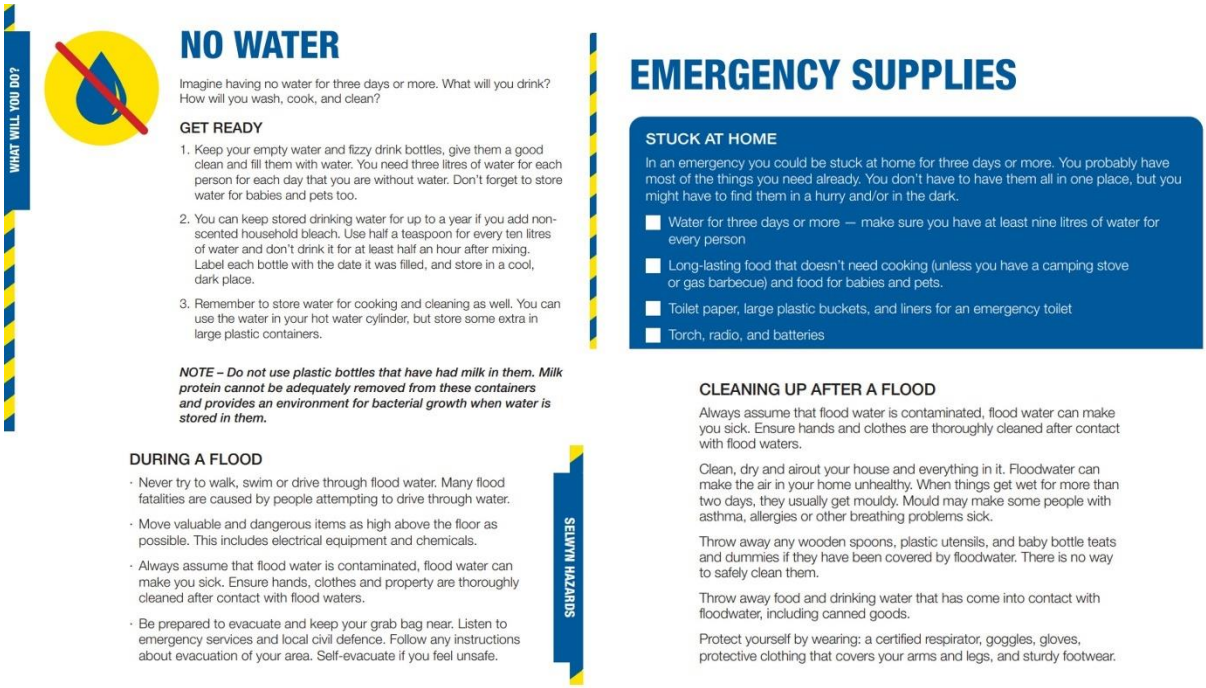

Figure 6: Example from Selwyn District Council's Are you ready?: a guide to emergency preparedness in Selwyn (Selwyn District Council, 2024).

Key findings: Some regions provide good case examples of a multi-agency approach (i.e., WREMO) and the sharing of emergency WASH guidance documents (i.e., Wellington/WREMO and Auckland/AEM). There were also good examples of public-private partnerships to improve emergency WASH preparedness and an attempt to address tikanga Māori perspectives (Wellington region). Other regions which had experienced significant emergency WASH challenges (i.e., Christchurch and Kaikōura earthquakes) showed little evidence of lessons learned to improve public health outcomes within their region in the event of another emergency. Most likely because of the timing of the NEMA emergency messaging guidance document (Nov 2024), other regional CDEM units have yet to incorporate consistent WASH messaging and guidance. It was noted, however, that overall, at a regional level within the 16 different units, WASH guidance was basic, with only some consistency in key messages and language used but there was no consistency in the infographics used or other forms of available multimedia resources were identified to promote public health in an emergency.

2.5 CASE STUDY: CANTERBURY AND KAIKŌURA EARTHQUAKES

The Canterbury (2010/2011) and Kaikōura (2016) earthquakes resulted in emergency events that had implications on public health due to issues with water, sanitation and hygiene. A report completed by Nicholas et al. (2017) *Emergency toilets in disaster situations: A scoping study learning from Canterbury and Kaikōura earthquakes*, investigated these events in terms of the emergency toilet response by using a "learning-from-experience" approach to understand how emergency toilets were selected, deployed, used, and serviced by interviewing residents and officials with direct experience during these natural disasters. This was supported by insights from literature, which were predominantly grey literature as limited peer-reviewed research on emergency sanitation existed at the time. The scoping study was to inform future responses to disasters that may require emergency sanitation. Some of the concerns mentioned in the report included health, cultural sensitivity, and the usability of emergency toilets with consideration of supply, transportation, and servicing.

The literature on emergency toilets was primarily sourced from organisations such as the WHO, relevant organisations that fall under the UN and regional civil defence units like WREMO. During the Christchurch and Kaikōura earthquakes, WASH guidance documents were not available at the national or regional level. However, post-earthquakes, WREMO (2013) was funded to investigate composting toilets as a preferred option when compared to portaloos and chemical toilets (see report for direct comparisons). The report recommended composting toilets should be the preferred choice and national guidelines should be developed in the event composting toilets needed to be deployed in a disaster situation.

The Nicholas et al. (2017) report identified health risks involved in disasters with specific reference to pathogens and their pathways, along with mental health, personal security when using composting toilets, and loss of dignity during disasters. Vulnerable groups were also discussed, stating that various groups require sanitation options that need to be tailored to their specific needs. For example, Phibbs et al. (2014) revealed that disabled individuals "preferred to shelter in their own homes, which were already specifically organised to meet their needs." Cultural diversity and contexts were also noted as necessary to consider as the emergency toilet requirements between genders and ethnicities may differ greatly. An example communicated by Nicholas et al. (2017) is the holistic world-view Māori have when approaching wastewater management, which could have significant impacts on how waste is dealt with post-disaster.

The uses of technology were also described, specifically the use of GIS, mobile-based applications, and drones to contribute to the safe and efficient management of public health, waste management, and assess damage and coordinating emergency responses.

The literature review was used to inform the interviews which included a range of informants:

- Canterbury Public Health Unit personnel
- Local authorities – infrastructure management personnel
- Takahanga Marae (Kaikōura) leadership
- Canterbury Medical Officer of Health
- Affected members of the general public.

The literature review and interviews resulted in a range of recurring themes:

Policy and organisation:
The report found that the policy and organisation during the emergency toilet selection, deployment, use and servicing was inadequate, did not have sufficient emergency management planning, the training and exercises with stakeholders was limited, had a lack of knowledge and strategy regarding emergency toilet deployment, toilet ownership and maintenance and maintenance responsibilities was unclear, and there was poor

collaboration with established organisations and councils, which included inadequate implementation of Whakawhanaungatanga (relationship-building processes). It should be noted that public officials that were interviewed referred to the emergency management plan, although this plan was more focused toward repairing and maintaining sewage infrastructure

Preparation and Distribution Process management:
Short-term (48 hours) and ongoing leadership through emergency response was both critical but was lacking especially between local and national civil defence. The report highlighted the importance of procurement and appropriate distribution of necessary materials such as emergency toilets and decision support tools that would allow smooth response and access to resources such as GIS to map damage to essential infrastructure. Personal hygiene and cleanliness of toilets were reported to generally increase throughout the emergency response. There seemed to be inconsistency in the decommissioning of emergency toilets with Christchurch residents being told to keep chemical toilets, while in Kaikōura chemical toilets that weren't used were returned to councils. There was also poor communication with regards to wastewater reticulation when it was turned back on which meant that people did not realise that they were able to use toilets in their own home again. Lastly, the fate of emergency toilets and maintaining an appropriate national stock of these toilets was discussed. While Civil Defence did communicate the concept of strategically distributing emergency toilets around the country, this was abandoned due to costs.

Equipment
Experience with emergency toilet facilities were variable and meant that individuals were in a state of trial and error. The report acknowledged that flushing toilets in an emergency was considered inappropriate, however several interviewed individuals continued to do so and experienced unsavoury consequences. Portaloos were eventually well distributed, although there was reluctance to use them for safety concerns or because they were too far away from homes. Long-drops were used initially, however, people tended to switch to other options when they were made available. Chemical toilets tended to be more popular and were provided on a per household basis, which made it more convenient for users, resulting in less likelihood of disease spread, and offered more privacy along with individuals not being exposed to weather conditions. Chemical toilets were accompanied by storage tanks, which were of sufficient capacity, however, there were associated problems such as risks of falling in, or individuals unable to figure out how to use them safely.

People factors

The report also touched on social support and how important local communities are in times of disaster and help. There were mixed perspectives on the social support provided by and to the community from government and council agencies. While some individuals were not interested in helping the wider community, others noted that the local community were their primary source of help and information. Some of these experiences caused people to look back with an individual stating:

> *'I must admit when I look back I wasn't emptying other people's toilets but maybe I should've done, you know, only think of that now'.*

The report touched on vulnerable people, behaviour change, and culture; however, the low number of interviews did not allow for a comprehensive analysis of these issues.

The overall insights within the report found that there was limited planning, and a lack of coordination, logistics of sourcing, distributing, and maintaining toilets were challenging. Hygiene practices varied throughout the affected population as a consequence. Existing organisations and people's networks were a valuable asset when dealing with emergencies.

The report illustrated that affected communities were not ready in an emergency response with respect to sanitation and waste management. In particular, it was quoted that:

> *'…when it went from a local emergency to a national emergency we had a 48 hour black hole… no one was in charge, no one knew anything and we weren't allowed to make any decisions'.*

Coordination, services, and support tended to increase in quality with time, however, it should be noted that the first 48 hours are critical in emergency response. Despite this, communication was seen as relatively successful as many communication channels that weren't the internet were tapped into fairly quickly. While the report contains valuable information, knowledge gaps have been well identified through the report in their relevant sections, which can inform future studies.

The report allowed specific points of action to be highlighted to ensure that the affected populations are better equipped and prepared for future responses. A consistent framework containing the planning, implementation, and recovery with respect to emergency toilets should be well established and can be adapted from a national context down to the local setting. This would include national guidelines for emergency toilets and their specific needs, understanding the right decision support tools to help with this specific framework, and ensuring a national stocktake and potentially a top-up of emergency toilets are completed to ensure New Zealand is well equipped to handle future disasters, regardless of location.

The Nicholas et al. (2017) emergency toilets scoping study raised a number of key questions for future consideration:

- How is emergency toilet provision dealt with in emergency management training?
- How are marae, kaitiaki and marae facilities considered in emergency management planning?
- What collation of post-quake (2010 and following) learnings about emergency sanitation management exists, and where can it be found?
- How was GIS technology used to manage the distribution and servicing of emergency toilets?
- How were decisions made about the allocation of toilet units per household and per suburb?
- What plans were in place, in relation to the use of emergency toilets, to manage a major disease outbreak?
- What are the stockholding arrangements for toilet units in anticipation of emergencies?
- What is the load-bearing capability and the durability of the toilets that were provided?

Key findings: The report specified some emergency sanitation recurring themes of policy and organisation, preparation and distribution process management, equipment and people factors. Some of the concerns mentioned in the report with regards to emergency sanitation included health, cultural sensitivity, and the usability of emergency toilets with consideration of supply, transportation, and servicing. A number of key questions for future consideration were raised in the report.

3. KEY INSIGHTS

Insights from the international emergency WASH guidance reveal that in order to minimise the impact on public health during an emergency, strengthening of guidance and the policy and planning enabling environment is critical during the preparation phase of an emergency. The international guidance confirms the importance of planning to manage the entire water and sanitation chain with an integrated approach while enabling healthy behaviours and access to hygiene supplies. This approach is affirmed by the amount of detail that the Sphere Association and WHO guidance provides which includes written, infographic and multimedia resources. The international guidance also mentioned the need to incorporate emergency WASH guidance within drinking water safety plans alongside WASH planning and preparation for communal emergency shelters/welfare centres.

Insights from the national and regional CDEM units reveal that there needs to be an effort from regional CDEM to utilise the nationally agreed messages to assist communities to increase their resilience in preparation for an emergency. There is also a need to provide more detailed guidance for different communities throughout New Zealand who will require specific and tailored WASH guidance. For example, those in densely populated urban environments (apartment buildings), steep urban terrain (Wellington), and isolated urban communities (Queenstown). The National and regional emergency WASH guidance also did not address the public health implications of having to utilise emergency WASH facilities and behaviours over a long period of time. As shown by the Christchurch emergency toilet insights (Nicholas et al. (2017) this may extend up to 2 years. For example, in the event of a long-term emergency, for composting toilet use among households, there is currently no national guidance on when the composting toilet waste is safe to handle or when it can be used as a soil conditioner. In addition, insights from the national and regional CDEM units revealed little specific guidance that addresses cultural needs (tikanga Māori perspectives) or those with special needs such as those with disabilities, the elderly and children, apart from guidance for bottle feed babies.

4. CONCLUSIONS

A review of WASH within an emergency context revealed the comprehensive availability of WASH guidance internationally. In particular, the Sphere Association and WHO provide the most comprehensive international guidance on WASH in emergencies with their guidance is widely used by organisations and government agencies. The Sphere Association and WHO guidance also covers a wide range of emergency and disaster contexts with careful consideration of cross-cutting issues such as gender, equity and inclusion alongside geographic and climatic issues.

Within a New Zealand context, NEMA provides consistent national messaging for civil defence units during the phases of emergency readiness, reduction, response and recovery which includes written WASH guidance to protect public health. The messaging considers cross-cutting issues such as inclusion, accessibility and cultural needs. Te Whatu Ora/Health NZ also provides consistent messaging for emergency WASH to protect public health. Across other national organisations, the emergency WASH guidance is fragmented, with numerous organisations contributing, which in some cases has resulted in a disparity between information and guidance given. Overall, no nationally consistent infographics or multimedia resources were identified that provide comprehensive emergency WASH guidance.

Some regions within New Zealand provide good examples of a multi-agency approach (i.e., WREMO/Wellington Water and Te Whatu Ora/Health NZ and the sharing of emergency WASH guidance documents (i.e., Wellington/WREMO and Auckland/AEM) so as not to duplicate efforts. Very few regions made attempts to address tikanga Māori perspectives with regards to emergency WASH. Other regions which had experienced significant emergency WASH challenges (i.e., Christchurch and Kaikōura earthquakes) showed little evidence of lessons learned to improve public health outcomes within their region in the event of another emergency. There was also very little WASH guidance available for the establishment of emergency shelters/welfare centres, in particular advice for a marae context.

Most likely as a result of the timing of the NEMA emergency messaging guidance document (Nov 2024), regional CDEM units have not had time yet to incorporate consistent WASH messaging and guidance. It was noted, however, that overall, at a regional level within the 16 different units, WASH guidance was basic with only some consistency in key messages and language used but no consistency in the infographics and multimedia resource options.

A review of the emergency toilet response during the Christchurch and Kaikōura earthquakes (Nicholas et al. (2017) revealed many issues with regard to the planning, implementation and recovery phases of the emergency toilet response. The current emergency WASH literature review has revealed that many of these knowledge gaps are yet to be resolved. In combination with the gaps in sanitation guidance to protect public health in emergencies, there remains gaps in New Zealand's water and hygiene guidance as well. Efforts to fill these gaps to ensure that New Zealand is well equipped to handle future emergencies is necessary at national and regional levels to protect public health.

5. ABBREVIATIONS

AEM	Auckland Emergency Management
FEMA	Federal Emergency Management Agency
FERP	Federal Emergency Response Plan
CDC	Centers for Disease Control and Prevention
CDEM	Civil Defence Emergency Management
ESR	Institute of Environmental Science and Research
GDWQ	Guidelines for Drinking Water Quality
GWC	Global WASH Cluster
HHS	Department of Health and Human Services
NEMA	National Emergency Management Agency
NGO	Non-Government Organisation
NIMS	National Incident Management System
NRF	National Response Framework
UNICEF	United Nations International Children's Emergency Fund
UNHCR	United Nations High Commissioner for Refugees
WASH	Water, sanitation and hygiene
WHO	World Health Organization
WREMO	Wellington Region Emergency Management Office

APPENDIX A:

The Sphere Standards: WASH in emergencies (individual standard description summaries) (Sphere Association, 2018).

WASH component	Standard	Description
Hygiene promotion	1.1 Hygiene promotion	Promotion and education of hygiene is one of the critical tools and is one of the primary barriers to ensure public health is maintained in emergencies. Key actions to ensure hygiene promotion success include identifying the primary risks to public health and what practices increase and decrease public health risks, working with populations in emergency to manage hygiene, and taking community feedback and health surveillance data on board to improve the hygiene promotion response. The key indicators including quantifying number of households with clean water and soap, the number of people storing food and water safely, and the number of households safely dealing with human excreta and waste, among others.
	1.2 Identification, access and use of hygiene items	The action items for this section include identify necessary hygiene items, provide timely access to these items, work with the population to ensure they can receive the hygiene items, and seek feedback for how to improve the mechanism of distribution and the products themselves. Key indicators include minimum quantities of hygiene items and containers required per person and states a potty, scoop or nappies may be required by children. Guidance notes are also included for details which may not be thought about. This includes identifying essential items, highlighting at-risk groups, and people moving/migrating to other areas.
	1.3 Menstrual hygiene management and incontinence	Key actions include understanding practices, social norms, and myths of menstrual and incontinence management, consulting with woman and individuals on the design and management of any required facilities and providing sufficient materials and other required items. Key indicators are the percentage of woman and individuals who are being provided access to required materials, who are satisfied with the management, materials, and facilities. Guidance is specifically targeting the goal of allowing people to live in dignity, understanding taboos, preferences for supplies and facilities, and also the minimum requirement of materials.
Water supply	2.1 Access and water quantity	Inadequate water supply is the most critical component for public health in an emergency situation, largely due to the damage the infrastructure that can happen. The key actions for standard 2.1 include identifying the most suitable water source, determining the requirement of water and how it will be delivered, and ensure wastewater is removed safely and effectively. The key indicators include the average volumes of water for drinking and domestic use, the number of people using water infrastructure, the percentage of people who can access clean water, as well as distance and wait times for these water resources. Due to this being an important component of WASH, guidance notes are extensive and

WASH component	Standard	Description
		note minimum requirements for survival, distance and queuing times, payment, maintenance of water infrastructure, and management of wastewater among others.
	2.2 Water quality	While access to an adequate quantity water is important, drinking water requires a minimum standard of quality to ensure there are no health risks when drinking or cleaning. The key actions to ensure sufficient water quality include identifying public health risks from the available water, determine the required treatment options at the point of water collection, and minimising the water contamination post-collection. The key indicators include percentage of people collecting water from protected water sources, households observed to store water safely, and the percentage of water quality testing meeting minimum standards. The minimum standards include: • <10 CFU/100 mL at point of water collection • 0.2-0.5 mg/L free chlorine at point of delivery • Turbidity <5 NTU The guidance notes contain extensive instructions for maintaining a safe water chain and water quality, water disinfection, post-delivery contamination, household treatment and storage and noting several types of contamination (chemical, microbial, radiological).
Excreta management	3.1 Environment free from human excreta	Human excreta is a major source of contamination in natural and human-made environments. It's critical that excreta is correctly contained to avoid this. To achieve this, key actions include establishing or rehabilitating facilities to immediately contain human excreta, decontaminate all areas and water sources where there has been contamination from faeces, design and build all waste management facilities by considering water sources and minimising exposure to excreta, and dispose of babies' and children's faeces safely.
	3.2 Access to and use of toilets	Ensuring adequate and secure access to toilet facilities complements Standard 3.1. To do so, determine the most appropriate toilet option for the context, quantify the affected populations toilet requirements, consult representative stakeholders about the design of the toilet (accommodating all), provide adequate hygiene facilities, including menstrual hygiene and incontinence materials, and lastly ensuring the water supply is sufficient to meet the toilet options chosen. Key indicators include the ratio of toilets to people, the distance from the toilet, and how safe and satisfied woman and girls feel with the toilets and menstrual hygiene management. Notes on typical toilet management are available and include accessibility, adequate toilet paper and menstrual hygiene, handwashing, maintenance of toilets, and minimum requirements for toilets to people. Typically, with a maximum distance of 50 metres this would be: • 1 toilet per 50 people immediately. • 1 toilet per 20 people medium term. • 1 toilet per 250 people that allow enhanced accessibility for disabled individuals
	3.3 Management and maintenance of excreta collection, transport, disposal and treatment	Managing facilities will ensure surrounding environment and individuals and minimally impacts and the risk of sickness from toilets is reduced as much as possible. The key actions to do so include establishing the collection, transport, treatment, and disposal,

WASH component	Standard	Description
		typically done with local waste management authorities. Defining systems for short- and long-term management of toilet facilities, desludging facilities safely, ensure individuals maintaining facilities are sufficiently equipped with the required resources to do so, and ensure required water is met without putting stress on water sources. The primary indicator is ensuring all human waste collected is safely disposed of to prevent contamination of the environment and exposure to the public.
Vector control	4.1 Vector control at settlement level	In standard 4.1 the main vectors described are mosquitoes and state it is important to understand life-cycles and identifying breeding sites. To minimise vectors of this nature, the action items describe assessing the vector-borne risk of the area, align humanitarian vector control actions with local vector control plants, and determine whether it is appropriate to use chemical or non-chemical controls based on the vectors being dealt with. Guidance notes describe carrying out human and waste management correctly, establishing settlements outside of vector areas, and removing vector sites that are created from WASH activities. Note: *While still important to consider, New Zealand currently has limited vectors similar to mosquitoes that are of serious consequence to human health, though care should still be taken.*
	4.2 Household and personal actions to control vectors	While planning at the settlement level is important for populations, responsibility is still in the hands of the individuals to ensure hygiene practices are carried out diligently. The key actions to maintain adequate control of vectors includes assessing how vectors are avoided and deterred at the household level, using campaigns that are accessible to educate people about local vectors, understanding what local preventative measures are able to be used, and training community members how to monitor and report disease vectors. You can ensure people are made aware and are able to highlight vectors and their controls by using the following indicators: Percentage of people in affected areas that can describe transmission pathways end vector controls at the domestic level, percentage of people who have proactively taken steps to protect themselves from vectors, and percentage of households with protection of stored food.
Solid waste management	5.1 Environment free from solid waste	Solid waste can be a source of environmental pollution, requiring it to be safely contained. The key actions to do so are designing the solid waste disposal program with the local context in mind (e.g., What facilities are possible to use), working with groups who are typically involved in waste management, organising solid waste clean-up where necessary using campaigns, provide adequate PPE to individuals at risk of illness who deal with solid waste, ensuring infrastructure is properly operating and maintained, and minimising the solid waste where possible. The key indicator is to ensure no solid waste is accumulating in areas where it is out of place (e.g., Neighbourhoods, roads). Guidance notes state it is critical for people to correctly dispose of solid waste, ensuring sufficient facilities exist to properly dispose of the waste, protecting front-line workers involved in solid waste work, and reuse, re-purpose, and recycle solid waste where possible.

WASH component	Standard	Description
	5.2 Household and personal actions to safely manage solid waste	Controlling solid waste at the community level starts by ensuring household solid waste management is done correctly. It is also possible to collect and treat solid waste at the household level, which will reduce the stress of the community solid waste management. The key actions to do so include providing households with solid waste storage that can be adequately contained, provide obvious collection points for solid waste pickup that are regularly cleared, organising consistent removal of household waste at collection points, and ensuring and burial or burning of waste is done safely. The key indicators for household solid waste management include the percentage of households with acceptable access to a designated neighbourhood solid waste collection point, and the percentage of households reporting their waste storage,
	5.3 Solid waste management systems at community level	Ensuring public collection points are maintained and are not overflowing and treatment and disposal is safe. While a separate standard, it is similar to **Standard 5.1**, however attention is given to ensuring institutions and organisations have clearly marked on-site storage for waste generation. The key indicator is the percentage of institutions that have adequate and safe waste storage.
WASH disease outbreaks and healthcare settings	6 WASH in healthcare settings	All healthcare settings should maintain minimum WASH infection prevention during disease outbreaks. During disease outbreaks, it is also important to keep up-to-date with technical information as emerging diseases behave differently and so will require different preventative measures. For more extensive information on healthcare and disease outbreaks, refer to **"communicable diseases Standards 2.1.1 to 2.1.4."** Key actions to maintain WASH infection prevention and controls for disease outbreaks include providing a reliable water supply of adequate quality and quantity, sufficient excreta disposal facilities, enough materials and equipment (including PPE) for everyone in the healthcare setting (staff, patients, and visitors), maintaining a clean environment, handling waste correctly, and managing and burying the dead in an appropriate and dignifying way. To do this, regular handwashing is perhaps the primary pathway to manage. The following indicators to maintain cleanliness and hygiene include: • 1 handwashing station per 10 inpatients • 0.1-1 mg/L of free chlorine in drinking water • A minimum of 5 litres per outpatient per day • A minimum of 60 litres per cholera patient per day • A minimum of 300-400 litres per viral haemorrhagic fever patient per day Also included is the number of accessible toilets, which is: • A minimum of four toilets in outpatient facilities which separate men, woman, children, and workers. • A minimum of 1 toilet for 20 inpatients which separate men, woman, children, and workers.

APPENDIX B:

Summary of technical notes of WASH in emergencies (World Health Organization, 2013b).

Technical note	Description	Mention of chemical requirements/notes
1. Cleaning and disinfecting wells	Describes the steps required to temporarily repair and rehabilitate hand-dug wells to pre-emergency condition. This is described in four steps: (1) catalogue existing wells that are likely useful, (2) rehabilitation and well cleaning, (3) disinfection of the well, referring to chlorine as the primary method to disinfect water, although mentions it is not completely effective against some pathogens. (4) Dewatering the well, where chlorine should be < 0.5 mg/L.	pH (6-8) and turbidity (<5 NTU) are used as physico-chemical determinants of well cleanliness. These are taken directly from WHO drinking water quality guidelines. Mentions the typical chlorine compound High Strength Calcium Hypochlorite (HSCH). In several sections, it is mentioned that the water may still not be completely clean.
2. Cleaning and disinfecting boreholes	Describes the difficulty in repairing boreholes and therefore focuses on drilled boreholes rather than driven boreholes. It is also noted that additional care is needed when dealing with boreholes that are close to the coast or near swamps due to saline intrusion. (1) Damage needs to be assessed on a case-by-case situation. (2) Repairs and flushing of the borehole through jetting should take place. (3) Disinfection and recommissioning of the bore using HSCH.	**Technical note 2** has also stated that there are pathogens which will not be removed from chlorination. It is also stated that residual protection from handling and storage should not be assumed and proper storage and handling is detailed in **technical note 5.**
3. Cleaning and disinfecting water storage tanks and tankers	Tanks should be chosen based on: normal use, ease of cleaning, and water storage hygiene. (1) Tanks should be selected based on previous use, which should only have ever used for food-grade material. All other tanks should not be used. (2) Emptying the tank and draining the remaining liquids, (3) disinfection of water tank (where HSCH is recommended), and (4) safely disposing of any liquid waste taken from the tank or used for cleaning.	Large quantities of water are necessary to ensure tank are clean to a drinking water standard
4. Rehabilitating small-scale piped water distribution systems	The networks connected to water distribution can have a large variability of damage, which may require repair before the system can be used again. This involved (1) assessing the damage, (2) keeping the public connected to the system informed on what is happening, (3) provide another means of water while repairs take place, (4) isolating the damaged sections of the network to reduce wasted water, (5) repairing network damage, starting with major damage first, and (6) test and disinfect the sections of the network that are damaged.	Technical details around required flows and velocities based on pipe diameter are available in the note. Calculating the required HSCH for disinfection of the network can also be found in the Technical note.
5. Emergency treatment of drinking-water at the point of use	Describes point-of use water treatment for drinking water. The document describes aeration, storage and settlement to allow suspended solids to be removed, a number of options for filtration, and disinfection through boiling, chemical or physical means. During an emergency, a pathway for illness is through handling of water, therefore proper handwashing is imperative to prevent contamination once water is considered safe to drink.	A number of figures and illustrations, including how to effectively wash hands, is present in **Technical note 5**. Only water that is used for drinking needs to be treated, although it is stated this is **approximately five litres per day.**
6. Rehabilitating water treatment works after an emergency	In urban areas, populations are typically reliant on a reticulated system. Rehabilitation of water treatment maximises the quantity of drinking water that can	Technical note its informative, however this would require extensive expertise and resources to

Technical note	Description	Mention of chemical requirements/notes
	be supplied to the public. The technical document underlines the assessment of the water treatment system, followed by a brief description of water treatment systems and processes.	undertake. This is not typically completed acutely unless expertise and resources are available.
7. Solid waste management in emergencies	Solid waste management is critical to ensure public health. This technical note defines solid waste, the objective of managing solid waste as well as health risks stemming from inadequate solid waste management, assessment of waste types and quantities, and protection required to ensure the public involved in the cleanup is protected.	Approximate volumes of waste are estimated to containers. Such as 100L containers being able to serve 200 people in the short-term, while long-term this will only serve 50 people.
8. Disposal of dead bodies in emergency conditions	Dead bodies are not so much a health-related risk as they are psychologically impactful. Unless death is related to communicable disease, priority should be given to finding and caring for living. The document discusses protecting the workforce, body recovery and temporary storage, and identification. While dead bodies in of themselves are not cause for concern, if death is related to communicable disease (which is rare), care should be taken when handling bodies. Preventative measures to reduce the risk of illness based on the disease types from dead bodies have been detailed.	The technical note states that bodies should be buried 1.5-3 metres deep in marked graves with consideration of local and cultural context. Minimum distances to water sources and the number of bodies contained in graves are also recommended, with consideration of the groundwater table.
9. How much water is needed in emergencies	Describes the factors affecting water requirements and the requirements themselves with specific reference to the Sphere Standards. Volume requirements from drinking to recreation and associated timelines for solutions are detailed. Guidelines for minimum emergency water quantities that are non-domestic use are outlined.	Most major relief agencies and their donors have accepted the Sphere Standards as the foundation for acceptable relief services. Details such as minimum vessels per household are outlined.
10. Hygiene promotion in emergencies	Details the principles of hygiene promotion and reason for preventing the spread of diseases and how to create barriers to prevent transmission of disease through self-hygiene. Included is how to properly wash hand. Included is how to create a promotion campaign for hygiene	Mentions that Sphere suggests one hygiene promotion facility per 1000 affected people as a minimum.
11. Measuring chlorine levels in water supplies	Technical note states what and why disinfection is important as well as why chlorine is important, which is the go-to disinfectant for these technical notes. Lists advantages and disadvantages of using chlorine as well as what concentration residual chlorine should be in domestic water (0.2-0.5 mg/L).	Measuring chlorine requires special equipment (comparator).
12. Delivering safe water by tanker	Highlights important logistical factors of transporting water such as fuel, drivers, and maintenance. Highlights cleaning and chlorination as necessary barriers to prevent illness as notes in technical note 3	States that chlorine should not drop below 0.2 mg/l and notes tinkering requirement capacity and times should be considered to ensure sufficient water is given to affected people,
13. Planning for excreta disposal in emergencies	Provides the process for excreta disposal over a timeframe of 1-2 days to months/years. The technical note states there is an immediate emergency phase were mortality and sickness may be high due to higher exposure to disease, while in the stabilisation phase death rates tend to fall as proper interventions can be implemented. Sphere standards are specifically mentioned. An example of a detailed plan and actions involved are presented.	Indicators for minimum service levels for excreta disposal in an immediate emergency and in a stabilisation phase.
14. Technical options for excreta disposal in emergencies	The technical note states the immediate tasks that need to be completed with respect to excreta disposal in emergencies. Outlines different methods for excreta disposal in emergencies, stating options presented are only temporary solutions.	Specifies depths and widths for each excreta disposal option.

Technical note	Description	Mention of chemical requirements/notes
15. Cleaning wells after seawater flooding	Provides technical advice and steps on how to rehabilitate wells after seawater contamination. While the technical note advises to use high-strength Calcium hypochlorite, it states it is not effective against all pathogens. It may be better to use alternative sources of drinking water.	Provides calculations for estimating the volume of water in a well to ensure it is sufficiently pumped.

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