# PREPARING TO FACE THE JUGGERNAUTS OF CLIMATE AND DEMOGRAPHIC CHANGE

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## ABSTRACT

Water suppliers in New Zealand need to consider the consequences of the effects of climate and demographic change. The first of these drivers is expected to cause water availability problems and the second an increased demand for water. Both effects contribute to the possibility of water shortage and adverse health effects because of water suppliers being unable to provide an adequate supply of water to their communities. This study looked at 20 water safety plans (WSPs) to understand how the risk of water shortage is being addressed by this type of plan. To make this assessment, four situations leading to water shortage were identified: emergency, short-term (drought), existing routine demand and future demand. The study concluded that WSPs are appropriate tools for managing risk resulting from the first three of these situations, but that external documents, eg long term plans, appear to be used for managing the last situation. Almost all supplies had implemented measures for managing short-term water shortage (drought), while only about one third had robust measures in place to manage increasing routine water demand. Three quarters of the supplies had less-robust measures in place that will still help manage the risk of routine of water shortage.

## KEYWORDS

**Water shortage, climate change, demographic change, drought, water safety plan**

# 1 INTRODUCTION

One of the primary requirements for the protection of public health within a community is an adequate supply of safe drinking-water, that is, the supply must provide enough water of satisfactory quality. The *Drinking-water Standards for New Zealand 2005 (Revised 2008)* (the Standards) sets out the requirements for a safe and palatable water (termed wholesome). The Standards focuses on the quality of drinking-water rather than ensuring that a supply is always capable of providing sufficient water to meet demand. It is the drinking water section within the Health Act 1956 (the Act) that requires water suppliers to provide an adequate supply of water (s 69S), and the preparation and implementation of water safety plans (required by s 69Z) is one of the tools by which the goal of avoiding water shortage is achieved.

This paper reports the findings of a study undertaken by ESR for the Ministry of Health to assess the likely ability of water suppliers to meet increased water demand or manage decreased water availability, based on the content of water safety plans (WSPs).

# 2 BACKGROUND

## *2.1 THE JUGGERNAUTS*

Demographic changes, which include population increase and changes to population structure, particularly population aging, are occurring in New Zealand as elsewhere. The country's population is expected to increase to five million by the mid-2020s (StatsNZ 2012a), although this increase will not be uniform across the country. The Statistics New Zealand medium-term projections for 2011 and 2021 (StatsNZ 2012a) estimate (taking the medium-term projections at face value) that of the 67 territorial authority areas, approximately 48 can expect increases in their populations, approximately 16 can expect declines in their populations, and the populations of three are expected to change little.

All territorial authority areas will experience population aging. While increases in population size will result in water suppliers having to produce more water, overseas studies record different findings about the way age influences water consumption (eg, Hummel and Lux 2007, Schleich and Hillenbrand 2009). The fraction of territorial authority area populations aged 65 years and over will increase from approximately 13 percent of the total population in 2011 to 17 percent of the total population in 2021 (StatsNZ 2012a). Moreover, this age bracket itself will age as the number of people over 85 years of age increases. By 2061, one in four people over the age of 65 years will be over 85 years of age, compared with one in eight people in 2012 (StatsNZ 2012b).

The extent of the aging depends on the city or district. The projected increase in the fraction of the population that is over 65 years of age in a territorial authority area ranges from approximately 2.6 percentage points to 7.9 percentage points (StatsNZ 2012a). These changes are not a consequence of the 'baby boomer' group moving through the population structure, but are caused by the transition to lower birth rates and lower death rates (StatsNZ 2012b).

Changes in household size (persons per household) are also occurring. Trends in population size and the number of people in a household will determine the number of households in the country. The average household size in New Zealand is projected (medium-term projection) to fall from 2.6 persons in 2011 to 2.5 persons by 2021 (StatsNZ 2010b). Looking at the individual territorial authority areas shows that in 2011 (projected from the 2006 census data) household sizes ranged from 2.2 to 3.3 persons, and in 2021 the projected household sizes will range from 2.0 to 3.2 persons.

The number of single-person households is projected to increase by an average of 2 percent per year between 2006 and 2031 due to the increasing number of older people (StatsNZ 2011). Three quarters of the growth in this type of household is due to the increases in the number of people of 60 years of age and older. In 2006, 49 percent of people in single-person households were aged 60 years and older. By 2031, this percentage will have increased to 61 percent.

Superimposed on the water demand arising from demographic change, and water-dependent economic development activities, will be periods of increased demand arising from the effects of climate change. Climate projections indicate that parts of New Zealand are likely to experience less rain during some seasons and that droughts will be become more frequent and/or severe (MfE 2008). Consequently, in some parts of the country water suppliers are likely to experience periods when the availability of source water decreases. During these dry periods, the need for irrigation water (domestic and agricultural) increases, further adding to water demand. Water shortage results when a community's demand for water outstrips the ability of its water supply to provide enough water to meet that demand. It is clear from the above that in the coming decades, some water suppliers are going to be squeezed by the two factors that will lead to water shortage: at times, a reduced availability of water, and an increasing demand for it.

## *2.2 THE CONTENT OF WATER SAFTEY PLANS*

In the early years of this century, the Ministry of Health identified the importance of shifting water supply management from reliance on monitoring to the use of risk management techniques. Consequently, although the legislative requirement for the use of water safety plans was not introduced into the Act until 2007 by the Health (Drinking Water) Amendment Act 2007, initiatives to encourage this transition started in 2001.

In that year, the Ministry of Health published tools to assist water suppliers in preparing water safety plans[1]. The Ministry's publications suggested that a plan needed to include a table identifying possible risks and how those risks would be managed, as well as contingency plans and an improvement schedule. The improvement schedule was to identify what needed to be done to address risks not already addressed. It also needed to include the relative importance of each improvement, the timetable for implementing the improvements and who had responsibility for making them.

The Ministry's publications were guidelines only. The Act now specifies what components of a water safety plan are legal requirements (s 69Z(2)(a)). These requirements include the need to identify public health risks associated with water supplies, the mechanisms by which these risks are to be managed and a timetable for managing the identified risks. Although not explicitly identified in the Act, these mechanisms should include **preventive measures**, **corrective actions** and **contingency plans**, as they are termed in the Ministry of

[1] Termed 'public health risk management plans' at that time

Health's framework. Although the terminology varies between water safety plans, they contain components that can be considered equivalent to these three components in the Ministry's framework.

# 3 APPROACH

## *3.1 SELECTION OF SUPPLIES FOR THE STUDY AND PROCUREMENT OF WATER SAFETY PLANS*

The study was restricted to a survey of water safety plans from 20 territorial authority water supplies. Public health units were contacted by email, outlining the study, providing the criteria for water supply inclusion, and seeking an appropriate contact for four supplies in their district to approach for a copy of their plan. The inclusion criteria for the study were that the plan was to have been approved, and that the water supply had experienced water shortage problems in the past, or that its water demand was increasing, or expected to increase. The project brief required the inclusion of the water safety plans for the Wellington and Auckland city water supplies.

Requests for a copy of their water safety plan were made to water suppliers once contact information was received from the public health units. All suppliers contacted were prepared to help.

Plans, or partial plans, were obtained. Basic information about the anonymised supplies is presented in Table 1.

A full water safety plan was not obtained from Supply S. The water supplier provided those sections of the risk table that they considered apply to the study. The supplier noted that other documents were also used in the management of water shortage and that these might be more useful.

Only the water safety plan for the reticulation of Supply T was obtained, although some risk management information concerning the source and treatment was included in this plan.

The incomplete nature of the water safety plans from Supplies S and T may have resulted in a distorted view of their management of water shortage, particularly for Supply S.

*Table 1 Outline of the character of the water supplies contributing to this study*

| Supply Identifier | Supply Size Category[1] | Type of source |
|---|---|---|
| A | Large | River, bores |
| B | Large | Rivers, dams |
| C | Large | Rivers (direct abstraction and infiltration gallery) |
| D | Minor | River |
| E | Minor | Bores |
| F | Minor | Rivers |
| G | Medium | River (infiltration gallery) |
| H | Large | Lake, river |
| I | Minor | Bores (infiltration gallery) |
| J | Large | Bores |
| K | Large | River |
| L | Large | River, stream, dam, springs |
| M | Small | Bores |
| N | Large | River |
| O | Large | Lake |
| P | Large | Stream |
| Q | Neighbourhood | Lake |
| R | Large | River |
| S | Large | Lakes, river, bores |
| T | Large | River/lake |

[1] As defined the legislation

## 3.2 REVIEW OF THE WATER SAFETY PLANS

The risk table, contingency plans and improvement schedule of each of the water safety plans received were scanned for items relevant to the management of water shortage.

This paper's findings and discussion focus on water shortage resulting from problems of water availability and demand. Water safety plans did identify other reasons for water shortage, such as the breakdown of pumps. Information associated with these causes was not within the scope of the study.

## 3.3 LIMITATIONS

There are three factors limiting the extent to which the conclusions that can be drawn from the water safety plans included in this study.

a. Sample size

The *Annual Report on Drinking-water Quality 2013–2014* (MoH 2015) states that by the 2013–2014 year, a total of 425 zones had approved water safety plans. The 20 water safety plans reviewed in this study constitute a small percentage of the total. While comment can be made on how well the surveyed

water safety plans are managing water shortage, how representative the finding will be for the remaining water safety plans is unknown.

b. Selection bias

Supplies known to be challenged by drought or increasing demand because of population growth were targeted for selection in the study. As these supplies are possibly more aware of needing to manage water shortage, their water safety plans may not be representative of how well other water safety plans from supplies throughout the country are managing water shortage.

c. Auxiliary documents.

The project brief for this study intentionally restricted the documents for consideration to water safety plans. Many water safety plans refer to other documents that may contain information key to accurately understanding how adequately the risk of water shortage is being managed. The level of detail in most of the surveyed water safety plans allows measures that in principle should contribute to managing water shortage to be identified. However, greater implementation detail is needed to be able to determine the adequacy of risk management. For example, the statement "Manage demand" indicates that intention is correct, but provides no information about what the measure entails. Drinking-water assessors, when they undertake their implementation assessment of water safety plans, will be better placed to assess the adequacy of the planning detail.

# 4 FINDINGS AND DISCUSSION

## *4.1 RISK SITUATIONS BEING MANAGED*

To help in the task of assessing how well water shortage is managed by water safety plans the situations that have to be managed were categorized. The risk of water shortage was considered to arise in four situations, as shown in Table 2.

*Table 2 Situations in which water shortage may arise and has to be managed*

| Situation being managed | Duration | Description of what is being managed |
|---|---|---|
| Emergency | Very short term | Emergency situations, such as an abstraction pump malfunction, in which water shortage (or even absence) may last hours or a few days at most. Other emergency situations, eg, floods or earthquake, may create water shortage of longer duration. The measures for managing drought could also be used in these situations. |
| Drought | Short term | Periods during which availability of source water may drop for weeks or months. |
| Existing routine demand | On-going | The continuing need to balance routine water demand (including fluctuations) and water availability at present and in the near future. |
| Projected future demand | On-going | The demand for water in the more distant future. |

For the complete management of the risk of water shortage, all of these situations have to be managed, including the future demand. The measures necessary for managing the risk will depend on the situation.

Drought duration is classified as short term, but both the frequency and duration of drought in the future may increase. Under these circumstances, the measures presently used to manage the routine situation, may also become appropriate for managing drought. For example, water restrictions being applied on a regular basis for extended periods may become unpalatable or ineffective, and the development of a new source to provide the capacity needed during drought would be a more suitable measure.

## *4.2 WATER SHORTAGE MANAGEMENT INFORMATION FROM WATER SAFETY PLANS*

### 4.2.1 GENERIC MEASURES TO MANAGE WATER SHORTAGE

From the preventive measures, corrective actions, contingency plans and improvement schedules of water safety plans it is possible to identify the steps the water supplier has taken, or is planning to take, to avoid water shortage. These fall into two categories: measures addressing water availability and those addressing water demand. Within each of these two categories, the measures recorded in water safety plans can be assigned to generic groups. The measures recorded in the 20 water safety plans surveyed in the study are listed in Table 3. Measures not contained in Table 3 could also be helpful in managing water shortage. The US Army Corps of Engineers (USACE 1994) have provided another view of possible management measures for drought.

A water safety plan does not require all of the measures given in Table 3 to manage water shortage. However, a measure, or measures, appropriate to the water supply in question will generally be needed in each of the two primary categories (water availability and water demand) to adequately manage water shortage.

Management of the existing risk of water shortage requires the first three situations identified in Table 2 to be adequately managed. Assessing how well this is done, requires the measures identified in Table 3 to be matched with the situations in Table 2. The letters in brackets in Table 3 show which of the situations in Table 2 the measure in Table 3 addresses.

Figure 1 integrates information in Table 2 and Table 3 to show the timescales over which different measures are applicable[2]. It also shows the timescales over which contingency plans and improvement schedules operate, and the duration of the effect (qualitative) and the rate of onset of the effect (qualitative).

[2] This is not the rate at which the measures can be implemented. It is the duration of the event they are best suited to manage. For example, increasing the amount of post treatment storage available may take months, but when completed this additional storage is still only going to be capable of managing water shortage arising from short duration events.

*Table 3 Categorised measures for managing water shortage*

*The letters in brackets denote which of the situations identified in Table 2 the measure generally manages: (E)mergency; (S)hort-term; (R)outine on-going.*

***Water availability***

**Increase the amount of water available**

- Develop new sources (R)
  - Replace the existing source
  - Augment the existing source
- Develop supplementary sources (to be brought online when the need arises) (S)
- Increase pre-treatment storage (R)
- Require on-site storage for (rural) properties (R)
- Provide tankered water (E, S)
- Increase treated storage (E)

**Increase the volume of water that may be abstracted**

- Address issues relating to consents/regulations (R)
  - Liaise with the consent authority
  - Work with the consenting authority in water resource planning
  - Ensure there is input to the consenting process
  - Restrict takes by other users

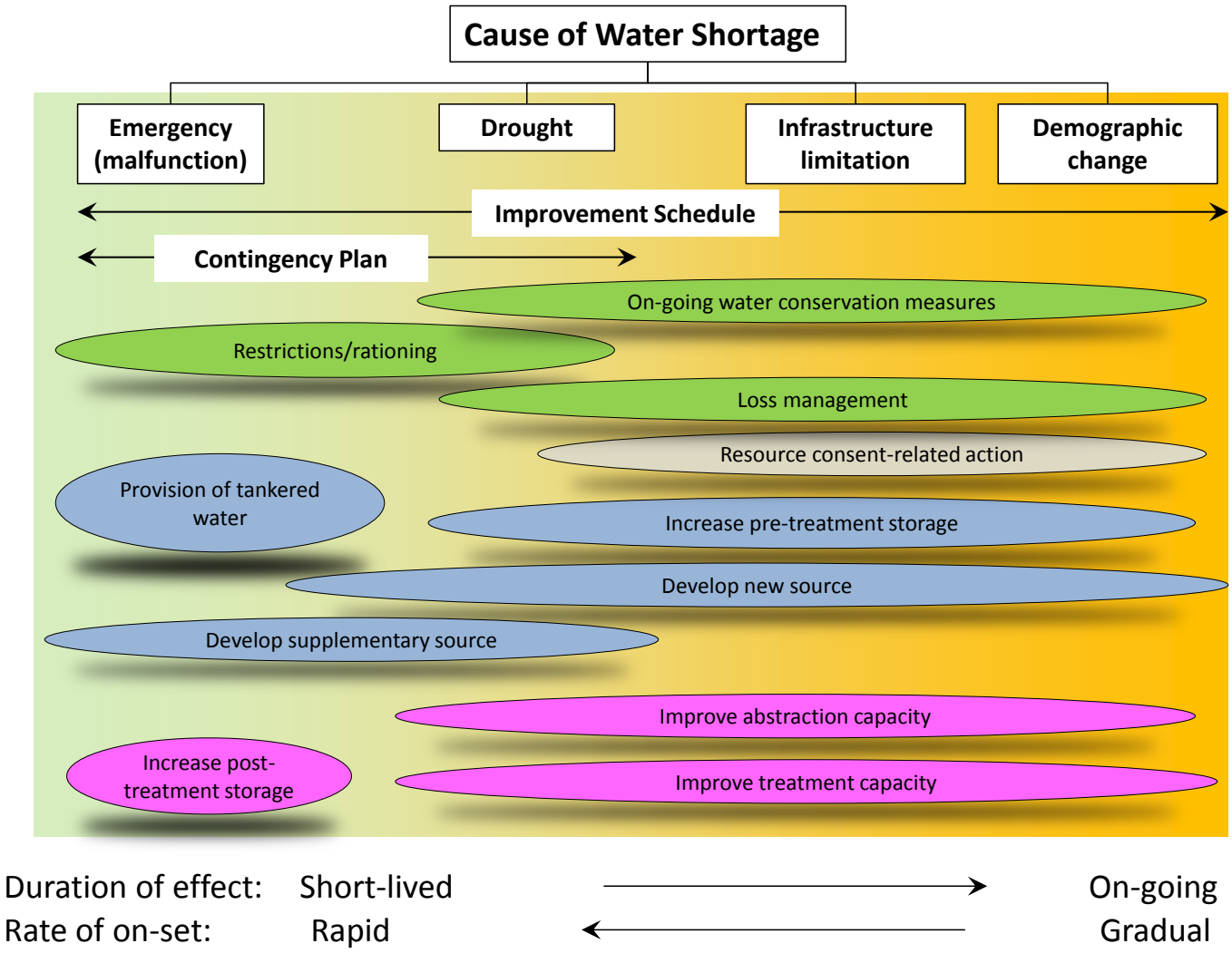
**Overcome infrastructure limitations**

- Improve ability to abstract water (R)
  - Increase number of takes from source
  - Design abstraction to allow for drops in water level in source (surface and groundwater)
- Increase treatment capacity (R)

***Water demand***

- Develop water demand management plans (R)
  - Obtain projections of future demand
  - Model system capacity
- Encourage water conservation (S, R)
  - Develop education programmes
- Ration or restrict water use (S)
  - Make by-laws or regulation to permit control of water use
- Draw up agreements with large industrial users to reduce demand or close down when water shortages become a concern (S)
- Investigate, detect and repair leakage from the network (R)

*Figure 1 Depiction of how management measures relate to the timeframes of the causes of water shortage*

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# 5 ASSESSMENT OF WATER SHORTAGE MANAGEMENT BY WATER SAFETY PLANS

## *5.1 SHOULD WATER SAFETY PLANS MANAGE ALL WATER SHORTAGE SITUATIONS?*

The purpose of water safety plans is to manage the public health risks that may be associated with a community's water supply. As water shortage presents a potential hazard to public health, it follows that such an event, its possible causes, the measures that can reduce the likelihood of the event and responses if an event occurs should be identified in the water safety plan.

What is not so clear is the timeframe over which a water safety plan should aim to manage risks. Water safety plans certainly have to manage existing risks. However, there is no statement in the Ministry of Health's guidance documentation specifying how far into the future water safety plans should look. This appears to be at the discretion of the water supplier[3] and raises the question: which situations that can cause water shortage, should water safety plans be aiming to manage?

[3] Clause 34 of the Local Government Act 2002 Amendment Bill (No.3) requires long-term plans to contain an infrastructure strategy over at least 30 consecutive financial years.

Risk tables and contingency plans include preventive measures to manage risks that exist currently, or can be expected to arise in the near future. These measures may aim to manage short-term water shortage and the routine on-going risk associated with population increase. More distant risks which are difficult to characterize because of the uncertainty associated with the effects of climate change, and in some cases , uncertainty in population growth, are not managed by risk tables and contingency plans. The improvements schedule might be regarded as the water safety plan component that is the most likely to consider future risks. Improvement schedules may include measures to address present risks that are not being adequately managed, but they also provide the opportunity to plan for risks arising further into the future.

Examination of the water safety plans surveyed in this study shows that this second role that might be played by improvement schedules is limited. The timeframe for implementation of near-future measures identified in improvement schedules is, generally, two to four years from the date of plan approval. In one instance the implementation period given is10 years. Improvement schedules also include on-going measures, such as the continuing need to apply for resource consents, without limiting the period over which this is done.

The relatively limited timeframe of improvement schedules is understandable. Water suppliers are likely to be reluctant to seek major investment to address future risk of water shortage when there is uncertainty in the magnitude of this risk. For large supplies, for which water demand is almost certain to increase, planning for measures to manage increased demand may be underway. For rural centres in which trends in demand are unclear, there may be insufficient certainty to invest in capital works, and focus is still on the use of measures to manage short-term risk. These are easily and cheaply implemented. Water safety plans have to be reviewed every five years, at least, and this too may have a bearing on the time-horizons of the plans.

There is a difference between the date of implementation of measures identified in the improvement schedule and the timeframe over which their benefits may accrue. The development of a new source in the next year or so, for example, may ensure that the demand for water can be met over several decades. There is only one water safety plan seen in the study that indicates how far into the future the benefits of measures to address water shortage are expected to reach. This water safety plan states that the development of a new source is expected to avoid the need for water restrictions for the next 50 years.

The limited timeframe of improvements schedules may also arise simply because they are not considered the appropriate mechanism for this planning. From the water safety plans reviewed, it seems that other planning documents with more distant time-horizons, such as water asset management plans and territorial authority long term plans address the more distant risks of water shortage.

## *5.2 WHAT SHOULD BE CONSIDED IN ASSESSING MANAGEMENT OF WATER SHORTAGE?*

The situations of interest here are drought and existing on-going demand. Water shortage due to emergencies is outside the interest of this study, and the more-distant situations arising from demographic and climatic changes, are managed by other planning documents.

Any of the measures in Table 3 will contribute to reducing the likelihood of short-term water shortage (arising from drought). Provided the frequency and duration of droughts do not increase, the use of short-term measures to manage demand during droughts may be adequate. However, frequently recurring droughts are likely to require a water supplier to develop new sources to ensure there is enough water to meet demand.

It is helpful at this point to distinguish two types of measure that can contribute to managing on-going routine demand. The first are what this report terms **limited measures**. These include loss management, and on-going water conservation measures (not including water restrictions). They have an on-going beneficial effect by reducing the demand for water. Although their ability to match increasing demand will be limited, they are valuable first steps to take because they will still achieve a reduction in the demand, and allow time to budget for more expensive measures.

The second type of measure is termed **robust measure**, here**.** These provide benefit beyond the lifetime of the limited measures. The development of a new source is the most important member of this group. It will increase the volume of water available to a supply. The period for which this increase will be adequate will

depend on the rate of increase in demand, and the increase in the daily volume that can be abstracted from the source.

There are other measures that could be considered robust because of their continuing effect. Actions to ensure resource consents allow adequate abstraction of water are an example. In some respects they go hand-in-hand with the development of a new source. A new source is of limited value if a consent to draw adequate volumes of water is not also obtained.

Pre-treatment storage, on a large enough scale, could also be considered a robust measure. Its degree of robustness will depend on circumstances. A pre-treatment reservoir provides a means of smoothing out fluctuations in water availability, but may be limited in its ability to meet a continually growing demand for water.

Water safety plans do not necessarily require all of the generic actions recorded in Table 3 to ensure that water shortage is being adequately managed. For some supplies, factors that have been considered important in influencing the supply of, or demand for, water do not apply. There are some water supplies for which there is no evidence of increasing long-term demand, and in fact, a decrease in the number of households needing to be supplied may be more likely (Nokes 2013). Also, the present study finds that there are some supplies for which the capacity of the source to provide water is practically "unlimited" (large lake with snow-fed inputs). For supplies in this situation, water shortage arising from meteorological or demographic factors need not be a concern, although restricted capacity to treat or deliver water may lead to water shortage.

## *5.3 IS WATER SHORTAGE BEING ADEQUATELY MANAGED?*

This section determines what can be concluded about the adequacy of water shortage management by water safety plans. Given the limitations noted Section 3.3, the approach to assessing the adequacy of water shortage management by water safety plans is to identify what generic measures could be expected to manage the risk and then determine whether the water safety plans contain these measures.

The following discussion is split into two sections discussing short-term risk and on-going routine risk of water shortage. Both sections discuss the contents of Table 4.

Table 4 table broadly categorises the water shortage risk management measures recorded by water safety plans with respect to which type of water shortage the measures aim to manage: short term or on-going routine demand. Within the routine demand classification, distinction is made between limited and robust measures (see Section 5.2). Whether a measure is presently implemented (P) or planned for future implementation (F) is denoted in the table.

*Table 4 Categorisiation of measures to manage short-term and on-going routine water shortage,*

P = presently implemented; F = future implementation noted

| Supply | Management of short term shortage (drought) | Management of routine on-going shortage (increased demand and/or high frequency drought) | | Likelihood and risk of drought assigned in water safety plans | |
|---|---|---|---|---|---|
| | | Limited measures | Robust measures | Likelihood | Risk |
| A | P | F | – | ★★★★★ | ★★★★★ |
| B | P | P | P | ★★★★★ | ★★★★★ |
| C | P | – | P | | |
| D | P | P | F | ★★★★★ | ★★★★★ |
| E | P | P | – | ★★★★★ | ★★★★★ |
| F | P | P | P, F | ★★★★★ | ★★★★ |
| G | P, F | – | F | ★★★★★ | ★★★★ |
| H[1] | P, F | P | – | ★★★★★ | ★★★★★ |
| I | P | P, F | F | ★★★★★ | ★★★★★ |
| J | P, F | P | F | ★★★★★ | ★★★★★ |
| K | P, F | P, F | – | ★★★★★ | ★★★★★ |
| L | P | F | P, F | ★★★★★ | ★★★★ |
| M | F | P, F | P, F | ★★★★★ | ★★★★★ |
| N | P | P | F | ★★★★★ | ★★★★ |
| O | P | F | P | ★★★★★ | ★★★★★ |
| P | P | P, F | F | ★★★★★ | ★★★★★ |
| Q | P, F | P | – | ★★★★★ | ★★★★★ |
| R | P, F | P, F | F | | ★★★½★[2] |
| S | P | P | – | ★★★★★ | ★★★★★ |
| T | P, F | P | P, F | ★★★★★ | ★★★★★ |

[1] The likelihood and risk in this case take account of the effects of existing preventive measures

[2] 3.5 stars

### 5.3.1 SHORT-TERM RISK OF WATER SHORTAGE

Table 4 shows that the majority of the 20 supplies score the likelihood of drought at the mid-level of their scale, or lower. Similarly, there are only three plans in which the risk arising from drought is at a level more than the mid-level of the scale.

Despite the relatively low likelihood assigned to drought, Table 4 shows that of the 20 water safety plans reviewed, 19 presently have measures in place to manage short-term threats of water shortage through drought. The one remaining plan records future measures intended to manage this risk.

A possible explanation for this apparent contradiction is that some likelihood scores may not relate to drought, but to the likelihood of there being a shortage of water for abstraction. If this is reported as the likelihood after mitigations are in place, the likelihood value will be lower than the likelihood of the drought itself.

*Summary*

On the basis of the information available from the water safety plans, a high percentage of water supplies have measures in place to manage the risk of water shortage arising during drought.

The probability of experiencing droughts more severe than those experienced to date is likely to increase with time because of the effects of climate change. Such events will test the ability of water restrictions (a common measure to avoid water shortage during drought) to cope, and may demonstrate the need for more robust measures for managing during these conditions.

### 5.3.2 THE RISK OF ON-GOING ROUTINE WATER SHORTAGE

The risk of water shortage arising from on-going routine demand, which gradually stretches the raw water resources of a supply, appears not to be as well managed as short-term risk.

Only seven of the 20 water supplies presently have robust measures in place for managing the routine demand. The water supplier in these cases may consider the capacity of their existing source(s), perhaps in combination with other measures, sufficient to routinely meet demand. Six of these seven supplies also have measures in place for managing drought (short-term water shortage).

There are an additional seven water safety plans identifying the investigation or development of new or alternate sources in future. Planning for new sources is also recorded in four of the seven water safety plans in which robust measures are already in place. This suggests that these water suppliers have determined that although present source capacity is adequate, it will not be in the future. This may show that demand projections are being used to guide their planning.

Fifteen water safety plans show that limited measures to deal with on-going routine demand are in place, and a further three have identified limited measures for future implementation. Ten supplies have limited measures in place, but no robust measures presently. These suppliers may judge that limited measures are satisfactory for the foreseeable future given the anticipated increase in demand. The information available from the water safety plans is insufficient for determining whether this is the case.

Apart from two plans in which there is evidence of demand projections having been taken into account, it is impossible to estimate the timeframe over which water safety plans generally aim to manage water demand. This is because the external documents mentioned earlier contain the longer term planning.

The supplies at greatest risk of routine water shortage are those without any presently implemented management measures, that is, those without “P” in either of the routine on-going shortage columns in Table 4. There are two supplies in this situation.

*Summary*

As far as can be determined from the water safety plans seen in this study, approximately one third of supplies have measures in place that are expected necessary to manage the routine risk of water shortage. However, three quarters of supplies have taken steps to manage the risk through limited measures. These might be satisfactory for the time being for the circumstances of the supply. Measures to manage routine water shortage will also help in managing short-term water shortage.

These statistics suggest that the risk of routine water shortage is not **presently** being well managed according to the assessment methodology used here. However, most of the surveyed water safety plans show that the risk is recognised and that it is either being managed or there are plans to improve its management.

The partial water safety plan information obtained from some water supplies means that these supplies may be managing the risk better than is indicated by the information to hand.

# 6 CONCLUSION

The purpose of this study was to assess how well water safety plans manage the risk of water shortage arising from low water availability or high demand or both.

The relatively small number of water safety plans examined (20), the selection criteria for the participating supplies, and restricting the study to considering only water safety plans, limit the confidence with which the conclusions from the report can be extrapolated to water safety plans in general throughout New Zealand.

Subject to this caveat, the study's conclusions based on the evidence available from the water safety plans are:

a. Water safety plans are the appropriate document for setting out how to prepare for and manage the risk of water shortage from brief emergency situations, drought and existing routine water demand

b. In general, documents external to water safety plans that have a more distant planning horizon, such as asset management plans, and territorial authority long-term plans, appear to be used for future water demand planning, not water safety plans

c. Almost all water supplies presently have implemented measures capable of managing the risk of water shortage arising from drought

d. Only about a third of water supplies have measures in place that are expected to robustly manage the risk of water shortage arising from routine water demand

e. Three quarters of the water supplies have measures in place that although less robust will still contribute to managing the routine risk of water shortage.

As a general observation, although water availability is widely identified as a possible reason for water shortage, increasing demand for water, the other facet of water shortage, is much less frequently identified as the possible cause of water shortage.


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