NEW ZEALAND
INFRASTRUCTURE
COMMISSION
Te Waihanga

Sector State of Play: Water

Discussion Document

Foreword

Our Wellbeing Depends on Our Infrastructure.

Our way of life depends on infrastructure. Whether it's moving freight to keep the supermarket shelves stocked, warming our homes, driving to work, or calling our friends, there are few parts of our lives that don't rely on the services provided by infrastructure.

Infrastructure decisions have intergenerational impacts, so it is essential that we take a strategic view of the planning, development, and operation of infrastructure in Aotearoa. New Zealand Infrastructure Commission was formed to give infrastructure this strategic voice, and the significance of this task is reflected in our Māori name, Te Waihanga, which means *cornerstone*.

Our first task is to develop a 30-year strategy for infrastructure - this paper is a part of this work. It takes a closer look at the current state of play in New Zealand's water sector. By understanding where we are now, we can set a course for where we want to go and the steps we'll need to take to get there over the next 30 years.

New Zealand faces a range of challenges and opportunities over the next 30 years which will have significant implications for infrastructure. Our changing climate, rapidly growing cities, aging population and evolving global technologies will change what we need from infrastructure to maximise the wellbeing of New Zealanders. Each of us has our own experiences of infrastructure, so we look forward to receiving your feedback to ensure this State of Play report accurately reflects the current state.

Ross Copland

Chief Executive

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1. Executive Summary

Water is an essential resource, amongst the most important on the planet. It is critical to life and to the way we live. Modern society would not be possible without the ability to divert water to where it is needed (e.g. urban communities, or the irrigation of crops and pastures); away from where it's not wanted (stormwater and flood control); to treat it so it's safe for human consumption and to cleanse it before it's released back into the environment.

By global standards New Zealand is water-rich. However, this abundance varies significantly from month to month and from year to year. There is also significant geographic variance – the West Coast receives almost a third of all rainfall[1], while only accounting for 10% of the country's total land area and less than 1% of New Zealand's total population. Our abundance of water has meant that the consequences of profligate use have not been as immediately apparent in New Zealand as it has been in other countries. This situation is rapidly changing. Pressure to supply adequate water for our growing cities, to preserve our environment and ecology, and to respect Te Mana o te Wai is considered by many commentators to require a step change in future freshwater management, which will have consequential impacts for waters infrastructure.

There is only one wai – and water services are inextricably linked. Stormwater and rural drainage networks include natural waterways, connections to groundwater and baseflows that interact with potable and irrigation water sources. Hydro-electricity dams also provide venues for recreation and natural habitats, including wetlands, for a myriad of flora and fauna. Nonetheless the broad range of uses means it is useful to separate the different characteristics of water use and to consider water infrastructure as falling within one of six general categories, as shown in Figure 1 below.

Figure 1 - There are Six Categories of Water Infrastructure

There is concern across all water sectors – whether drinking, waste or stormwater (three waters); productive water or river control, flood protection and drainage – that the existing management and regulatory environment for freshwater lacks coherence and requires attention. The recent adoption of a new National Policy Statement for Freshwater is a small step in the right direction, but a more coordinated approach to freshwater management is needed to achieve optimal environmental, social, cultural and economic outcomes. This reflects the reality that water has many competing and complementary uses, and that fundamental issues relating to the allocation of water (including the resolution of Māori rights and interests) require resolution.

[1] Roddy Henderson, and Christian Zammit, "The Water Accounts of New Zealand," The National Institute of Water and Atmospheric Research, accessed November 23, 2020, https://niwa.co.nz/freshwater-and-estuaries/freshwater-and-estuaries-update/freshwater-update-70-august-2016/the-water-accounts-of-new-zealand#:~:text=Compared%20with%20many%20other%20countries%20New%20Zealand%20is,much%20at%20times%20%28flooding%29%20or%20too%20little%20%28drought%29.

Water operators are facing a growing number of challenges which are stretching their financial and human capital resources. These include:

- Providing resilience to meet the demands of climate change, including coping with more extreme weather events (ranging from severe flooding through to droughts) and the consequences of sea level rise on public and private (e.g. homes and business) assets that have historically tended to be located on or near the coast.
- Funding the cost of renewing ageing networks, many of which are now reaching the end of their serviceable lives.
- Meeting increasing community expectations that the water they receive will meet basic health needs; be of sufficient volume and reliability to support productive activities and robust enough to keep communities safe.
- Meeting increasing environmental expectations for discharges and the impact of abstraction on minimum flow levels, catchment ecologies and Te Mana o te Wai.
- Councils with high and growing populations face significant costs extending and/or retrofitting existing plant and networks to cope with demand for housing and associated industrial and commercial activities
- For non-growth Councils, the challenge is coping with de-population and the difficulties of funding expensive systems with a declining rating base.
- Accessing technical skills, both specialised human capital and new technologies, required to provide water services to new standards.
- Managing affordability within existing funding mechanisms and in an environment where rate increases are highly visible and often contentious.

2. Context

2.1. Who We Are and What We Do?

The New Zealand Infrastructure Commission, Te Waihanga is working to improve New Zealanders' lives through better infrastructure. It aims to lift the level at which infrastructure is planned and delivered, taking a strategic approach so that we maximise the social return on our collective dollar and stand well prepared in the face of an uncertain future.

Our Māori name, Te Waihanga, means a cornerstone, or to make, create, develop, build, construct, generate. Te Waihanga therefore reflects the significance of long-term planning in shaping New Zealand's future.

A major part of this work is the development of a 30-year strategy for infrastructure. The strategy will look ahead to 2050, and consider how infrastructure might support environmental, social, cultural and economic wellbeing for all New Zealanders. This will be delivered to the government in September 2021 and will set out how we can make sure our investment in infrastructure delivers what we need, where we need it and at the right time.

2.2. About Our Sector State of Plays

We understand that our infrastructure works together - it is a system of systems. Our roads carry pipes and powerlines, and they connect to homes, workplaces and schools. For this reason, our strategy will focus on cross-cutting themes rather than infrastructure sectors in isolation. However, we believe that it's important we understand the infrastructure we have today, why we have what we have, and how it's already contributing to New Zealanders' wellbeing.

The sector State of Plays are structured around the components of Te Waihanga's working definition of infrastructure, set out in our discussion document, "Infrastructure Under One Roof"[2]. Our definition places wellbeing outcomes at the core, while recognising commonalities, including the use of capital such as financial and environmental resources; the interconnectedness of physical structures; and the delivery of shared services, as well as the wellbeing benefits we get from those shared services. In short, Te Waihanga defines infrastructure as follows:

"A system of inter-connected physical structures that employ capital to provide shared services to enhance wellbeing."

Figure 2 illustrates the components of our working definition, showing how they are related to one another in delivering wellbeing services.

[2] NZ Infrastructure Commission, *Infrastructure under One Roof: Standardising How We Think about the Shared Services around Us* NZ Infrastructure Commission, December 2020.

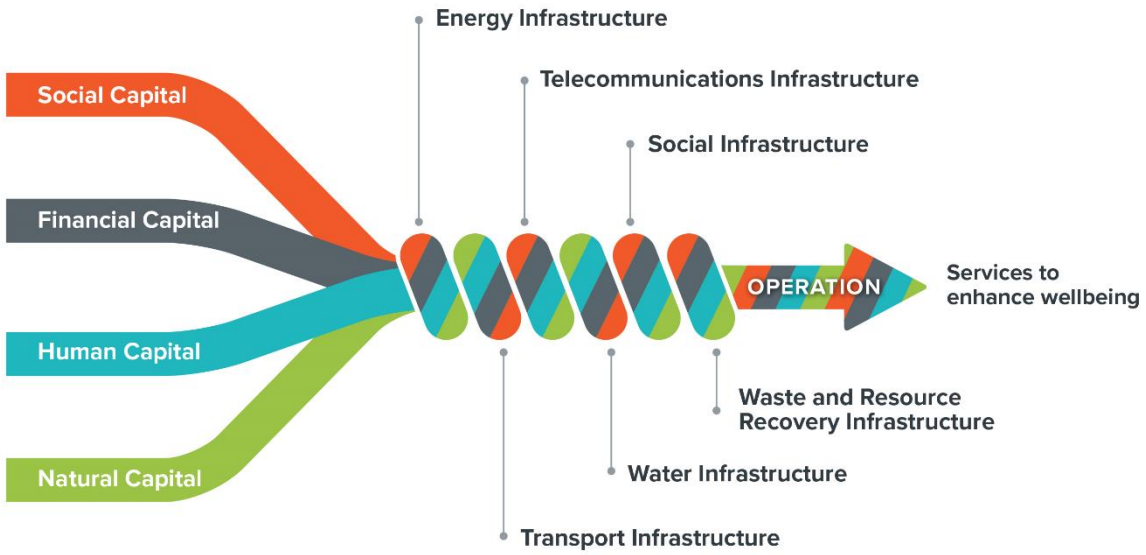

Figure 2: Te Waihanga's Definition of Infrastructure

By defining infrastructure in this way, we have then been able to develop a common framework to think about the integrated management of infrastructure. This considers the relationship between the enabling environment for our infrastructure, the sustainable use of the capitals employed in its development, the investment management process and the wellbeing benefits created by infrastructure services.

Our sector State of Plays are the result of desktop research, augmented by insights from our survey of infrastructure asset owners, and engagement with sector experts. These reports will be updated over time. We want to improve the picture as our understanding grows and different elements come in to focus.

2.3. Our Next Steps

As well as continuing to build on our picture of the State of Play, next steps include building our understanding of future trends and likely challenges, including climate change, incorporation of Mātauranga Māori, demographic change, and the role of technology. We will look at what our way of life might be 30 years from now. Based on all of this, we will begin to make recommendations as to how infrastructure might support New Zealand's future wellbeing.

We'll share our thinking on what will be included in the strategy, focusing on the cross-cutting themes that affect all sectors, the opportunities and challenges we can expect in the future, as well as our initial recommendations and options for consideration.

This will then be followed by a draft strategy that firms up our thinking on recommendations and provides greater detail as well as the evidence base behind them. From there, we'll develop the document that goes to Ministers.

2.4. Have Your Say

We'll share our work as we go and are keen to hear what you think, starting now. Tell us what you think about our State of Play reports – have we got it right or are there issues, information or problems that we've missed?

You'll also have the opportunity to comment on the draft strategy. We'll be continually refining and assessing our work based on the feedback we get from you and others.

3. About Waters Infrastructure

3.1. Introduction

Water is an essential resource, amongst the most important on the planet. It is critical to life and to the way we live. Modern society would not be possible without the ability to divert water to where it is needed (such as urban communities, or for the irrigation of crops and pastures); away from where it's not desired (stormwater and flood management); to treat it so it's safe for human consumption and to cleanse it before it's released back into the environment.

Water infrastructure is everywhere, but often under-appreciated. Much of it is located out of sight; under streets, submerged in ground water or in remote locations. This means it is often out of mind until, due to natural disaster or human oversight, a failure occurs. Water infrastructure also services a range of activities. For the purpose of this discussion document we have considered water infrastructure as falling within one of six general categories:

- Potable (drinking) water
- Wastewater (sewerage)
- Stormwater
- Irrigation (productive water)
- River control and flood protection
- Rural drainage.

Water exists within a complex framework of competing environmental, economic, social and cultural needs and aspirations. These include (but are not limited to):

- Declining freshwater quality and ecosystems
- The rights and interests of iwi/māori in water
- Ever increasing competition for water allocations
- The impacts of climate change.

By global standards New Zealand is water rich, with an average freshwater availability in excess of 72,500m3/person compared to less than 6,000m3/person globally[3]. However, this abundance varies significantly from month to month and from year to year. There is also significant geographic variance. The West Coast region receives almost a third of all rainfall (as shown in the graph below), while only accounting for 10% of the country's total land area and less than 1% of New Zealand's total population.

[3] "Renewable Internal Freshwater Resources per Capita," The World Bank, accessed November 26, 2020, https://data.worldbank.org/indicator/ER.H2O.INTR.PC

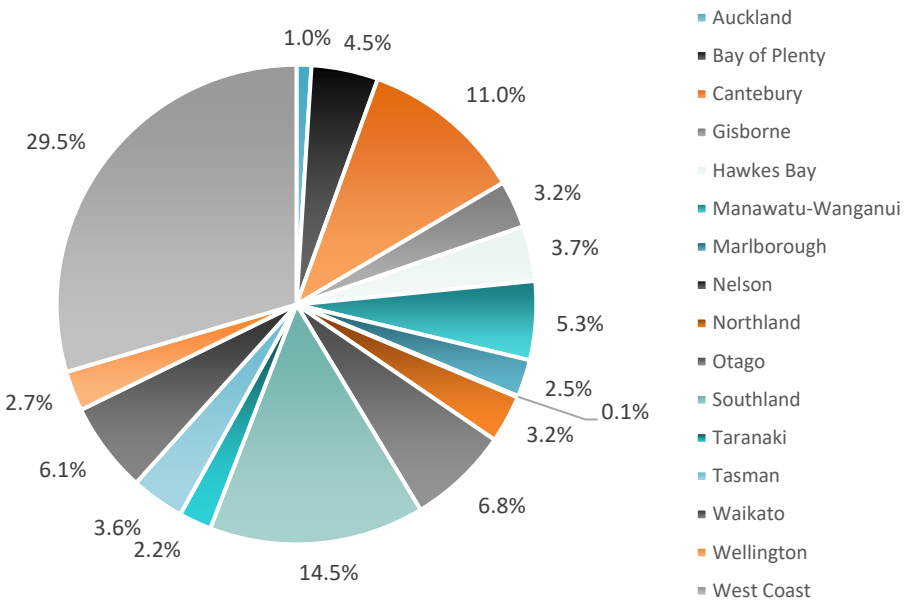

Figure 3: The Proportion of New Zealand's Average Surface Water Resource by Region.[4]

Our abundance of water has meant that the consequences of profligate use of freshwater has not been as immediately apparent in New Zealand as it has been in other countries. As shown in the following graph, New Zealanders are amongst the highest per capita users of freshwater.

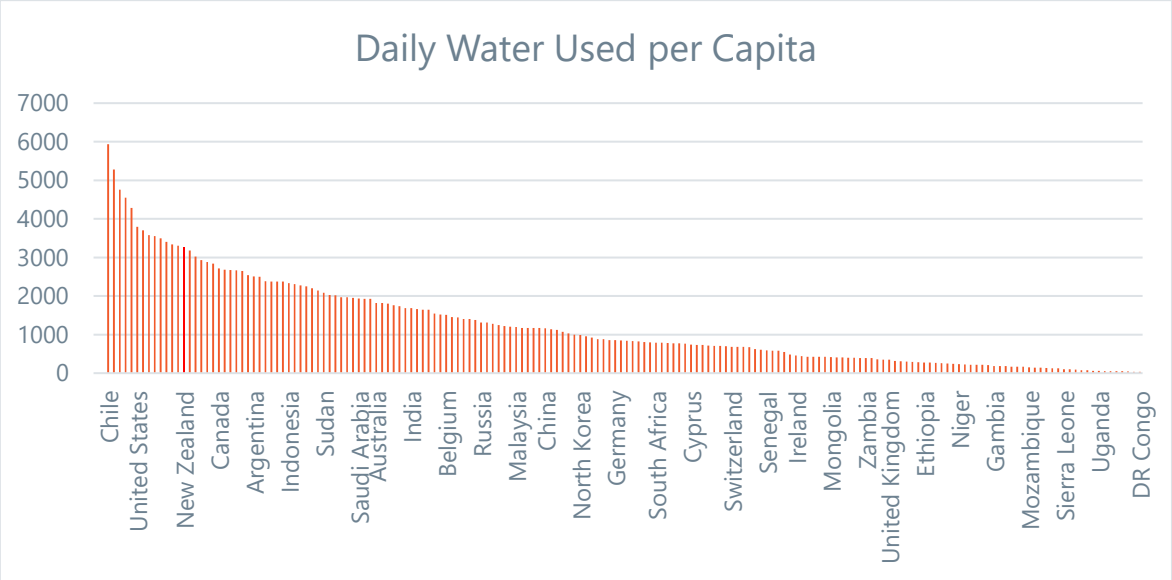

Figure 4: Daily Water Used per Capita by Country.[5]

This situation is changing. Pressure to supply adequate water for our growing cities, to preserve our environment and ecology and to respect Te Mana o te Wai is considered by many commentators to

[4] Roddy Henderson, and Christian Zammit, "The Water Accounts of New Zealand," The National Institute of Water and Atmospheric Research, accessed November 23, 2020, https://niwa.co.nz/freshwater-and-estuaries/freshwater-and-estuaries-update/freshwater-update-70-august-2016/the-water-accounts-of-new-zealand#:~:text=Compared%20with%20many%20other%20countries%20New%20Zealand%20is,much%20at%20times%20%28flooding%29%20or%20too%20little%20%28drought%29.

[5] "Renewable Internal Freshwater Resources per Capita," The World Bank, accessed November 26, 2020, https://data.worldbank.org/indicator/ER.H2O.INTR.PC

require a step change in future freshwater management, which will have impacts for waters infrastructure.

The diagram below illustrates the interconnectedness of water and how the six main types of water infrastructure interact with and allow management of water resources. It makes the point that ultimately there is only one wai, a key and emergent theme of this sector snapshot.

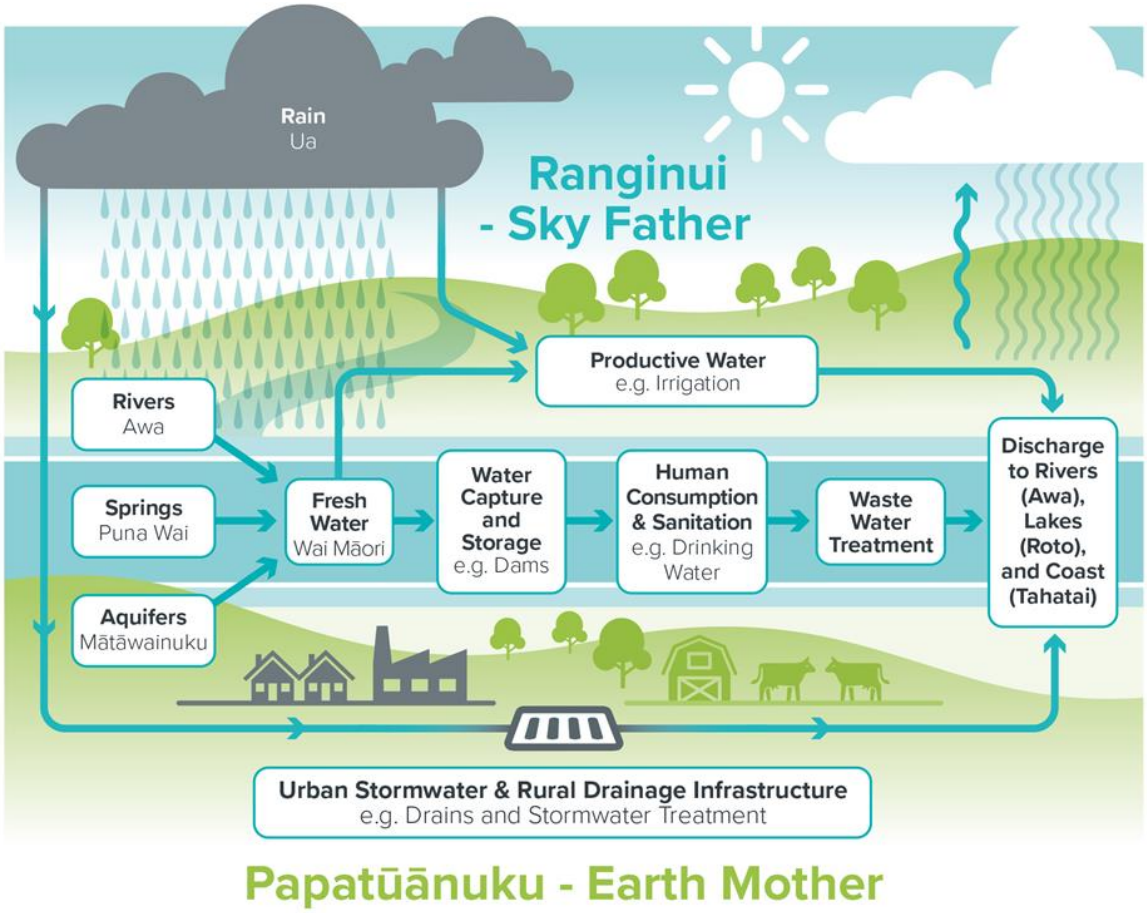

Figure 5: Only One Wai - Water is Interconnected.

3.2. Definition of Water Infrastructure

Water infrastructure can be defined as the consumption of capitals to store, treat and/or transport water to and from consumers for the purpose of enhancing social, cultural, environmental and/or economic wellbeings[6]. Outside of the natural environment, water is transported to the point of consumption (or discharge) through tens of thousands of kilometres of reticulated pipe networks. Reticulation networks are supported by a complex array of dams, reservoirs, stop banks, pumping stations, tunnels, power houses[7], SCADA[8] and treatment plants.

[6] For a fuller discussion on the definition of infrastructure see: NZ Infrastructure Commission, *Infrastructure under One Roof: Standardising How We Think about the Shared Services around Us* (NZ Infrastructure Commission, December 2020),
[7] Hydro-electric generation is discussed in greater detail in the NZ Infrastructure Commission's 'Sector State of Play: Energy'.
[8] Supervisory control and data acquisition (SCADA) is a control system architecture comprising computers, networked data communications and graphical user interfaces (GUI) for high-level process supervisory management

3.3. Services

There is only one wai – and water services are inextricably linked. Stormwater and rural drainage networks include natural waterways, connections to groundwater and baseflows that interact with potable and irrigation water sources. Hydro-electricity dams also provide venues for recreation and natural habitats, including wetlands, for a myriad of flora and fauna. Nonetheless the broad range of uses means it is useful to separate the different characteristics of water use and to consider water infrastructure as falling within one of six general categories, as shown in Figure 6 below.

Figure 6: Six Categories of Water Infrastructure.

These categories can be defined more specifically as follows:

3.3.1. Potable (Drinking) Water

Potable water describes water that is suitable for human consumption or for use in food preparation.

Drinking water infrastructure is the network of physical assets for carrying safe drinking water from a source supply[9] to the end consumer. Typically, this includes assets which:

- Collect and/or store water from a raw water source
- Treat water to ensure it is safe for human consumption
- Store and distribute water to end users.

In 2018/19 there were 490 drinking-water suppliers serving populations of more than 100 people registered with the Department of Health. Collectively these drinking water suppliers provided the drinking water for 4,077,000 New Zealanders. The remaining 840,000 New Zealanders receive drinking water from mostly self-supplier (rain-water tank and bores) and very small (less than 100 people) community supplies.[10]

Water NZ's 2019 National Performance Review reported that the 42 Councils who voluntarily took part in their survey collectively owned 351 water treatment plants, 44,472kms of water supply pipes and 792 water pump stations.[11] These assets were valued at $12.6 billion. However, based on a recent assessment

[9] Typically, a source of raw input of water is an aquifer, river or rainfall collection. Other sources used internationally could include desalination plants or wastewater recycling.
[10] Ministry of Health, *Annual Report on Drinking-Water Quality 2018 - 2019* (Wellington: Ministry of Health, June 2020), 9. https://www.health.govt.nz/system/files/documents/publications/annual-report-drinking-water-quality-2018-2019-25june2020.pdf
[11] Water New Zealand, *National Performance Review 2018 – 2019* (Water New Zealand, 2019), 22. https://www.waternz.org.nz/Attachment?Action=Download&Attachment_id=4271
The National Performance Review is a voluntary survey of council-owned water assets. In 2019, the survey was completed by 42 of 64 territorial authorities, who have responsibility for delivering three waters services for 4,536,520 New Zealanders (approximately 93% of the population).

of the value of three water assets conducted by the Water Industry Commission for Scotland, it is likely that these values have been under-estimated.[12]

Urban drinking water supplies are used for a range of activities other than human consumption. These other uses make up the majority of the total use of potable water, and range from essential services such as firefighting, toilet flushing and laundry; through to watering gardens, parks and reserves; and washing cars, houses and paths. Questions are being raised about the efficiency of treating large volumes of water to a high (potable) standard when the majority will not be ingested by humans. In rural areas reticulated water supplies are often used for agricultural purposes, including for watering stock. In urban areas approximately 18% of treated drinking water is lost through leakage. The proportional use of household water in New Zealand was investigated by BRANZ in 2007. Their results are shown in the following charts:

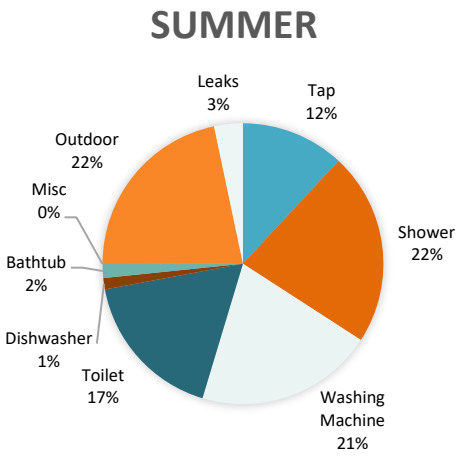

Figure 7: End uses of Household Water - Summer.[13]

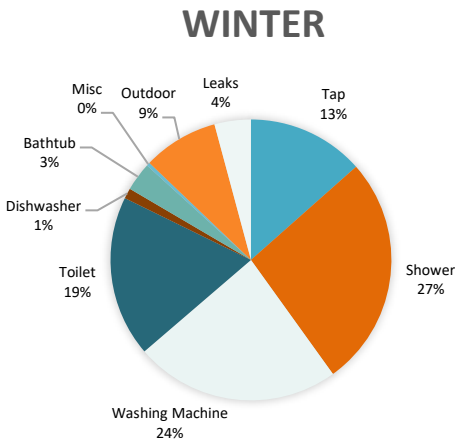

Figure 8: End uses of Household Water - Winter.[14]

[12] Water Industry Commission for Scotland. *Economic Analysis of Water Services Aggregation: Report Prepared for the Department of Internal Affairs*. Department of Internal Affairs, December 2020, 13. https://www.dia.govt.nz/diawebsite.nsf/Files/Three-waters-reform-programme/$file/Analysis-of-economic-impacts-of-water-services-aggregation-Briefing-to-Minister.pdf.
[13] Matthias Heinrich, *Water End Use and Efficiency Project (WEEP) - Final Report*, (BRANZ, 2007), 28. https://d39d3mj7qio96p.cloudfront.net/media/documents/SR159_Water_End_Use_and_Efficiency_Project_WEEP.pdf.
[14] Ibid, 18.

There is growing interest in water conservation through demand management, water-sensitive urban design and supplementing urban supplies by 'rain-water harvesting' and through the reuse of grey water for activities that don't require drinking quality water, such as toilet flushing and watering gardens. Alternative, non-potable water sources are being used in some locations to support industrial, commercial and construction uses. A good example are the measures introduced in Auckland in 2020 to increase drought resilience. These practices are generally in keeping with the Māori perspective that water is a taonga, and not to be wasted.

3.3.2. Wastewater (Sewerage)

Wastewater is any water that has been contaminated by domestic or commercial use. Wastewater typically comprises 99% water and about 1% human and other waste, but can contain bacteria, viruses, emerging contaminants of concern and other chemicals which are hazardous to the health of water, human health and the environment.

Wastewater infrastructure is the network of physical assets that ensures the transmission of wastewater from its source through to treatment plants where it is purified and transported for discharge back into the environment. Typically, this includes assets which:

- Transport wastewater from homes, offices, factories and other urban sites to treatment plants
- Treat and decontaminate the polluted water
- Transport the treated wastewater for discharge back into the environment, or for recycling.

There are 321 Wastewater Treatment Plants across New Zealand owned and operated by Territorial Local Authorities (councils). The geographical location of these plants is variable. The Waikato region contains the most plants (55) and the Nelson region contains the least (1). Environments where wastewater is discharged are equally varied and include land, fresh water and coastal waters. The Manawatu-Whanganui region has the most wastewater treatment plants that discharge to freshwater environments.[15]

As at December 2019, nearly a quarter of Waste Water Treatment Plants (comprising 73 plants) were operating on expired discharge consents, with the average time operating on an expired consent being four years.[16] Only 27% of wastewater treatment plants fully complied with their consent conditions in the 2017/18 year, with 15% recording significant non-compliance.[17] Water NZ's 2019 'National Performance Review' recorded 2,846 discharges of sewage into the environment in the 2018/19 year, although this is likely to be an under-estimation, for reasons discussed later in this chapter.

Wastewater networks include engineered and informal overflow points which can discharge untreated wastewater in a variety of conditions. Dry weather overflows may occur due to blockage, due to problems like collapsed pipes or blockage by tree roots, particularly where active asset management has been neglected. Wastewater networks can leak or "exfiltrate" to ground or surface waters and private connections are sometimes, knowingly or unknowingly, cross-connected to stormwater systems. Wet weather overflows occur when the wastewater network is undersized and/or when rainwater inflow (stormwater or overland flow connections to wastewater) and infiltration (groundwater and interflow passing into leaky pipes) exceed network capacity. Private networks which are less formally managed represent a significant inflow and infiltration risk. Methods for managing overflow include maintenance and operational response measures, increased transmission capacity, network storage and even overflow screening and treatment facilities.

[15] GHD, *National Stocktake of Municipal Wastewater Treatment Plants: Final Report* (Department of Internal Affairs, December 2019), 10. https://www.dia.govt.nz/diawebsite.nsf/Files/Three-waters-documents/$file/Report-1-National-Stocktake-of-Municipal-WWTPs.pdf
[16] Ibid, 9
[17] Ibid, 25

Private wastewater systems collect, treat and dispose of wastewater on site in areas not serviced by municipal networks. Local council policies control the design, installation and operation of on-site wastewater disposal systems (septic tanks), but active enforcement is patchy. The Ministry for the Environment has estimated that failure rates of on-site systems are in the range from 15 to 50 per cent, which equates to between 40,000 and 130,000 failing systems nationally[18]. Risk of failure or contaminant discharge is higher in areas where lot size, slope, infiltration and evapotranspiration capacity (which is the combined processes of water surface evaporation, soil moisture evaporation, and plant transpiration) is outside of desirable ranges

Water NZ's 2019 'National Performance Review' also reported that the 42 Councils surveyed collectively owned 240 wastewater treatment plants; 28,087 kilometres of wastewater pipes and 3,158 water pumping stations. These assets were valued at $16.3 billion, although this is likely to be understated[19]. On site wastewater disposal systems range between $10,000 to $30,000 replacement value.

3.3.3. Urban Stormwater

Urban stormwater refers to the runoff of water from urban surfaces generated by rainfall or melting snow. It is the urban equivalent of rural drainage. The stormwater system is an above ground and underground network of pipes and channels which drains water off properties, roads and footpaths, and diverts it into streams, rivers or directly into the coastal environment. Typically, this infrastructure includes pipes, channels and swales that receive stormwater, treat it and then divert it into the receiving environment. Roads are commonly designed to be used as secondary flow-paths, and reserves are also often used for temporarily holding water during heavy rainfall.

Stormwater infrastructure is closely connected with land use. Stream corridors, treatment devices and overland flow paths require land area both in public and private ownership, which is often compatible with recreation and access uses. However impervious surfaces and earthworks also reduce infiltration and evapotranspiration capacity. The reclamation of natural waterways increases the rate and volume of runoff and with it the load of contaminants discharged to the environment. These contaminants include litter, heavy metals and harmful pathogens.

Greater use is being made of water sensitive design approaches to reducing runoff and contaminants. This can include rainwater tanks supplying non-potable use, raingardens for filtration and infiltration and constructed wetlands to detain high flows and remove contaminants from stormwater before discharge into the environment.

Water NZ's 2019 National Performance Review reported that the 42 Councils surveyed collectively managed 17,719kms of stormwater pipes and 246 stormwater pump stations. These assets were valued at $11 billion. This does not include the property value of open watercourses, which are a critical part of stormwater networks. This valuation is likely to be an underestimate, based on work undertaken for the Department of Internal Affairs.[20]

3.3.4. Irrigation (Productive water)

Irrigation, sometimes also referred to as productive water, refers to the practice of supplying fresh water to land and crops to promote plant growth. It can also affect animal welfare as poor irrigation

[18] COVEC Ltd., *Preliminary Cost Benefit Analysis: National Environmental Standard for On-site Wastewater Systems, unpublished* (Wellington: Ministry for the Environment, 2007)
[19] Department of Internal Affairs, *Three Waters Review: Preliminary Analysis of the Economic Impacts of Water Services Aggregation*, (Department of Internal Affairs, December 2020), https://www.dia.govt.nz/diawebsite.nsf/Files/Three-waters-reform-programme/$file/Analysis-of-economic-impacts-of-water-services-aggregation-Briefing-to-Minister.pdf.
[20] Water Industry Commission for Scotland. *Economic Analysis of Water Services Aggregation: Report Prepared for the Department of Internal Affairs.* Department of Internal Affairs, December 2020, 13. https://www.dia.govt.nz/diawebsite.nsf/Files/Three-waters-reform-programme/$file/Analysis-of-economic-impacts-of-water-services-aggregation-Briefing-to-Minister.pdf.

(and poor flood control) can cause problems for stock, particularly in unmanageable drought and flood conditions. Adequate irrigation ensures feed throughout the seasons, fully fed stock etc. The infrastructure needed can include reservoirs, dams, pipes, pumps and channels. It will often support multiple uses such as hydro-electric generation, farm troughs, ground water recharge, water-based recreation and urban drinking water supply.

For the purpose of this chapter the focus is primarily on irrigation schemes serving multiple landowners. This reflects the limitation of data available about on-farm irrigation notwithstanding that cooperative irrigation schemes make up only slightly more than a third of total irrigated hectares.

The use of water for the generation of hydro-electric energy is covered in our Energy State of Play[21].

Irrigation has a long history in New Zealand. Large scale irrigation began in the late 19th Century principally in the Central Otago region. The majority of irrigated land is still located in the central and lower South Island, particularly in the Canterbury and Otago regions, as shown in Figure 9 below.

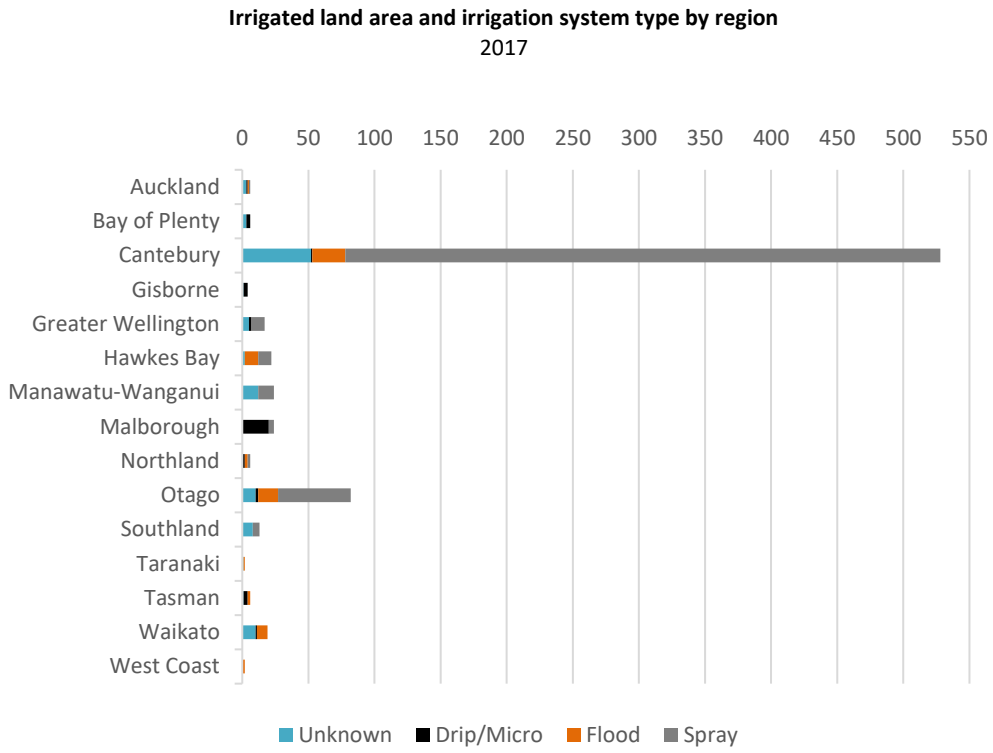

Figure 9: Irrigated Land Area and Irrigation System Type by Region.[22]

In 2017, irrigated land covered 3.0 percent (794,440 ha) of New Zealand's total land area.

It has been estimated that approximately $2.5 billion is invested in infrastructure supplying water to farms and a further $4 billion is invested in on-farm irrigation systems[23].

[21] The Energy State of Play Discussion Document can be found at: Energy-Sector-State-of-Play-Discussion-Document-February-2021.pdf (infracom.govt.nz)
[22] "Irrigated Land in New Zealand," Ministry for the Environment, accessed January 26, 2021. https://www.mfe.govt.nz/fresh-water/freshwater-guidance-and-guidelines/irrigated-land-new-zealand.
[23] Irrigation New Zealand, *Submission: A New Independent Infrastructure Body* (Irrigation New Zealand, October 2018), 4. https://www.irrigationnz.co.nz/News/Advocacy/Attachment?Action=Download&Attachment_id=494.

3.3.5. River Control, Flood Protection and Rural Drainage

For the purpose of this chapter River Control, Flood Protection and Rural Drainage are considered together, notwithstanding that the purpose of rural drainage, which includes the drainage of fertile land for productive purposes, may be considered different to flood protection and river control works.

Flood protection schemes are broadly allocated into four 'types'. These are rural drainage (getting excess water off productive and inhabited land and into a watercourse), flood control (keeping unwanted water in watercourses, in both rural and urban settings), river management (keeping rivers functioning in situ), and tidal inundation (keeping seawater off land). In the interest of readability, we have referred to river control, flood protection and rural drainage as 'flood protection' throughout this chapter.

Flood protection networks are located throughout New Zealand, including within the boundaries of many highly populated urban areas.

More than 100 towns and cities across New Zealand, numerous communities and rural homes, and around 1.5 million hectares of our most productive land are protected by more than 364[24] river management and flood protection schemes spread throughout the country. The infrastructure for these schemes includes stop-banks, floodgates, pump stations and spillways with a calculated replacement value of $2.3bn.

3.4. Capitals

Water infrastructure requires natural, social, financial and human capital, as shown in the diagram below. Each capital is significant in its own right and, as shown in the graphic below, freshwater enables a range of outflows, and in most cases produces higher outflows than the inputs required.

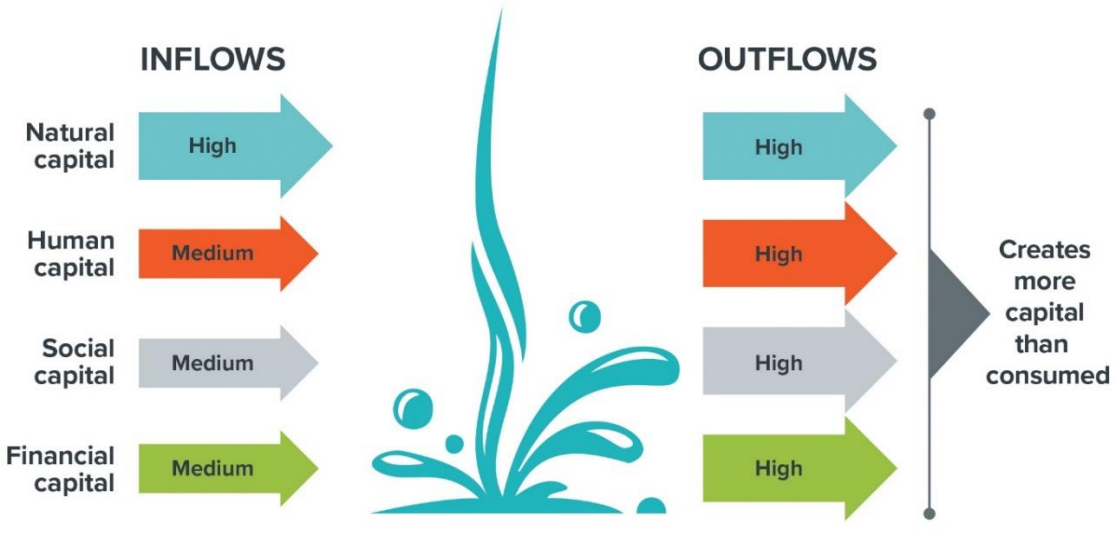

Figure 10: Capital Flows for Water Infrastructure.

In this section we discuss the human and financial capital elements, while the social and natural capitals are covered as part of our discussion on community wellbeing.

[24] Figures stated in the report understate the total number of schemes and associated costs, as only regional councils were included in the base survey data and therefore many schemes managed by TLAs are omitted.

3.4.1. Accessing Expertise - Human Capital

There are in excess of four thousand individuals employed full time in public water, wastewater and stormwater services in councils throughout New Zealand.[25] Approximately 60% of these are employed directly by councils and the remaining 40% are employed as contractors[26]. Thousands more are employed as plumbers, river managers and irrigators, and associated occupations. Even more owe their livelihoods to the availability of water for agricultural and/or horticultural purposes, manufacturing processes, tourist activities and the production of clean energy.

Maintaining expertise for core water services requires succession planning and commitment. Stakeholder feedback received by Local Government New Zealand during their three waters project identified that accessing technical expertise was an issue of concern for rural and remote councils.[27] Increasing regulatory requirements, particularly environmental and health standards, are likely to exacerbate this situation.

The number of staff directly employed in the three waters sector by New Zealand councils, including vacant positions and contractors, is shown in the graph below, which is taken from Water NZ's National Performance Review.

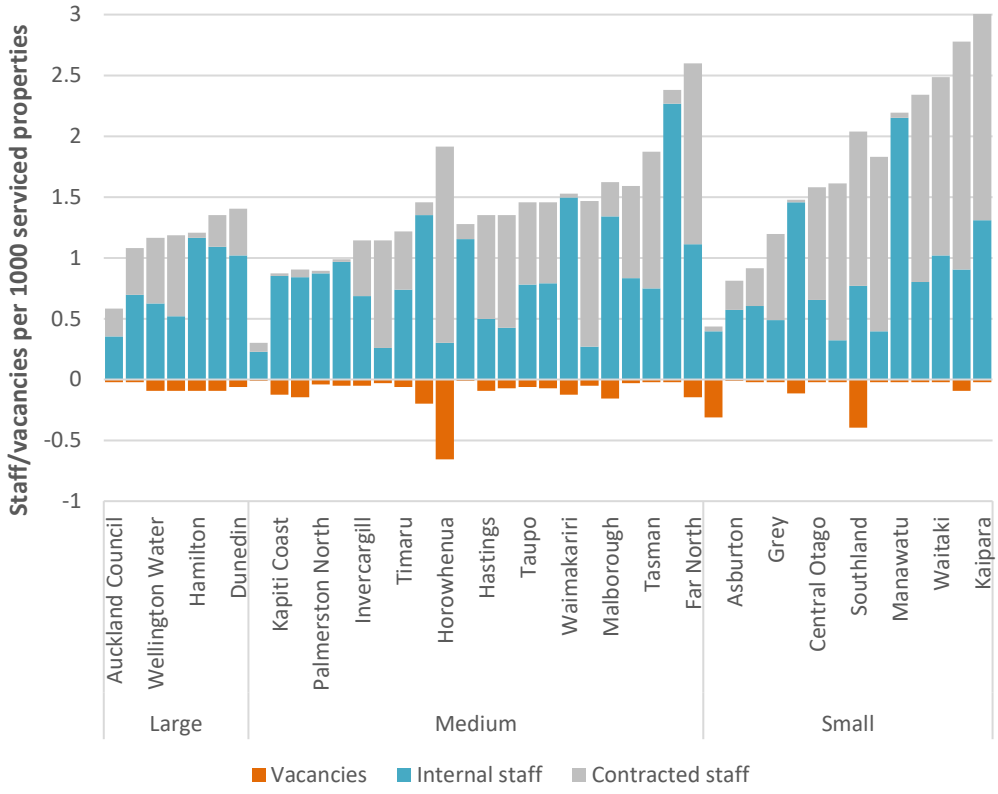

Figure 11: The Number of Staff Directly Employed in the NZ Water Sector by Local Authorities. [28]

The 'National Performance Review' survey identifies that total vacancies in the three waters sector are nearly 10% of total staff employed. This confirms that staff attraction is an important industry need, not

[25] Water New Zealand, *National Performance Review 2018 – 2019* (Water New Zealand, 2019), 18. https://www.waternz.org.nz/Attachment?Action=Download&Attachment_id=4271

[26] This includes construction and maintenance contractors and consultant engineers.

[27] Local Government New Zealand, *Improving New Zealand's Water, Wastewater and Stormwater Sector* (Local Government New Zealand, September 2015), 14. https://www.lgnz.co.nz/assets/2aa82f85f1/29617-three-Waters-Position-Paper.pdf

[28] "Workforce: Staff Numbers," Water New Zealand, accessed January 26, 2021, https://www.waternz.org.nz/Category?Action=View&Category_id=995. .

only in rural centres. However, it is exacerbated in smaller councils where the pool of technical staff is much shallower, and where the loss of even one experienced water specialist can have a big impact. In the coming five years, 11% of the workforce is due to retire, assuming a retiring age of 65.

The 'National Performance Review' survey suggests increasing vacancy levels may reflect an expansion in the total number of available positions. There was an increase of 135 jobs reported in the 2018/19 year over the previous year. The changing nature of water infrastructure planning, design and asset management is also seeing an increase in science, geospatial and data science skill requirements in the sector

The establishment of Taumata Arowai[29] is likely to place additional pressure on the existing workforce. There are two reasons for this:

- Taumata Arowai will need to employ a core of experienced water specialists. A possible new focus on economic regulation and enhanced environmental regulation will also place an increased demand on a finite pool of expertise.
- Section 11(f) of the Taumata Arowai – the Water Services Regulator Act 2020 provides Taumata Arowai with a function to *"facilitate, promote, or support research, education, and training…"*and Section 11(g) provides a function to *"build and maintain the capability of drinking water suppliers to fulfil their regulatory responsibilities"*. This also has the potential to place pressure on the existing pool of water specialists, as happened in the case of building control officers when new accreditation requirements were introduced as consequence of the Building Act 2004.

There is an emphasis on workforce training from sector leaders, such as Water NZ and the Water Industry Professionals Association (which is administered by Water NZ). Engineering NZ are also consulting on changes to the Chartered Engineer (CPEng) competencies, with submissions closing in January 2021. Other initiatives include continuing professional development, accreditation and a competency framework[30]. It is anticipated that Taumata Arowai will require mandatory accreditation for water professionals, which is likely to lead to a step change in formalised workforce training. Data from the Ministry of Education (see below) suggests that the pool of people in training has already more than doubled from a low of less than 400 in 2014.

[29] Taumata Arowai is a water services regulator established as a Crown agency in July 2020 with the purpose of administering and enforcing new drinking water regulatory system and contributing to improved environmental outcomes from wastewater and stormwater networks.

[30] Water New Zealand, *Competency Framework.* (Water New Zealand,2020), 11, accessed November 27, 2020, https://www.waternz.org.nz/Competency-Framework-Overview.

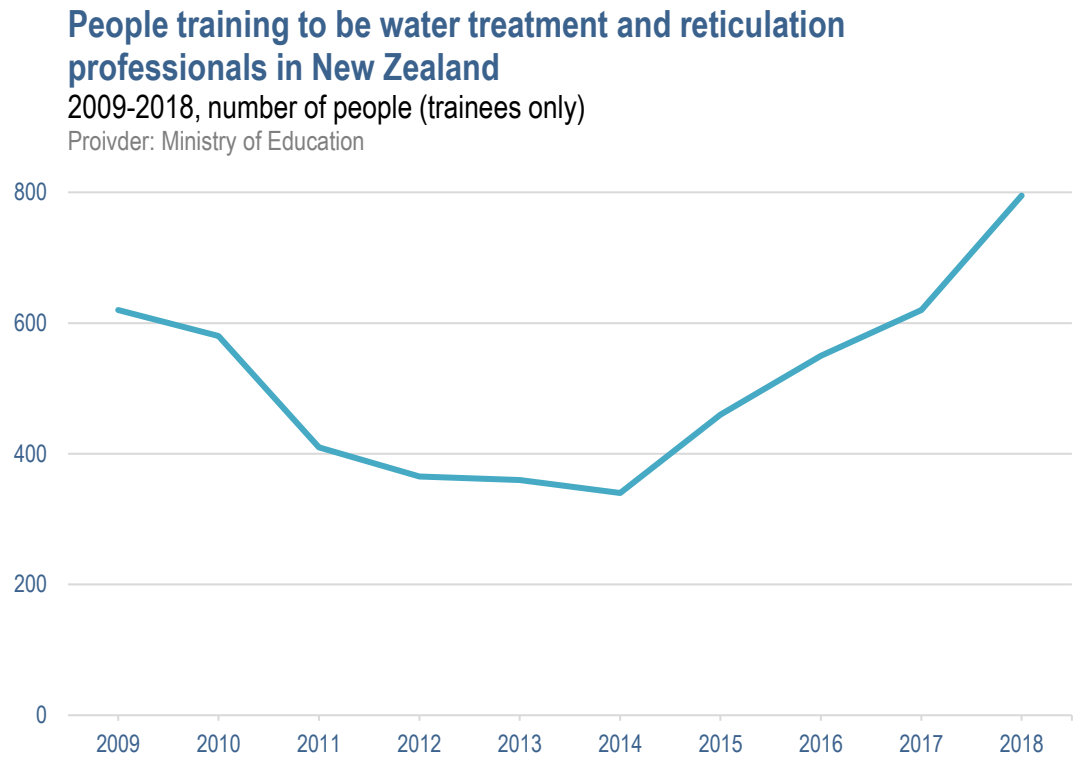

Figure 12: People Training to be Water Professionals in NZ.[31]

Workforce Diversity

A 2019 study undertaken by Water New Zealand found the water sector performs better for diversity in the workplace than the wider engineering workforce[32]. The findings of the survey were constrained by data availability. Of the ten water consultancies surveyed for the study only three collected data on staff ethnicity and none collected information on workforce disability or sexuality. Good information exists in relation to gender representation, as shown in figure 13 below.

[31] Ministry of Education, "People Training to Be Water Treatment and Reticulation Professionals in New Zealand," Figure.nz, June 2019, https://figure.nz/chart/2diQhxpXRY0SUtNX-vc1mYMC3dP6NBTJk.
[32] Troy Brockbank, and Liam Foster, "Evaluating Diversity in NZ's Water Sector," WSP, September 17, 2019, https://www.wsp.com/en-NZ/insights/evaluating-diversity-in-nz-water-sector.

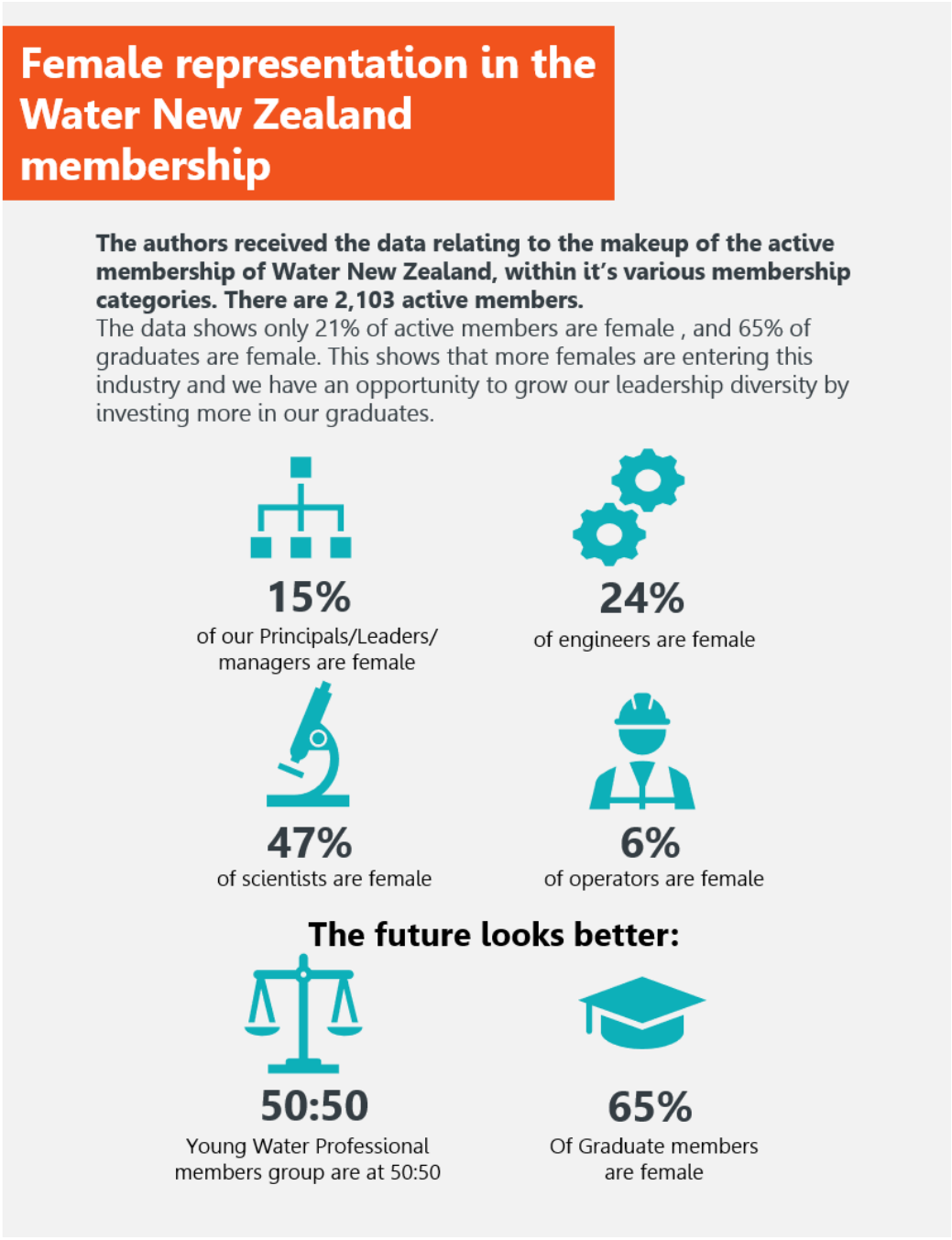

Figure 13: Female Representation in Water NZ Membership.[33]

3.4.2. Accessing Funding - Financial Capital

Ownership

Territorial councils are the owners of most drinking water, waste water and stormwater ('three-waters') infrastructure, although there are a number of small, community-led schemes; government agencies (defence force bases, schools and prisons); rural industries (including farms); marae and papakainga and tourist areas (such as ski-fields) which also provide three-waters services. Regional councils own most (but not all) river control, flood protection and drainage infrastructure. In contrast, irrigation schemes

[33] Troy Brockbank, and Liam Foster, *Evaluating Diversity in NZ's Water Sector* (Water Industry Aotearoa, September 17, 2019)

are generally held within the private sector, although some are held in public ownership through State-owned Enterprises such as **Pāmu** (the trading name of Landcorp Farming Limited).

Historically, the majority of water services, including irrigation, have been held in public ownership. The Crown was heavily involved in the funding and construction of many substantial irrigation projects throughout the 20th Century. However, from 1988 central government began transferring schemes into private ownership. Today, while the Crown continues to have a financial interest in several large irrigation schemes, its only direct ownership interest comes through arms-length entities such as Pāmu (Landcorp Farming Ltd). The cessation of Crown involvement in irrigation is considered to have impacted the sector. Irrigation NZ has noted that: *"With government funding being discontinued for a number of irrigation projects, some projects which would have resulted in positive environmental and economic outcomes are struggling to progress."*[34]

Although most water services are publicly owned there is still a sizeable private investment. The Ministry for the Environment estimates there are about 270,000 domestic on-site wastewater systems in New Zealand (including around 60,000 used for holiday homes). Private infrastructure includes pipework and connections to public networks in urban areas. In un-serviced rural areas private infrastructure includes roof water tanks, bores and stream takes and on-site wastewater disposal systems. Private stormwater systems including soakage and infiltration, permeable paving, detention and retention tanks and treatment devices are becoming increasingly common as water sensitive design matures to include on-lot source controls. Asset management and data collection for these private assets varies greatly.

Funding for Three Waters

Given that local authorities are the primary owners of water infrastructure, it is not surprising that ratepayers are the predominant funders. The following table shows the cost per household in New Zealand for the highest and lowest cost drinking water supplies.

Highest cost water entities

District	Cost per household ($/200m^3/year)		
	Drinking Water	**Wastewater**	**Stormwater**
Western Bay of Plenty	708	1044	389
Tasman	767	699	284
Horowhenua	654	654	175
Far North	863	329	36
Nelson	618	432	318

Table 1 - Highest Cost Water Entities.[35]

[34] Irrigation New Zealand, *Submission: A New Independent Infrastructure Body* (Irrigation New Zealand, October 2018), 5. https://www.irrigationnz.co.nz/News/Advocacy/Attachment?Action=Download&Attachment_id=494.
[35] Water New Zealand, *Charges dataset from National Performance Review 2018 - 2019* (Water New Zealand, 2019) https://www.waternz.org.nz/Category?Action=View&Category_id=1004.

Lowest cost water entities

District	Cost per household ($/200m^3/year)		
	Drinking Water	**Wastewater**	**Stormwater**
Palmerston North	257	252	-
Mackenzie	327	237	42
Hamilton	327	329	65
Invercargill	372	341	169
Hastings	357	261	-

Table 2 - Lowest Cost Water Entities.[36]

Each Council, with the exception of Auckland Council, sets its own price structure for water services which is subject to public consultation as part of the annual rates setting process. For Auckland, water charges are established by WaterCare Services Ltd (a Council Controlled Organisation), which is subject to the overview of the Auckland Council.

The approach to charging for water varies between districts. Most Councils, with Auckland again the exception, levy a rate for water services which is wholly, or in-part, based on the land or capital value of a landowner's property. This often includes a charge for properties not connected to reticulated water or wastewater services and may also include additional charges for separately used or inhabited parts of a rateable property, such as multiple tenancies and/or 'granny flats'. Over time, a growing number of councils have moved to the use of water metering (also known as volumetric charging) as the principle method for funding drinking water. Auckland also uses the volume of water received as a proxy for a wastewater charge, where a household is connected to both networks.

Water metering continues to be contentious in many communities. There are a range of reasons for this including:

- The introduction of household water meters enables user-charges for water consumption. This very often raises apprehensions that water networks will be privatised which is a controversial proposition in many communities. It is worth noting that the privatisation of water networks in New Zealand is prohibited under the Local Government Act 2002.
- There is a perception, which is contested, that it has the potential to alter the incidence of charging away from high value property, which is considered a proxy for wealth and therefore 'ability to pay'.
- There are substantial cultural implications, as water is considered a taonga by Māori.

[36] Water New Zealand, *Charges dataset from National Performance Review 2018 - 2019* (Water New Zealand, 2019) https://www.waternz.org.nz/Category?Action=View&Category_id=1004. Note that cost does not necessarily equate to quality. For example, low costs may reflect ease of access to plentiful, high quality raw water sources (perhaps a secure groundwater aquifer), alternatively they could reflect a lack of investment.

However, the introduction of volumetric charging is inked to a reduction in water use, which has environmental as well as economic benefits (for example, the opportunity to defer growth-related capital expenditure)[37] It can also provide a financial incentive for consumers to consider alternatives to the public supply, such as rainwater harvesting and/or grey water recycling. Over half the nation's residential properties have a water meter including many of New Zealand's large centres. Auckland, Christchurch, Central Otago, the Far North, Hauraki, Nelson, Tauranga, Western Bay of Plenty and Whangarei have 100% residential water metering coverage (for those connected to the public reticulation network), and Kāpiti Coast, Selwyn, Tasman, Whakatane and Waipa all meter the majority of residential properties with coverage levels of greater than 80%. Auckland's Watercare Services Ltd is the only water entity which charges entirely on a volumetric basis, all other Councils retain a fixed charge component, normally as a guard against fluctuating demand (and therefore revenue). Christchurch has comprehensive water meter coverage but does not charge volumetrically.

Based on responses to Water New Zealand's 'National Performance Review' the national average cost of water and wastewater services has been assessed at just under $850 per annum (2018/19). However, there is significant variability. In the most expensive jurisdiction, the average consumer would pay just over $1700 for water and wastewater services.[38]

It is difficult to extract the true cost of supplying water services from council balance sheets, and therefore to determine exactly how much consumers are paying for services. Councils are multi-functional entities and therefore decisions about how corporate costs are allocated can have a substantial impact. Transparency becomes even more difficult for the average consumer when three-water services are aggregated on rates bills. Stormwater is particularly complex, as there are significant crossovers with other activities, such as roading and reserves.

Analysis prepared for the Department of Internal Affairs has identified the cost of upgrading wastewater treatment systems discharging to coastal and freshwater bodies to meet national minimum standards at an estimated $3 - $4billion[39]. The cost to upgrade networked drinking water plants to meet existing standards was assessed to be in the order of a further $309 - $574million based on a March 2018 report to the Department of Internal Affairs[40]. This does not include stormwater upgrades or pipe renewals (which make up approximately 80% of asset replacement value). A more recent report, released in December 2020, has estimated that the total investment required to meet environmental and drinking water standards could be as much as $46bn[41]. While this is an upper estimate, the conservative estimate ($27bn) does not include provision for population growth or seismic resilience, which almost certainly means that it is too low.

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[37] See for example: Chloe Ranford, "Water Meter Test-Runs in Marlborough Continue to Throw up Eye-Watering Results." *Stuff*, October 26, 2020, https://www.stuff.co.nz/national/politics/local-democracy-reporting/300140576/water-meter-testruns-in-marlborough-continue-to-throw-up-eyewatering-results

[38] Water New Zealand, *National Performance Review 2018 – 2019* (Water New Zealand, 2020). https://www.waternz.org.nz/Attachment?Action=Download&Attachment_id=4271 .

[39] GHD Limited and Boffa Miskell Limited, *Cost Estimates for Upgrading Wastewater Treatment Plants That Discharge to the Ocean: Final Report* (Department of Internal Affairs, December 2019), 27. https://www.dia.govt.nz/diawebsite.nsf/Files/Three-waters-documents/$file/Report-2-Cost-Estimates-for-Upgrading-WWTPs-that-Discharge-to-the-Ocean.pdf.

[40] BECA, *Cost Estimates for Upgrading Water Treatment Plants to Meet Potential Changes to the New Zealand Drinking Water Standards* (Department of Internal Affairs, March 2018), 23. https://www.dia.govt.nz/diawebsite.nsf/Files/Three-Waters-Review-Cabinet-papers-April-2018/$file/Beca-report-Cost-Estimates-for-Upgrading-Water-Treatment-Plants.pdf.

[41] Department of Internal Affairs, *Three Waters Review: Preliminary Analysis of the Economic Impacts of Water Services Aggregation* (Department of Internal Affairs, December 2020), 5. https://www.dia.govt.nz/diawebsite.nsf/Files/Three-waters-reform-programme/$file/Analysis-of-economic-impacts-of-water-services-aggregation-Briefing-to-Minister.pdf.

The Department of Internal Affairs is currently working with local councils to develop an evidence-based assessment of total future investment requirements based on Council Asset Management Plans. This data is expected to be available in early 2021.

Funding for River Control, Flood Protection and Rural Drainage

Like 3-waters, Flood Protection schemes are ratepayer funded mostly by way of rates targeted at direct beneficiaries. Total expenditure (operational and capital) allocated in Regional Council Long Term Plans (2018 – 2028) is in the order of $2bn. It is however noted[42] that this is based on existing designs which do not necessarily reflect the challenges of climate change, their efficacy, age / condition or their sensitivity to ecological concerns. It has been estimated that a further $174m per annum will be required if flood protection infrastructure is to be made resilient to the increasing amount of rainfall from more intense, climate-induced storms and the impacts of sea level rise[43].

Flood protection experts are concerned about the lack of standardised national guidance concerning appropriate future design standards. As noted below, there is a danger that essential infrastructure will not meet the expectations of communities if each council is left to determine, and fund, their own preferred level of residual risk.

In total, New Zealand's flood control infrastructure is estimated to provide an annual benefit in excess of $11bn each year[44]. This is nearly five times their calculated replacement value, $2.3bn.[45] A benefit cost ratio of 55:1 for Flood Protection has been calculated, based on a total net present benefit of $198bn and an asset replacement / operational expenditure value of $2.3bn.[46]

Funding for Irrigation

The transfer of irrigation schemes from public ownership to the private sector means irrigation schemes are predominantly privately funded. Local councils may contribute funding and financing to some schemes, either to support local economic development or where water storage is used as a source for urban supplies. Crown Irrigation Investments Ltd currently manages four investments (Central Plains Water Limited Stage 2, Kurow Duntroon Irrigation Company Limited, Waimea Water Limited and Tasman District Council).

It has been estimated that approximately $2.5bn is invested in infrastructure supplying water to farms and a further $4bn is invested in on-farm irrigation systems. Irrigation New Zealand has projected that irrigation contributes over $5.4bn to New Zealand's economy annually[47].

Irrigation NZ has undertaken a series of surveys of irrigation schemes over time. As shown in the chart below, the 2016 survey calculated the average cost of water supplied by irrigation schemes as $780/ha/year, but with an increasingly wide range, $91 – $1,471/ha/year.

[42] Tonkin & Taylor Ltd., *Hiding in Plain Sight: An Overview of Current Practices, National Benefits and Future Challenges of Our Flood Protection, River Control and Land Drainage Schemes* (Wellington Regional Council, April 2018), 3-5.
[43] Hutchings, et al., *Central Government Co-Investment in River Management for Flood Protection Critical Adaptation to Climate Change for a More Resilient New Zealand* (Taranaki Regional Council, August 2019),
[44] Tim Denne and Louis Wright, *Economic Value of River Control, Flood Protection and Drainage (RCFPD) Schemes in New Zealand* (COVEC, April 2018), 26.
[45] Ibid, 26
[46] Ibid, 26
[47] Irrigation New Zealand, *2020 Election Manifesto: Irrigation for a Healthy and Thriving Aotearoa New Zealand* (Irrigation New Zealand, August 2020), 3. https://www.irrigationnz.co.nz/Attachment?Action=Download&Attachment_id=626.

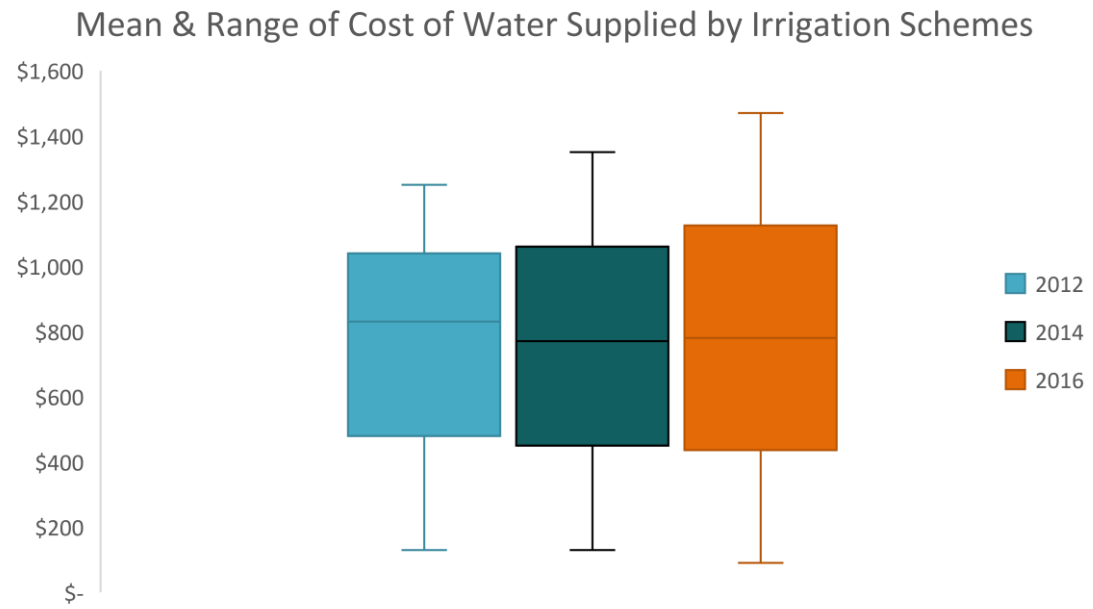

Figure 14: Mean and Range of Cost of Water Supplied by Irrigation Schemes.[48]

Factors contributing to the range of costs include the range of scheme ages (older schemes have a cost advantage with most or all of their capital having been paid off), the purchase or development cost of the scheme, the need and extent of infrastructure required (irrigation schemes can vary greatly in the mix of infrastructure required), and differences in ongoing operational expenses.

The average cost of a new irrigation scheme is $1,181ha/year (or $0.21m3/year). This is based on nine of the most recent new and upgraded irrigation schemes. It should be noted that survey costs do not include on-farm costs. Balancing against this, it has been estimated that the net impact of irrigation would be equivalent to approximately $7,000 per irrigated hectare of farm gate production[49].

3.5. Wellbeing

The 'Infrastructure Under One Roof' discussion document notes that "Our wellbeing depends on our infrastructure. Whether it's taking kids to school, moving freight from a to b, keeping our homes warm or connecting our businesses to the world, there are few parts of our life that don't rely on the shared experience of infrastructure."[50] This is undeniably accurate for water.

3.5.1. Water Infrastructure's Contribution to Community Wellbeing

Water is fundamental to the cultural, social, environmental and economic wellbeing of Aotearoa New Zealand: water sustains our ecosystems, life and the productive sector. Water infrastructure is the manifestation of the capital inputs required to provide the broad range of community wellbeings and outcomes.

[48] Irrigation NZ, *Cost of Irrigation Scheme Water Supply in New Zealand: 2016 Update,* (Irrigation NZ, 2016)
[49] NZIER, *The Economic Impact of Increased Irrigation. A Dynamic Computable General Equilibrium Analysis of Increased Irrigation in New Zealand* (Ministry of Agriculture and Forestry, November 2010), i
[50] NZ Infrastructure Commission, *Infrastructure under One Roof: Standardising How We Think about the Shared Services around Us (*NZ Infrastructure Commission, December 2020), 1.

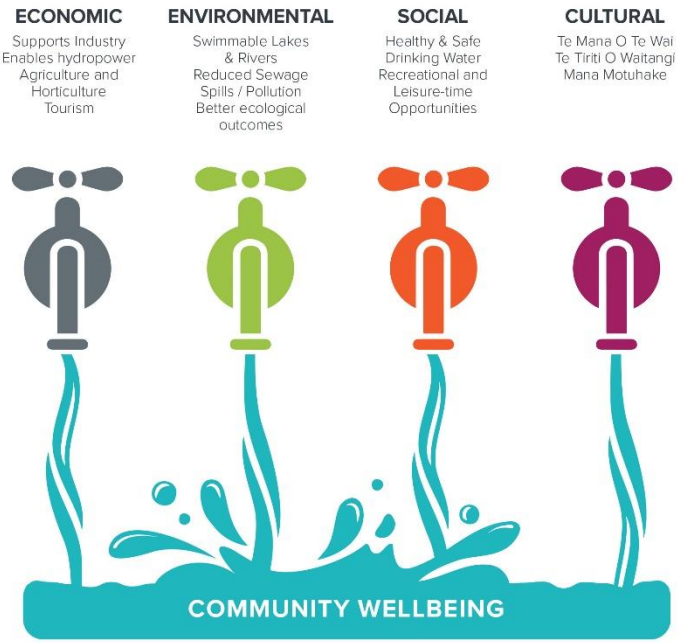

Figure 15: Water Infrastructure's Contribution to Community Wellbeing.

3.5.2. Importance of Water to Māori (Cultural Wellbeing)

For Māori, wai (water) is an important and precious taonga (treasure). It is the essence of all life, and part of their whakapapa (genealogy) and identity.

Māori regard wai as a gift from the Atua (deities) to Māori as ira tangata (human element). Wai is associated with the toto (blood) of Papatūānuku (earth mother) who supports all people, plants and wildlife. Wetlands are considered as the kidneys of Paptūānuku to cleanse contaminants from waterways (arteries).

Most, if not all Iwi, hapu and whanau consider themselves as descendants of the Atua and environment, and hence see themselves as part of the environment. They will whakapapa to a body of water whether it is a river, lake, spring or sea,[51] and personify the waterbody as a living entity. Wai has a mauri (life force) and as such water use and practices must not demoralise or degrade this mauri, but rather respect, enhance and maintain it. It is the role and obligation of Iwi / Māori, as Kaitiaki, to act as the guardian and protector of water and bodies of water.

For Māori, the health of the water is connected to the health of the people. We are one and the same. If the water is unhealthy, we are unhealthy.

Water is a vital source of food, and mahinga kai (food systems). It is central to marae life. The ability to manaaki and provide food is considered a reflection of mana, demonstrating a marae's wealth and ability to care for their natural resources, increasing esteem as hosts and honouring responsibilities to Atua.

For Māori water exists within a complex framework, but is also deeply personal, as described below:

> *Our ability to interact with these many forms of water appropriately depended upon our ability to 'commune' with the water, to listen, smell, taste and observe the waters and understand what each*

[51] New Zealand Conservation Authority, *Protecting New Zealand's Rivers* (Department of Conservation, November 2011), 13. https://www.doc.govt.nz/globalassets/documents/getting-involved/nz-conservation-authority-and-boards/nz-conservation-authority/protecting-new-zealands-rivers.pdf

variation meant. Water has intelligence, comprised of its nature and the multitude of life forms within it that respond to various stimuli. Water communicates its needs to us, and our comprehension depends entirely upon the intimacy of our relationship with it. The maintenance of this relationship sits at the heart of kaitiakitanga – our principle of care and protection[52].

Te Tiriti o te Waitangi

Māori rights and interests in water have been considered by the Waitangi Tribunal. In their 2012 'Interim Report on the National Freshwater and Geothermal Resources Claim'[53] they advise that:

> *"Our generic finding is that Māori had rights and interests in their water bodies for which the closest English equivalent in 1840 was ownership rights, and that such rights were confirmed, guaranteed, and protected by the Treaty of Waitangi, save to the extent that there was an expectation in the Treaty that the waters would be shared with the incoming settlers."*

The implications of this finding have yet to be resolved, and it was a common observation from individuals across the water sector (three waters, irrigation and Flood Protection) that progress towards a holistic approach to freshwater management would be impeded until Māori rights and interests in freshwater have been determined.

The recent report of the Resource Management Review Panel entitled 'New Directions for Resource Management in New Zealand' (known as the 'Randerson report') reinforces this view where it observes that:

> *"[t]he Panel's view is that it would be desirable for the Crown and Māori to address and resolve this issue sooner rather than later. Without such a solution, we believe the allocation and use of water rights will continue to pose significant difficulties for all those involved in the system."*[54]

The multiplicity of local, regional and central government agencies involved in water management is also a matter of concern for some Iwi. Tangata whenua capacity and capability is stretched when dealing with multiple government agencies within one rohe.

3.5.3. Importance of Water Infrastructure for Human Health, Safety and Liveability (Social Wellbeing)

Water plays a pivotal role in human society. The health and safety issues are compelling, and are discussed in further detail below. Water also has an integral social role as part of a range of leisure and recreational opportunities, from swimming to yachting to simple reflection and contemplation.

Health

Access to safe drinking water and sanitation is so fundamental to human health and wellbeing that it was declared a 'human right' by the UN in 2010. This commitment is enshrined in the UN's Sustainable Development Goal 6: ensure availability and sustainable management of water and sanitation for all.

[52] Tina Ngata, "Wai Māori: A Māori Perspective on the Freshwater Debate," *The Spinoff*, November 6, 2018, https://thespinoff.co.nz/atea/06-11-2018/wai-Māori-a-Māori-perspective-on-the-freshwater-debate/.
[53] Waitangi Tribunal, The Stage 1 Report on the National Freshwater and Geothermal Resources Claim (Wellington : Legislation Direct, 2012)
[54] Randerson et al., *New Directions for Resource Management in New Zealand: Report of the Resource Management Review Panel (*Resource Management Review Panel, June 30, 2020), 6. https://www.mfe.govt.nz/sites/default/files/media/RMA/rm-panel-review-report-web.pdf.

Figure 16: United Nations Sustainable Development Goals.

Access to poor quality drinking water due to substandard infrastructure has an inevitably adverse impact on health, irrespective of where this occurs in the world. Access to safe drinking water is a significant concern in developing countries. Even in the developed world there have been a number of high profile instances of potable water being compromised with tragic results. The City of Flint, Michigan – where over 100,000 people were exposed to lead poisoning – is a relatively recent (2014) example, but New Zealand has its own history of drinking water becoming compromised, most often through bacterial incursions.

There have been many confirmed incidences of gastrointestinal disease transmitted through public water supplies in New Zealand[55]. High profile examples include:

- In 1984 an estimated 3,500 people were taken ill in Queenstown when, it is thought, a sewer overflowed close to the town's water supply intake. A number of people were hospitalised and almost half the population's school pupils were absent at the height of the outbreak.
- In July 2006 contamination of a drinking-water source at Cardrona ski field resulted in at least 120 cases of gastroenteritis.
- An estimated 109 people were estimated to have contracted Campylobacteriosis in Darfield in 2012 as a result of animal effluent entering a drinking water well.
- In August 2016, a widespread outbreak of gastroenteritis caused by the presence of E. coli in the public water supply led to more than 5000 people becoming ill and contributed to the deaths of three people in Havelock North, a town of 15,000 people.

Research conducted for the Ministry of Health in 2007 estimated the overall burden of sporadic or underlying drinking water-borne gastrointestinal disease in New Zealand at 18,000 to 34,000 cases per year.[56] Another study estimated in 2010 that 35,000 cases of acute gastrointestinal illness were contracted from reticulated drinking water each year.[57] However, these numbers are highly likely to be an underestimation of the true incidence of disease faced by New Zealanders.[58] The Havelock North

[55] Andrew Ball, *Estimation of the Burden of Water-Borne Disease in New Zealand: Preliminary Report* (Ministry of Health, November 2006), https://www.health.govt.nz/system/files/documents/publications/water-borne-disease-burden-prelim-report-feb07-v2.pdf
[56] Ibid, 16.
[57] Moore, et al., *Cost Benefit Analysis of Raising the Quality of New Zealand Networked Drinking Water* (LECG, 2010), 6. http://srgexpert.com/wp-content/uploads/2018/02/cba-raising-quality-of-networked-drinking-water-jun20101.pdf.
[58] As to be recorded the unwell person must be examined by a doctor and risk factor questions must be asked to be counted.

Drinking Water Inquiry heard evidence that a figure of 100,000 cases plus per year was more likely to be accurate, particularly when small private supplies were included.[59]

Cases of water-borne gastrointestinal illnesses have been calculated to have cost New Zealanders $496.1 million over 40 years, principally in terms of health care and lost productivity.[60] In 2006, the Ministry for the Environment estimated that water-borne disease cost New Zealand $25 million a year.[61] The economic cost of the Havelock North outbreak to the country was calculated to be $21 million.[62] In addition, the impact of contamination events occurring in tourist centres has the potential to risk New Zealand's global reputation.

Concerns about the quality of New Zealand's publicly reticulated water networks are reinforced by the large number of boil water notices issued each year. The Government Inquiry into Havelock North Drinking Water heard evidence that in 2015-2016, 44 public supplies had boil water notices issued affecting 15,000 people. Twenty-six of the boil water notices were permanently in place (affecting 7,200 people)[63].

Summertime water restrictions are also common in New Zealand. Restrictions are used by suppliers to ration demand for potable water, usually because either there is insufficient raw water supply or because existing infrastructure is inadequate to meet demand. In Water NZ's 'National Performance Review' it was noted that 21 of the 47 Council participants used water restrictions in 2018-19. They were used most extensively in Wellington, with 28,739,580 resident days affected.

The following is a concluding observation from the Havelock North Drinking Water Government Inquiry:

> *"These findings point to a widespread systemic failure among water suppliers to meet the high standards required for the supply of safe drinking water to the public. The industry has demonstrated that it is not capable of itself improving when the standards are not met."*[64]

Safety

Water infrastructure is critical for the protection of human life and property from natural and man-made hazards.

As an example, urban reticulation is the predominant source of water for firefighting, where easily accessed and secure supply is imperative. Most emergency appliances only carry a limited volume of water and although tankers can be provided, they may not be available everywhere, their capacity is limited, and they are ultimately also dependent on having a nearby water source for replenishment.

In New Zealand, urban supply authorities are expected to ensure that water is available in communities in sufficient quantities to meet reasonable firefighting needs. District Plans often mandate this requirement through subdivision and urban development standards, which ensure that all new urban developments can supply sufficient water for firefighting purposes. The cost of developing systems to

[59] Government Inquiry into Havelock North Drinking Water, *Report of the Havelock North Drinking Water Inquiry: Stage 2* (Department of Internal Affairs, December 2017), 31. https://www.dia.govt.nz/diawebsite.nsf/Files/Report-Havelock-North-Water-Inquiry-Stage-2/$file/Report-Havelock-North-Water-Inquiry-Stage-2.pdf.
[60] Moore, et al., *Cost Benefit Analysis of Raising the Quality of New Zealand Networked Drinking Water* (LECG, 2010), 159. http://srgexpert.com/wp-content/uploads/2018/02/cba-raising-quality-of-networked-drinking-water-jun20101.pdf.
[61] Ministry for the Environment, *Proposed National Environmental Standard for Sources of Human Drinking-Water: Resource Management Act Section 32: Analysis of the Costs and Benefits* (Ministry for the Environment, March 2007), 33.https://www.mfe.govt.nz/sites/default/files/nes-drinking-water-section-32-mar07.pdf
[62] Government Inquiry into Havelock North Drinking Water, *Report of the Havelock North Drinking Water Inquiry: Stage 2 (*Department of Internal Affairs, December 2017), 33. https://www.dia.govt.nz/diawebsite.nsf/Files/Report-Havelock-North-Water-Inquiry-Stage-2/$file/Report-Havelock-North-Water-Inquiry-Stage-2.pdf
[63] Ibid, p. 29
[64] Government Inquiry into Havelock North Drinking Water, *Report of the Havelock North Drinking Water Inquiry: Stage 2* (Department of Internal Affairs, December 2017), para.924. https://www.dia.govt.nz/diawebsite.nsf/Files/Report-Havelock-North-Water-Inquiry-Stage-2/$file/Report-Havelock-North-Water-Inquiry-Stage-2.pdf.

these standards is borne by the developer and recouped through section sales. Urban developments are audited by Council engineers to ensure that any new water reticulation infrastructure can supply water in sufficient quantity and at sufficient pressure to meet firefighting needs. If supplies have not been constructed to the defined standard, Councils have the ability to require upgrades before sections can be sold and/or occupation occurs.

Fire supply measures are solely based on the potable water network and therefore ignore the potential of other non-potable sources which may be appropriate for fire supply and may offer capacity savings in the potable network. New Zealand has no non-potable or recycled water standards indicating what non potable water is safe for firefighting supply.

At the other end of the emergency management spectrum, water infrastructure also plays an important (but largely underappreciated) role in protecting life and property from the impacts of floods. Flooding is the most frequent, and costly, natural hazard faced in New Zealand. Between 1968 and 2017, the country experienced over 80 damaging floods.[65] The consequences of severe flooding can be catastrophic, ranging from severe economic costs[66] through to loss of life. Inadequate attention and resourcing of Flood Protection infrastructure has the potential to contribute to disastrous property damage, and potentially loss of life. In some situations, it has become apparent that the historical siting of some urban developments has been inappropriate. Calls for 'managed retreat' in coastal areas and within some river flood plains are not new, but come with considerable consequences for inhabitants.

Fortunately, most New Zealanders are insulated from the impacts of flooding by a combination of stormwater engineering, river management and flood control. As noted previously, more than 100 towns and cities across New Zealand, numerous communities and rural homes, and around 1.5 million hectares of our most productive land are protected by more than 364[67] river management and flood protection schemes spread throughout the country.

3.5.4. Water Infrastructure has Environmental Impacts (Environmental Wellbeing)

Water infrastructure impacts on the sustainability and health of the natural environment, specifically through the diversion of water from natural bodies for drinking water, industrial consumption and horticultural / agricultural purposes; the damming and storage of water for irrigation or hydro-electric generation and the discharge of contaminated waste and stormwater into waterways[68]. These actions have a direct impact on the health and sustainability of waterways as ecosystems and taonga that support cultural practice and recreation.

As New Zealand has developed, water courses have been altered, confined and/or reclaimed and water has been diverted for human needs. Low river flows reduce the habitat of freshwater fish and other species, including many of New Zealand's threatened birds.[69] Essential fish movements up and downstream are made more difficult, or impossible, by low flows and artificial barriers like dams in rivers and streams. Reduced or less variable flows can increase the temperature and the concentration of nutrients and pathogens (disease-causing microorganisms) in a waterway and increase the chance of harmful algal blooms.

[65] Eileen McSaveney, "Floods - New Zealand's number one hazard," *Te Ara - the Encyclopedia of New Zealand*, accessed December 10, 2020, http://www.TeAra.govt.nz/en/floods/page-1

[66] The Insurance Council of New Zealand calculated that industry payments for flood damage between 1976 and 2004 averaged $17M per year.

[67] Figures stated in the report understate the total number of schemes and associated costs, as only regional councils were included in the base survey data and therefore many schemes managed by TLAs are omitted.

[68] The discharge of significant volumes of treated 'freshwater' into coastal (saline) environments also has an environmental impact.

[69] Ministry for the Environment & Stats NZ, *New Zealand's Environmental Reporting Series: Our Freshwater 2020* (Ministry for the Environment, April 2020), 19. https://www.mfe.govt.nz/sites/default/files/media/Environmental%20reporting/our-freshwater-report-2020.pdf

In urban centres an increase in impervious surfaces compounds stormwater runoff by reducing evapotranspiration and infiltration and thereby reducing baseflow and accelerating runoff. This can result in ongoing destabilization of urban streams and the mobilisation of large volumes of sediment, which smothers natural habitat and leads to a need for expensive remedial works. Land disturbing activities such as forestry harvest, intensive agriculture, quarrying and urban development expose soils and increase runoff allowing erosion and sedimentation of waterways.

Stormwater and rural drainage spreads a range of contaminants from the land surface. When these are above background levels receiving environments are impacted. In rural areas this includes sediment, nutrients and pathogens from productive land use. In urban areas discharges include sediment, litter, nutrients, heavy metals, hydrocarbons, pathogens and various other contaminants of concern. Wastewater overflows, highly trafficked roads and carparks, zinc roofs and industrial areas generate the most urban contaminants.

Discharges of wastewater and stormwater are an obvious point source of pollution, which degrades the hauora (health), mauri, and wairua of waterways. Pathogens such as campylobacter from untreated wastewater can make people ill when they drink or swim in polluted water. A recent (2019) national stocktake of wastewater treatment plants found that nearly 25% (73) were operating under expired consents. The stocktake found further that the majority of overflows are unconsented (and poorly understood) and that 25% of plants recorded significant con-compliance.[70,71]. As noted previously, only 27% of wastewater plants achieved fully compliance.

Climate change, and the need to consider embodied and operational carbon in water systems are issues which water suppliers will need to consider. Approaches designed for greater carbon efficiency are being actively considered in some organisations, however it is generally acknowledged that more work is required.

Irrigation

Historical irrigation practices have had a substantial environmental impact. Wild flooding and dyke irrigation create significant environmental damage which is now considered unacceptable. Problems include damage to the continuity of rivers and their ecologies, runoff of nutrients (like nitrogen and phosphorus) which lead to algal blooms that degrade ecosystems and the cultural and recreational value of water, and silting of waterways which makes the water cloudy and smothers natural habitats on the bottom and banks of rivers and lakes. Habitat loss is also associated with intensification of land use made possible by irrigation.

Most of New Zealand's irrigated land now utilises an array of spray and sprinkler systems, although there are still a few inefficient border dyke systems in use. Spray and sprinkler systems apply water more efficiently, allow more land to be irrigated and can precisely correct soil moisture deficits. They also reduce the unintended environmental impact of irrigation, such as the drainage of nutrient-loaded water into groundwater and streams. Spray irrigation now accounts for 87% of all irrigation schemes (70% by total land area). Drip or micro irrigation schemes, which are more prevalent in areas with high horticultural land use, total 8% of all schemes. Flood irrigation is still used, but only in 5% of schemes.[72]

[70] 2017/18 data for 170 out of 321 plants

[71] GHD, *National Stocktake of Municipal Wastewater Treatment Plants: Final Report* (Department of Internal Affairs, December 2019), 39. https://www.dia.govt.nz/diawebsite.nsf/Files/Three-waters-documents/$file/Report-1-National-Stocktake-of-Municipal-WWTPs.pdf.

[72] "Irrigated Land," *Stats NZ: Tatauranga Aotearoa*, April 18, 2019, https://www.stats.govt.nz/indicators/irrigated-land.

3.5.5. Economic Growth and Wellbeing

Water is a vital factor of production, so ensuring a sufficient and constant supply under increasing allocative pressure is essential to achieving economic wellbeing.

The availability of water in New Zealand provides a potential competitive advantage over many countries. As noted previously (see Figure 2), New Zealand is considered water rich on a global scale with almost 70,000 cubic metres of renewable freshwater resources per person, compared to a world average in the order of 6,000 cubic metres per person[73].

To benefit from this natural advantage, it is important to ensure that water infrastructure receives adequate investment, both for new assets and for the maintenance and operation of existing networks. Policies to promote water efficiency and improve water allocation, including consideration of economic instruments such as tradeable water permits, have been discussed in support of investment decisions, but a policy decision to introduce them has not been made despite the potential to deliver greater net benefits.[74] However, the Randerson report[75] has recommended a greater use of economic instruments, including that:

> *" i. future legislation should ensure there is a broad mandate for the use of tradeable rights and permits, incentives and environmental taxes and charges*
>
> *ii. central government should provide institutional support for the development and use of economic instruments by local authorities through a combination of national direction, guidance, and support for capability."*[76]

Historically, industrial development has been able to use as much water as is available, but it is increasingly recognised that this cannot continue. Anecdotally it appears that industry is acknowledging this change. Less fresh water is being drawn by industries and more wastewater is being treated. Purifying wastewater and recovering elements used in production processes is growing and is likely to continue to grow in importance as the real costs of accessing raw freshwater increase. It is however noted that current standards discourage the use of wastewater for agricultural and horticultural purposes. In fact, some entrepreneurs are now seeing the value in 'mining' wastewater for discarded minerals and recycling and on-selling grey water, including for irrigation. This trend is more prevalent overseas than in New Zealand and is something that New Zealand consumers, utilities and regulators will have to consider.

[73] "AQUASTAT - FAO's Global Information System on Water and Agriculture," Food and Agriculture Organisation of the United Nations, accessed November 23, 2020, http://www.fao.org/aquastat/en/.
[74] Julia Talbot-Jones, Sophie Hale, and Suzie Greenhalgh, "Review of Policy Instruments for Freshwater Management," *Motu Working Paper 20-10* (November 2020): 54.
[75] Randerson et al., *New Directions for Resource Management in New Zealand: Report of the Resource Management Review Panel (*Resource Management Review Panel, June 30, 2020) https://www.mfe.govt.nz/sites/default/files/media/RMA/rm-panel-review-report-web.pdf.
[76] Ibid, 365

4. What Shapes the Sector Today?

4.1. A Fragmented Governance Environment

There are participants in each of the water sectors – whether three waters, productive water or flood protection – who feel the existing management and regulatory environment for freshwater lacks coherence and is not capable of taking a holistic view of water, and the water cycle. The common consensus is that to achieve the best environmental, social, cultural and economic outcomes a more coordinated approach to freshwater management is required. This reflects the reality that water has many competing (and synergistic) uses, and that fundamental issues relating to the allocation of water (including the resolution of Māori rights and interests) require resolution. Some suggest that a central entity with a mandate to balance these uses would add value. As noted by Irrigation NZ:

> *"Changes to allocation should not just be driven by a philosophy of always moving water to its 'highest value' use in terms of economic value. Other types of value (such as social, cultural, and environmental value) needs to be considered under an allocation framework, in order to prevent water or land use monocultures."*

4.1.1. River Control, Flood Protection and Drainage (Flood Protection)

For flood protection practitioners the manifestation of fragmentation is a lack of cross-agency coordination. As an example, regional councils have the primary role for flood protection but urban stormwater services, coastal protection and elements of rural drainage are still directly managed by territorial authorities. Historically, central government provided a leading coordination role. However, since significant sections of the Soil Conservation and Rivers Control Act were repealed and the Ministry of Works and Development disbanded that responsibility has fallen to regional councils. Requirements for flood protection schemes are now defined in individualised regional plans and policy statements which has led to variability in matters such as design standards and the Acceptable Residual Risk faced by communities. This generates a risk that the public may not be aware of the extent to which they are being protected.

4.1.2. Three Waters

For three waters, the issues facing territorial authorities are compounded by historical institutional settings, which have led to an industry which lacks meaningful regulation and is fragmented into a multiplicity of often very small suppliers. As of 2019 there were 403 drinking water suppliers in New Zealand, providing 677 supplies. The majority of the population (3,434,362 people) are served by 36 publicly owned (Council) suppliers, with the remainder of the population being served by a mix of 267 others.

New Zealand's rural communities have a relatively low connection rate to municipal supplies in comparison with peer countries, such as the UK and Australia. This is a reflection of our sometimes challenging geography, however, it means that a large number of New Zealanders (between 20,000 to 100,000) receive their drinking water from very small suppliers[77]. This does not include domestic self-suppliers.

Small rural suppliers encompass a diverse range of circumstances, ranging from several households sharing a common water source (such as a bore); through to rural industries such as dairy factories

[77] BECA, *Additional Analysis on Drinking Water Costs for Compliance* (Department of Internal Affairs, November 2019), 1. https://www.dia.govt.nz/diawebsite.nsf/Files/Three-waters-documents/$file/Additional-Analysis-on-Three-Waters-Drinking-Water-Work.pdf.

and meat processing plants which supply water services to local communities (sometimes as a condition of consent); through to suppliers that may service, at times, a significant number of people (e.g. ski-fields and other tourist operators). This group also encompasses a significant number of Māori community drinking water suppliers, including marae, papakāinga, kohanga and iwi trusts.

The financial impact of raising the standard of service for small rural supplies, particularly marae (which are normally non-profit) has not been quantified but could be significant. The non-financial implications may also be significant, such as the closure of uneconomic supplies or supplies that the operating entity considers to be unrelated to core business.

The multiplicity of suppliers means very few are big enough to optimise efficiencies have the scale needed to optimise efficiencies. It also creates a range of consequential inefficiencies, such as limiting access to specialist skills, being less attractive to private equity and making access to sophisticated technology prohibitively expensive. It further complicates government's ability to apply and enforce an effective regulatory framework, while simultaneously increasing the cost of regulation.

4.1.3. Irrigation

The lack of a consistent framework for decision-making was most explicitly commented on in our consideration of irrigation. Water storage provides a good, topical example. Reliability of supply is a key concern for irrigators – there is no value in investing in expensive systems if water is not accessible when it is most needed. The most efficient and environmentally sensitive methods of water application depend on a reliable water supply. High value, and low discharging, horticultural and viticulture crops are enabled by reliable water for irrigation, whereas low reliability tends to favour less environmentally friendly uses, such as some forms of agriculture. A widely accepted rule of thumb is that reliability needs to increase above 90% to encourage a broad range of potential uses. The consequence is that limiting irrigation to 'run of the river' schemes, which are subject to seasonal flow variations, inhibits the move to higher value production which provides better environmental (and economic) outcomes. In addition, water storage has a wide range of other potentials, including the ability to provide an alternative raw water source for community supplies, to power hydro-electric generation, for a wide range of leisure and recreation activities and to achieve environmental outcomes, such as increasing wetland margins.

Historically, most irrigation schemes were built when water allocation was focussed on minimising production losses and little regard was given to the in-stream consequences of taking water from the environment in low-flow seasons, or during droughts. The desirability of storing water during high flow (or flood) events for use during low flow seasons was not generally considered.

Well planned and executed water storage schemes can provide a range of social, environmental and economic benefits. These include recreational opportunities, urban drinking water storage (including mitigation against droughts), hydro-electric generation (including mitigation against droughts), increased agricultural and horticultural productivity, and a transition to a lower carbon emission model for primary production. The Land and Water Forum has given considerable thought to the issue of water storage. They identified that it has the potential to provide a range of economic and environmental advantages, including environmentally 'clean' energy production, the production of higher value crops, reduction of contamination and the replenishment of aquifers.[78]

However, to achieve these outcomes a holistic view of water management, where trade-offs can be managed and synergies encouraged, is required.

[78] Land and Water Forum, *Report of the Land and Water Forum: A Fresh Start for Fresh Water* (Land and Water Forum, September 2010), 40. http://www.landandwater.org.nz/Site/Resources.aspx#H126743-12.

4.2. Councils are Facing Increasing Costs in the Management of Water and Ownership of Water Infrastructure

In December 2020 the Department of Internal Affairs proactively released a preliminary analysis prepared by the Water Industry Commission for Scotland.[79] The report was commissioned by the Department to assess the potential for economic benefits as a result of aggregation. Some of the key findings of this report were that:

- All local authorities, with the exception of Christchurch City, have been under-investing in their three-waters assets.
- That between $27 billion and $46 billion will be required in additional investments to meet future environmental and drinking water standards. These estimates do not allow for population growth or for enhanced seismic resilience and therefore under-estimate the total investment actually required.
- Without service delivery reform which enable economies of scale the increase in cost to households is likely to be unaffordable for small communities and low-income households.

The Water Industry Commission considers its report to be 'directionally accurate'[80], but notes that a more detailed analysis is underway based on a comprehensive request for information from local authorities. It is expected that this second stage report will be completed in March 2021 and used as the basis for consultation with the local government sector in April / May 2021.

In addition to the Water Industry Commission report, the Department of Internal Affairs has previously commissioned two more specific and detailed reports considering the cost of upgrading water treatment plants to full compliance with existing drinking water standards (DWSNZ), which was found to be in the order of $3.0 - $4.4bn[81]; and the cost of upgrading existing waste water treatment plants to achieve potential new environmental standards for coastal discharge, which was found to be in the order of $1 - $1.5bn[82]. These costs do not include the cost of renewing infrastructure (including the pipe networks), increasing health and environmental standards, meeting carbon zero targets, managing the impacts of climate change and coping with increasing population growth.

A July 2020 study of three waters infrastructure in Hawkes Bay considered future costs and calculated how they were likely to impact each of the four territorial authorities – Central Hawke's Bay (population 15,000), Hastings (population 90,000), Napier (population 62,000) and Wairoa (population 9,000). The conclusion was that the costs of future three waters investment were likely to be unaffordable for the smaller communities of Wairoa and Central Hawke's Bay[83]. This assessment was based on an international affordability metric which sets a target limit of no more than 2% of household income spent on water and wastewater.

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[79] Water Industry Commission for Scotland, *Economic Analysis of Water Services Aggregation: Report Prepared for the Department of Internal Affairs* (Department of Internal Affairs, December 2020). https://www.dia.govt.nz/diawebsite.nsf/Files/Three-waters-reform-programme/$file/Analysis-of-economic-impacts-of-water-services-aggregation-Briefing-to-Minister.pdf.

[80] Ibid, 5

[81] BECA, *Additional Analysis on Drinking Water Costs for Compliance* (Department of Internal Affairs, November 2019), 22. https://www.dia.govt.nz/diawebsite.nsf/Files/Three-waters-documents/$file/Additional-Analysis-on-Three-Waters-Drinking-Water-Work.pdf.

[82] GHD Limited and Boffa Miskell Limited, Cost Estimates for Upgrading Wastewater Treatment Plants That Discharge to the Ocean: Final Report (Department of Internal Affairs, December 2019), 29.https://www.dia.govt.nz/diawebsite.nsf/Files/Three-waters-documents/$file/Report-2-Cost-Estimates-for-Upgrading-WWTPs-that-Discharge-to-the-Ocean.pdf,

[83] Morrison Low and WSP Opus, *Hawke's Bay Three Waters: Business Case of Three Waters Service Delivery Options* (Hawkes Bay Regional Council, July 2020), 125. https://www.hb3waters.nz/assets/Uploads/HB-3-Waters-Delivery-Detailed-Analysis-29.07.20-Full-Report.pdf,

The Hawke's Bay findings are consistent with further work undertaken by the Department of Internal Affairs which also found that small, rural communities were likely to be disproportionately impacted by increasing three-waters costs, as shown in the graph below.

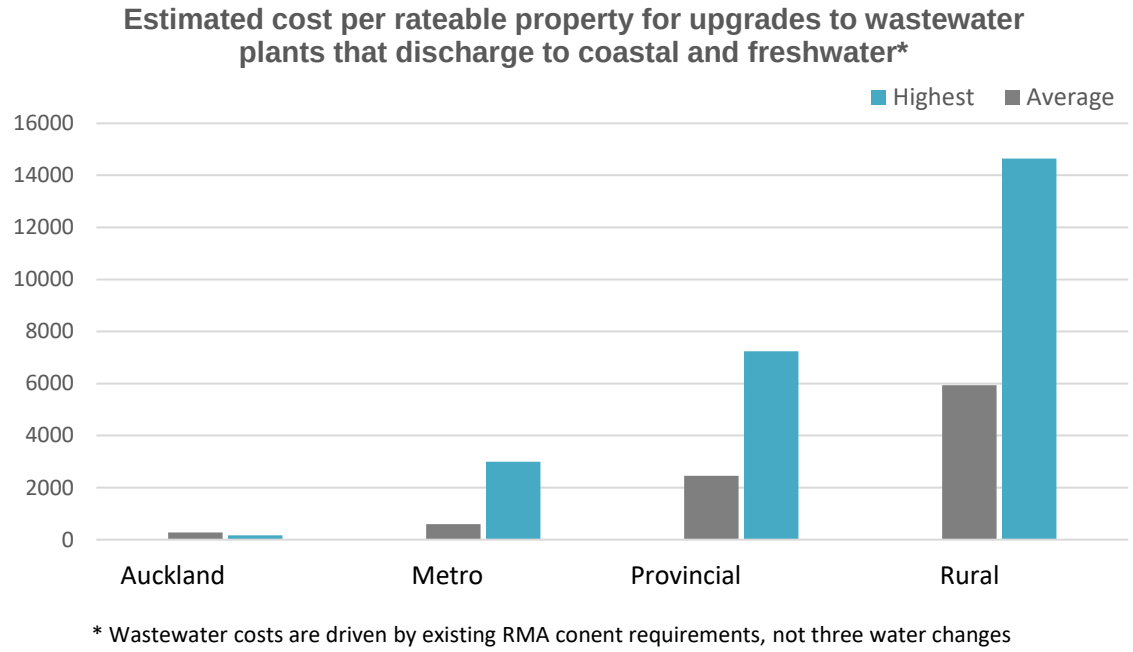

Figure 17: Estimated Cost Per Rateable Property for Wastewater Upgrades.[84]

Several reports considering local government funding, such as the 2007 'Shand report'[85] and the 2019 Productivity Commission report on local government funding and financing[86], have highlighted that the Crown is often exempt from paying council rates, including for water services. The Crown is also exempt from development contributions, which are used as a primary source of funding for new developments. Crown exemption essentially means that other ratepayers must pick up the funding deficit, which in some cases can be significant. It also creates a particularly anomalous situation in the case of flood protection, where Crown assets such as rail and road corridors, and health and education facilities are protected by schemes funded by the contributions of private landowners (normally by way of a targeted rate) and not by the wider beneficiaries. The Shand report estimated that the cost to ratepayers of the Crown exemption was in the order of $120 million annually[87], however this is based on land value only and therefore likely to be an under-estimate.

[84] Department of Internal Affairs, "Three Waters Reform Programme: A Proposal to Transform the Delivery of Three Waters Services," presented at the Regional Three Waters Forums, Various, July / August 2020, https://www.dia.govt.nz/diawebsite.nsf/Files/Three-waters-reform-programme/$file/Slide-pack-from-July-Aug-2020-workshops.pdf.

[85] Shand et al., *Funding Local Government: Report of the Local Government Rates Inquiry = Pakirehua Mo Nga Reiti Kaunihera A-Rohe* (Local Government Rates Inquiry Panel, 2007), https://play.google.com/store/books/details?id=70O2tQEACAAJ.

[86] New Zealand Productivity Commission, *Local Government Funding and Financing: Final Report* (NZ Productivity Commission, November 2019), 198. https://www.productivity.govt.nz/assets/Documents/a40d80048d/Final-report_Local-government-funding-and-financing.pdf

[87] Shand et al., *Funding Local Government: Report of the Local Government Rates Inquiry = Pakirehua Mo Nga Reiti Kaunihera A-Rohe* (Local Government Rates Inquiry Panel, 2007), https://play.google.com/store/books/details?id=70O2tQEACAAJ, 232.

4.3. Regulatory Framework is Ineffective, Incomplete or Absent

4.3.1. Three Waters

Overseas experience demonstrates that optimal performance for water utilities operating in a monopolistic environment necessitates strong regulatory oversight and the consistent definition and enforcement of health, economic and environmental standards. [88]

In New Zealand the variety of uses of water and the different infrastructure requirements, have given rise to a plethora of central government agencies (such as the Ministry for the Environment, Ministry of Health, Ministry of Primary Industries, Ministry of Business, Innovation and Employment, Department of Internal Affairs, Environmental Protection Authority and Parliamentary Commissioner for the Environment) plus regional and local councils who each have an interest in a particular element of freshwater. Coordination between government agencies occurs, but could be improved.

Existing regulatory elements are discussed below:

Health

The current water quality framework, targeted at ensuring safe drinking water, is provided through the Health Act 1956 and the Drinking-water Standards for New Zealand 2005 (Revised 2018). The Act and Standards are administered by the Ministry of Health, who report annually on the compliance of drinking water suppliers serving more than 100 people. Its 2018-19 report outlined that 76.2% of the target population received water from suppliers who achieved full compliance with bacteriological, protozoal and chemical standards. However, non-compliance with the standards can be technical (i.e. failing to monitor/test on sufficient days of the week) and is often argued to be misleading as an indicator of actual public health risk by local authorities.[89]

The drinking water standards are the key regulatory mechanism for drinking water quality. They require water suppliers to have a water safety plan for each of their drinking water distribution networks which mandates acceptable protozoal and bacterial levels that each water treatment plant must meet. Drinking Water Assessors, who report to the Director-General of Health but are employed by District Health Boards, have a key role in approving water safety plans and overseeing the safety of drinking water.

A key finding of the Inquiry into Havelock North Drinking Water was that the current, Ministry of Health-led system, was seriously deficient, complacent and 'ineffectual' in preventing breaches.[90] As a consequence, the government has established a new water regulator, Taumata Arowai as a sole focus water quality regulator. The legislation formalising the creation of Taumata Arowai received Royal Assent on 6 August 2020 and an enabling Bill, which defines the functions and powers of Taumata Arowai was introduced to Parliament on 28 July 2020 and (at the date of writing) had been referred to the Health Select Committee to consider, with public submissions closing on 2 March 2021.

Once enacted, the Water Services Bill will manage public health risks relating to the collection, treatment and provision of drinking water, although self-supplies are excluded. In its current form the Bill creates duties that must be met by drinking water suppliers by embedding six fundamental principles of drinking water safety, which are:

[88] Ingo Vogelsang, *Public Enterprise in Monopolistic and Oligopolistic Industries* (London: Harwood Academic Press, 1990)
[89] Nonetheless a failure in the delivery of safe drinking water could have substantial consequences and therefore, based on the 'Swiss-cheese model of accident causation, any failure must be considered significant.
[90] Government Inquiry into Havelock North Drinking Water, *Report of the Havelock North Drinking Water Inquiry: Stage 2* (Department of Internal Affairs, December 2017), 125- 126. https://www.dia.govt.nz/diawebsite.nsf/Files/Report-Havelock-North-Water-Inquiry-Stage-2/$file/Report-Havelock-North-Water-Inquiry-Stage-2.pdf

- A high standard of care must be embraced in relation to drinking water
- Protection of source water is of paramount importance
- Multiple barriers against contamination of drinking water must be maintained
- Change precedes contamination of drinking water and must never be ignored
- Suppliers must own the safety of drinking water
- A preventive risk management approach must be applied in relation to drinking water.

Environmental

Environmental oversight of water is spread amongst eleven regional councils and six unitary authorities. Unitary authorities have the functions of both territorial and regional authorities, and therefore are both environmental regulators as well as providers of various water services, including three-waters and Flood Protection. This raises concerns about the potential for conflicts of interest (or the perception of a conflict of interest).

The role of councils in compliance, monitoring and enforcement activities has raised concerns[91]. These include the cost of enforcement (which can act as a dis-incentive) and the role of elected members (i.e. 'politicisation of decisions). There is no dedicated environmental regulator for waters, or any 'guards of the guardians'[92] overseeing the enforcement choices of local authorities, although the Ministry for the Environment and the Environmental Protection Authority both have strong interests in environmental water quality.

Key regulatory mechanisms include:

- Resource Management Act 1991: The Resource Management Act regulates how councils and communities manage water. The waters focus of the Act is primarily administered by regional councils, including unitary authorities, and covers both water use (how water is taken, used, dammed or diverted) and the quality of water discharged into the environment. The Resource Management Act also makes provision for National Policy Statements, such as the National Policy Statement for Freshwater Management, National Environmental Standards, such as the National Environmental Standard for Sources of Human Drinking Water, and National Planning Standards.
- Regional Policy Statements and Plans: The Resource Management Act is actioned through a hierarchy of regulatory documents. At a national level these include Regulations, National Policy Statements, National Environmental Standards and National Planning Standards. Through these documents, central government can provide direction to local authorities and indirectly to communities and the private sector. These national planning documents are required to be taken into account by regional councils in the development of Regional Policy Statements, Regional Plans and the issuing of resource consents which is where key water allocation and environmental quality decisions are made. Territorial authorities have a lesser role in regulating water use, however they have the responsibility for consenting ancillary land uses under the Resource Management Act (including the protection of source water), the consenting of structures (under the Building Act) and the ability to establish a range of bylaws, such as for trade waste, all of which impact on water use.

[91] Julia Talbot-Jones, Sophie Hale, and Suzie Greenhalgh. "Review of Policy Instruments for Freshwater Management," *Motu Working Paper 20-10* (November 2020): 54.
[92] Leonid, Hurwicz, "But Who Will Guard the Guardians?" *The American Economic Review* 98, no. 3 (June 2008): 577–85.

Table 3 outlines the current National Policy Statements and National Environmental Standards which regulate water infrastructure from an environmental perspective.

Name	Effect
National Policy Statement on Freshwater Management	The National Policy Statement on Freshwater Management sets targets for freshwater quality, including national environmental bottom lines, which control how water can be used, what can be discharged into freshwater bodies and processes to set and manage water allocations. It provides direction to local authorities on managing the activities that affect the health of freshwater (including water infrastructure) and enshrines Te Mana o Te Wai as a fundamental consideration in freshwater management.
National Environmental Standards for Freshwater	The National Environmental Standard for Freshwater sets requirements for carrying out certain activities that pose risks to freshwater and freshwater ecosystems. Anyone carrying out these activities must comply with these standards.
New Zealand Coastal Policy Statement 2010	This Policy Statement sets objectives and policies for the management of the costal environment, including instances of treated or untreated wastewater and stormwater discharges.
National Environmental Standard for Sources of Human Drinking Water	The National Environmental Standard for Sources of Human Drinking Water is a regulation made under the Resource Management Act 1991 that sets requirements for protecting sources of human drinking water from becoming contaminated.

Table 3 - Current National Policy Statements and Environmental Standards

- Council Bylaws and District Plans: Local councils have the authority to establish bylaws, which are a subordinate form of legislation, for a wide range of local purposes. In the context of water, trade waste bylaws, which manage the quality of industrial discharge into stormwater and wastewater systems, are very common. Water and wastewater bylaws also allow controls on network connections and disconnections, damage and interference with public reticulation and standards for vesting assets. Other bylaws (such as for reserves) may incorporate water-related issues (e.g. protection of source water).

- District Plan objectives, policies and rules tend to be focussed on land use activities. However these can also have a significant impact on water management, for example through the protection of source water from inappropriate activities; by regulating urban site coverage or de-forestation (and therefore stormwater run-off); by ensuring development is located away from flood-prone land.

- Council development engineering: Infrastructure and development standards produced by territorial authorities specify the volumes and configuration of rainwater tanks for habitable structures not connected to a reticulated supply. These are typically required to provide in the order of 45m^3 per household to allow for drought resilience and fire supply. Supplementary supply in dry periods are often sourced from private or municipal bores often via tanker services. In some locations this places pressure on groundwater aquifers leading to reduction of environmental flows or saltwater intrusion.

In addition to the above, the Water Services Bill (discussed previously) includes provisions empowering Taumata Arowai – the Water Services Regulator to monitor and report on the environmental performance of wastewater and stormwater schemes nationally.

Economic

There is no independent economic regulator for waters services in New Zealand, and neither is there any explicit provision for consumer protection (something becoming more common internationally). Each water provider in New Zealand sets their own charges based on local circumstances. Because territorial authorities deliver a range of functions it is usually difficult to robustly determine whether charges accurately reflect the actual cost of service or whether the water service is being subsidised by other activities (or is subsidising other activities).

There appear to be a number of reasons that economic regulation of the waters industry has not been considered a priority. Firstly, there are logistical issues involved in adequately providing regulatory overview for a large number of providers, particularly when there are substantial disparities in size and capability. It is also likely that the public sector nature of local government has diminished the perceived need for independent regulation, with elected members effectively left to occupy this role on behalf of their electors.

There is a clear body of evidence demonstrating that independent economic (and other) regulation would be beneficial. A range of publications[93] have demonstrated that the inefficiencies of natural monopolies apply equally in the public sector, including the provision of water services, as they do in the private sector. By reducing these inefficiencies, economic regulation has been shown to generate positive benefits for consumers beyond cost saving and irrespective of ownership. For example, in the decade following privatisation and the establishment of an economic regulator in England and Wales, the sector delivered a 30% reduction in leakage"[94].

As shown in Table 4 below, New Zealand's current regulatory framework compares poorly against what is considered to be the minimum standard for water regulation in Australian states (noting that the health component will improve with the passage of the Water Services Bill and consequent enabling of Taumata Arowai).

[93] See for example: Sean Ennis and David Deller, *Water Sector Ownership and Operation: An Evolving International Debate with Relevance to Proposals for Nationalisation in Italy* (Centre on Regulation in Europe, July 2019)
[94] Ofwat, *Reference of the PR19 Final Determinations: Overview* (UK: Office of Water Services, March 2020), 10. https://www.ofwat.gov.uk/wp-content/uploads/2020/03/Reference-of-the-PR19-final-determinations-Overview.pdf.

STATE	Economic Regulation	Environmental Regulation	Health Regulation
NSW	Metro / Regional	✓	✓
VIC	✓	✓	✓
QLD	✗	✓	✓
SA	✓	✓	✓
WA	○	✓	○
TAS	✓	✓	✓
ACT	✓	✓	✓
NT	✗	✓	○
NZ	✗	○	✗

Table 4 - Australia and NZ's Performance against Minimum Regulatory Standards.[95]

Given the disjointed (or absent) nature of existing regulation it is not surprising that outcomes for local communities vary. Many communities receive excellent water services. However, there are many troubling examples of poor service, including Darfield, Havelock North, Dunedin and Featherston for drinking water; and Raglan, Taupo and Wellington for sewerage. Furthermore, it is likely that many communities, like Havelock North prior to 2016, simply don't know what the state of their water's infrastructure is, and what the attendant risk to health and livelihoods may be.

4.3.2. River Control, Flood Protection and Drainage

Flood protection is primarily managed by regional councils through an array of legislation including the Local Government Act 2002, Resource Management Act 1991, Soil Conservation and Rivers Control Act 1941, Land Drainage Act 1908 and the Civil Defence and Emergency Management Act 2002.

Until the 1989 local body reforms, sole-focussed Catchment Boards were the frontline providers of flood protection and were themselves provided with support through a centralized regulatory and research organization, the National Water and Soil Conservation Authority (NWASCA). Post-1989 the role of catchment boards has been subsumed into regional councils and NWASCA (which was a part of the former Ministry of Works) has been abolished. There is now no nationally coherent framework for flood protection.

This is a key concern for flood protection practitioners and is particularly important when considering the need for a consistent approach to climate change response and the national implications of

[95] Adapted from Frontier Economics and ARUP, *Urban Water Regulation Reform: A Report Prepared for Infrastructure Australia* (Infrastructure Australia, December 2017), vii. https://www.infrastructureaustralia.gov.au/sites/default/files/2019-06/frontier_economics_and_arup_urban_water_regulation_reform.pdf ,

adopting mitigation and avoidance policies, such as managed retreat. It is noteworthy that the lack of national coordination is a widely held concern throughout each of the waters sectors.

Recently the Resource Management Review Panel has recommended significant changes to environmental legislation, including the preparation of a Strategic Planning Act and a Managed Retreat / Climate Change Adaptation Act[96]. From a flood protection perspective, a significant purpose of this latter proposed new legislation is to alter the presumption of 'existing use rights' in circumstances where there is substantial risk that the occupation of a site is no longer safe, or is likely to become unsafe.

4.3.3. Irrigation and the Resource Management Act

The Randerson report[97] has identified a range of deficiencies in the Resource Management Act, including its increasing complexity (largely as a result of numerous amendments), lack of responsiveness to changing circumstances and the cost and delay caused by its processes. These concerns are not new and have become clearer as water over-allocation and quality concerns have become more prevalent. Issues such as the lack of flexibility (for example, in the use of economic instruments) and large gaps in information and data are other common concerns.

Allocative efficiency is also constrained by the court-mandated practice of considering applications for water permits on a *first in, first served* basis. This practice means that consent applications are processed and determined in the order they are received. Under this approach, there can be no guarantee that allocative decisions will support the highest or best yielding uses. Where there is sufficient water available to meet all demands, allocation decisions will not be compromised. However, where supply is constrained the risk is that the most meritorious uses will miss out.

In the context of water infrastructure one of the major concerns is the legislatively fixed cap on the duration of resource consents. The upfront capital costs of even moderately sized water projects, whether they be for irrigation, flood control or three waters, are substantial, and the period from initiation to full operation can be lengthy. The fact that consenting authorities are unable to provide certainty beyond 35 years generates uncertainty for investors and financiers, and therefore increases costs. This is true for all forms of water infrastructure, but it is becoming more relevant for irrigators as demand grows for security of supply which can only be provided through greater water storage.

This concern was noted, as follows, by the Land and Water Forum in its first, 2010 report, entitled 'A fresh start for fresh water'.

> *"The development of irrigation and hydro-electric schemes have been particularly litigious, bedevilled by fears that the economic benefits will be accompanied by damage to the environment, and by the hesitant growth of processes to identify outcomes that provide cultural, economic, environmental and social benefits."*[98]

4.3.4. Te Mana o Te Wai

With the implementation of the National Policy Statement on Freshwater Management in 2020, Te Mana o Te Wai has been reinforced as an integral principle for freshwater management in New Zealand. Te Mana o Te Wai creates a hierarchy of obligations which are applicable to freshwater management, as described below:[99]

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[96] Randerson et al., *New Directions for Resource Management in New Zealand: Report of the Resource Management Review Panel (*Resource Management Review Panel, June 30, 2020) https://www.mfe.govt.nz/sites/default/files/media/RMA/rm-panel-review-report-web.pdf.

[97] Ibid

[98] Land and Water Forum, *Report of the Land and Water Forum: A Fresh Start for Fresh Water* (Land and Water Forum, September 2010), ix. http://www.landandwater.org.nz/Site/Resources.aspx#H126743-12.

[99] Kahui Wai Māori, *Te Mana O Te Wai: The Health of Our Wai, The Health of Our Nation* (Ministry for the Environment, April 2019), 4. https://www.mfe.govt.nz/sites/default/files/media/Fresh%20water/kahui-wai-Māori-report.pdf

1. The first obligation is to protect the health and mauri of the water.
2. The second obligation is to provide for essential human health needs, such as drinking water.
3. The third obligation is to enable other consumptive use, provided that such use does not adversely impact the mauri of freshwater.

This framework now governs applications for future water allocations by prioritising water allocations, recognising that where catchments have the potential to be, or are, oversubscribed, the health of the catchment will be given primacy over all other uses. Te Mana o te Wai has now been embedded in the Taumata Arowai – the Water Services Regulator Act 2020. There is also a requirement in the newly introduced Water Services Bill that all persons who perform or exercise functions, powers, and duties under the legislation must give effect to Te Mana o te Wai.

The implications of Te Mana o te Wai are significant. As an example, it is assessed that 18% of all water in New Zealand treated for human consumption is lost through leakage. In the 2019 fiscal year, participants in Water New Zealand's 'National Performance Review' lost 119 million cubic metres of water through their water supply systems, equivalent to over 47,000 Olympic-sized swimming pools. In some communities, such as Greytown, testing has recently shown that water losses were in the order of 69%.[100] This wastage of treated water is unlikely to be acceptable as catchments come under further allocative pressure.

Councils, and the water industry generally, are still getting to grips with Te Mana o te Wai and Māori perspectives generally. There is a general concern that the water industry lacks capability and capacity to effectively address these matters, and that Iwi / Māori lack the resources to actively engage and assist.

4.4. Water Infrastructure Asset Management is Variable

4.4.1. Three Waters Infrastructure

There are a multiplicity of actors engaged in providing three-waters infrastructure, with a substantial variance in scale between them. Providers range from corporate entities such as WaterCare Services Limited, who manage almost $11bn in assets, through to very small rural and marae-based suppliers who may serve only one household. This variance in scale inevitably gives rise to a variance in the standard of asset management. Improved asset management has been identified as a key issue for three waters in a number of studies, including work undertaken by Water New Zealand, Local Government NZ[101], the Office of the Auditor General and the Department of Internal Affairs.

> "There are reasons to be concerned that investment decisions in the sector are being made with limited information on the state of the assets. Responses to the LGNZ National Information Survey revealed that a large proportion of three waters assets are ungraded, and some councils' entire networks have not been graded according to their condition. In addition, despite the requirement for renewal profiles in councils' LTPs, 16 per cent of respondents to the National Information Survey stated that they do not have a renewals profile for potable water assets, and 20 per cent of respondents did not have a renewals profile for their wastewater assets."[101]

[100] Marcus Anselm and Arthur Hawkes, "Water Loss Alarming," *Wairarapa Times-Age*, September 1, 2020
[101] Local Government New Zealand. "Improving New Zealand's Water, Wastewater and Stormwater Sector." Local Government New Zealand, September 2015. https://www.lgnz.co.nz/assets/2aa82f85f1/29617-three-Waters-Position-Paper.pdf

A 2017 study of asset management planning maturity commissioned by the Department of Internal Affairs found that while most service providers had the underpinnings of basic asset management there was a direct correlation between the quality of asset management planning and the scale of operations. The findings of this study are described in the following graph.

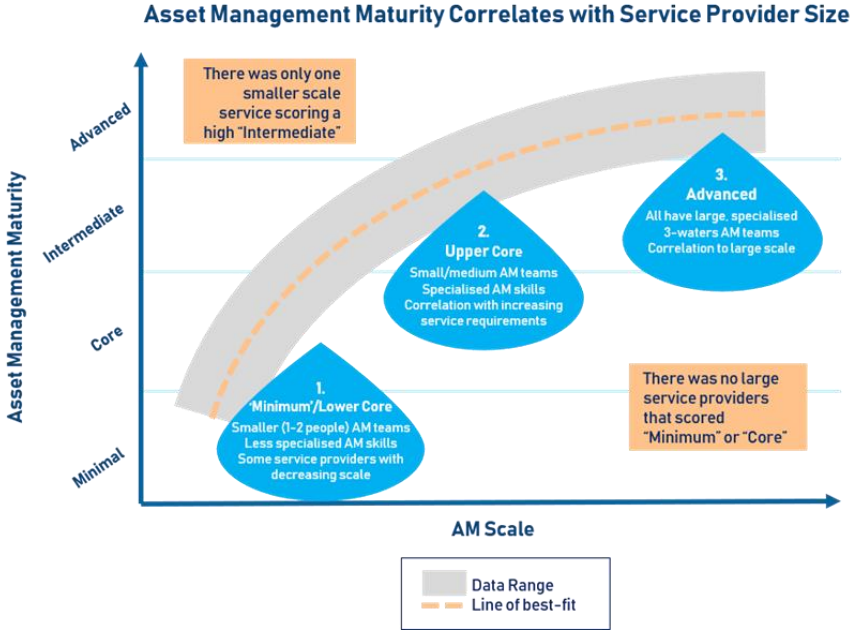


Figure 18: Asset Management Maturity Correlates with Service Provider Size.[102]

For three waters infrastructure the best source of asset information comes from Water NZ's 'National Performance Review' survey. Based on this survey we know that a significant portion of assets are assessed as being in "poor asset condition". Water NZ reports 10 of 41 respondents had at least 20% of drinking water pipework rated as condition grade 4 (poor) or 5 (very poor) with a further 11 having at least 20% of the condition of their drinking water network unassessed[103].

The following districts have over 20% of their drinking water, wastewater and stormwater pipelines assessed as being in poor or very poor condition. This report only takes into consideration the 42 of 64 councils that took part in this survey, but in total they account for 92% of New Zealand's population.

[102] Castalia Advisory Group, *Three Waters Asset Management Maturity in New Zealand* (Department of Internal Affairs, October 2017), ii. https://www.dia.govt.nz/diawebsite.nsf/Files/Three-waters-documents/$file/Castalia-ThreeWaters-Asset-Management-Maturity-in-NZ-(final-report)-Oct-2017.pdf.
[103] Water New Zealand, *Pipeline Condition Dataset from National Performance Review 2018 - 2019* (Water New Zealand, 2019). https://www.waternz.org.nz/Pipecondition.

Drinking water pipelines graded as poor or very poor condition

District	Percent graded poor or very poor (%)
Masterton	46
Taupo	42
Invercargill	41
Far North	35
Kapiti Coast	27
Rotorua	27
Grey	23
New Plymouth	22
Kaipara	22
Marlborough	21

Table 5 - Drinking Water Pipelines Graded as Poor or Very Poor Condition.[104]

Wastewater pipelines graded as poor or very poor condition

District	Percent graded poor or very poor (%)
Nelson	50
New Plymouth	35
Wellington	33
Invercargill	31
Palmerston North	35
Masterton	24

Table 6 - Wastewater Pipelines Graded as Poor or Very Poor Condition.[105]

[104] Water New Zealand, *Pipeline Condition Dataset from National Performance Review 2018 - 2019* (Water New Zealand, 2019). https://www.waternz.org.nz/Pipecondition.
[105] Ibid.

Stormwater pipelines graded as poor or very poor condition

District	Percent graded poor or very poor (%)
Hauraki	30
Invercargill	39
Masterton	39

Table 7 - Stormwater Pipelines Graded as Poor or Very Poor Condition.[106]

4.4.2. Flood Protection Infrastructure

Ensuring flood protection works are maintained to a high standard is just as important as maintaining a high standard of drinking water. A recent national assessment of current practices found that regional councils have adopted an appropriate approach to asset management, renewal and upgrades, notwithstanding that there was a concern that asset criticality and performance were not well documented. It was also noted that *"… the methods used by councils to understand, interpret and approach both technical and non-technical river management issues are inconsistent, and this variability may unknowingly expose some New Zealand communities to a greater likelihood of asset failure and its consequences."*[107]

4.4.3. Irrigation Infrastructure

Each sector suffers, to a greater or lesser degree, from shortcomings in data collection. In the case of irrigation, the lack of a consistent data set across all schemes means that it is not possible to definitively assess the standard of asset management of irrigation schemes. The National Infrastructure Unit's 2015 Evidence Base noted that there was anecdotal evidence that the asset management practices have been historically immature. It was however noted that a number of factors were likely to be improving this position, including:

- *"Increasing liability – the significant investment that efficient irrigation and its resulting land uses requires has created an increased level of shareholder debt which the irrigation scheme water supply performance underpins;*
- *Changing management structures – the majority of large schemes have recently employed skilled general managers with specific responsibility for the operation of the scheme, which has inevitably resulted in the gradual introduction of more formal asset management systems;*
- *Increasing focus on regulatory factors with water use under increased scrutiny due to scarcity in some catchment areas and also new dam safety requirements (larger races are also captured by the same legislation);*
- *A number of new schemes and proposed schemes that need to raise capital, requiring greater discipline; …"*[108]

[106] Water New Zealand, *Pipeline Condition Dataset from National Performance Review 2018 - 2019* (Water New Zealand, 2019). https://www.waternz.org.nz/Pipecondition.
[107] Tonkin & Taylor Ltd, *Hiding in Plain Sight: An Overview of Current Practices, National Benefits and Future Challenges of Our Flood Protection, River Control and Land Drainage Schemes* [Executive Summary], (Wellington Regional Council, April 2018)
[108] National Infrastructure Unit, *Infrastructure Evidence Base 2015 Refresh: Productive Water* (Treasury, March 2015), 8. https://www.treasury.govt.nz/sites/default/files/2019-10/3142330_1%202015%20Evidence%20Base%20Productive%20Water.pdf.

4.5. Resilience

Resilience is important for all water infrastructure but is particularly vital for flood control works and for the provision of healthy drinking water. In the waters sector it has been suggested that resilience has been taken to mean being large enough or strong enough to cope with extreme scenarios or to absorb gradual degradation over time. However, design solutions are increasingly incorporating alternative solutions, such as hybrid or distributed systems with nested decentralised and centralised capacity or green infrastructure systems. These alternatives also combine multiple outcomes, such as adaptive diversity and carbon mitigation.

4.5.1. Flood Protection Infrastructure

Figure 19: Edgecumbe Flood, 2017.[109]

On April 6, 2017 a section of floodbank in Edgecumbe in the Bay of Plenty suddenly gave way following torrential rain from cyclones Cook and Debbie (as shown in the photograph above). Approximately 2,000 people had only minutes to evacuate their homes and many had to be rescued.

Incidences of flooding are not uncommon in New Zealand. For example, a local state of emergency was recently (10 November 2020) declared in Napier following a heavy rain event. The River Managers' Forum has raised a concern at the significant costs required to upgrade existing flood control works to cope with the impacts of climate change. The need for future investment in flood risk mitigation has been estimated at more than $350m per annum over at least ten years.[110] This does not include the cost of enhancing rural drainage from the impacts of increased flooding and coastal inundation, nor does it eliminate the residual risk of flooding.

In July 2020, the government announced that 150 climate resilience and flood protection projects had been included in the $3bn Covid Response and Recovery Fund. These projects have a total value of $210m.

[109] Whakatane Beacon, "Edgecumbe Flood, 2017" Te Ara - the Encyclopedia of New Zealand, August 1, 2017, online image http://www.TeAra.govt.nz/en/photograph/46848/edgecumbe-flood-2017.
[110] Hutchings, et al., *Central Government Co-Investment in River Management for Flood Protection Critical Adaptation to Climate Change for a More Resilient New Zealand* (Taranaki Regional Council, August 2019),

4.5.2. Three Waters Infrastructure

The UC Quake Centre is a partnership between the New Zealand Government, the University of Canterbury, several local authorities (including Christchurch and Wellington City Councils) and industry groups. It has developed guidelines for assessing the technical resilience of three waters piped assets with the aim of enabling asset managers to improve network resilience. The national uptake of this work, and the resources allocated to enable it, are unclear.

Ad hoc indicators of national resilience are available from the 'National Performance Review' survey. For example, we know only slightly more than one third of wastewater treatment plants have backup electricity generators, and that this figure is lower for water treatment plants and pump stations. The number of backup generators in place for pump stations and treatment plants are shown in the graph below.

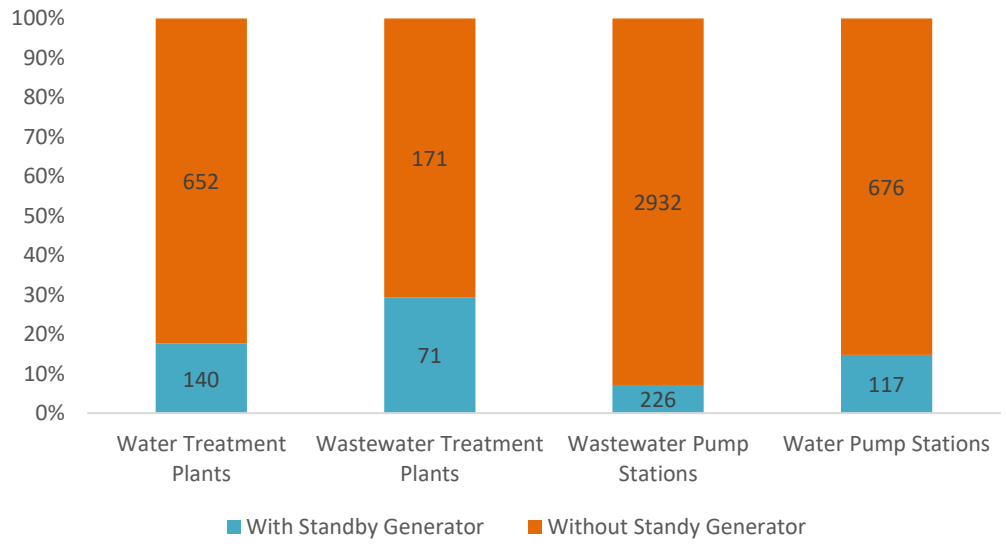


Figure 20: Standby Generators for Water and Wastewater Plants and Pump stations.[111]

We also know the average reservoir level and average days of treated water stored in reservoirs (as shown in the figures below). The quantum of stored water reflects how long an urban supply can last if circumstances, such as mechanical fault or a drought, lead to the treatment plant or raw water supply becoming compromised.

[111] Water New Zealand, National Performance Review 2018 – 2019 (Water New Zealand, 2019). https://www.waternz.org.nz/Attachment?Action=Download&Attachment_id=4271

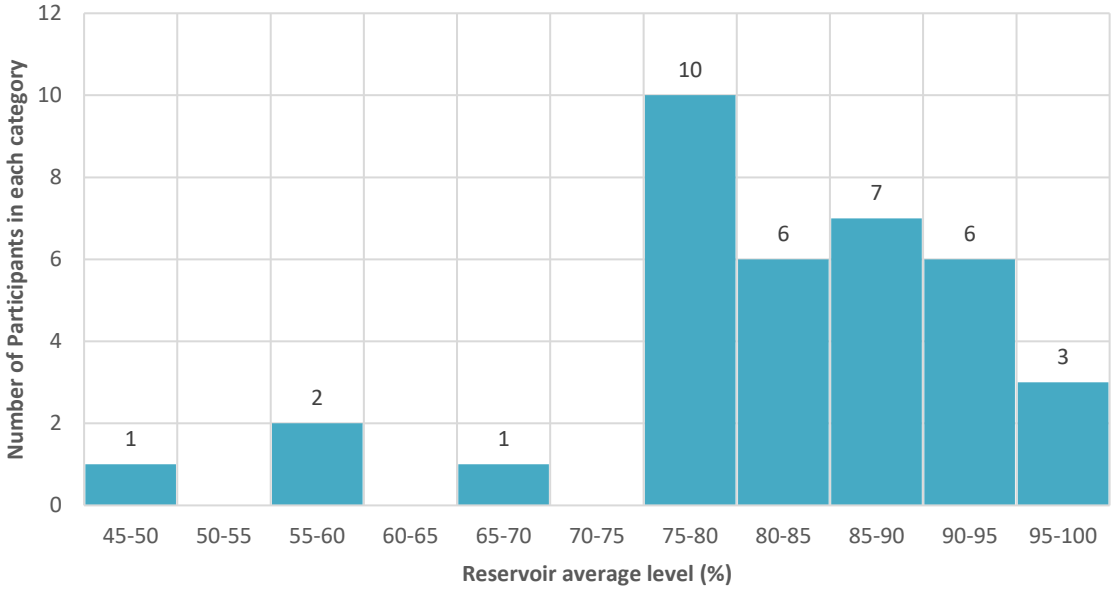


Figure 21: Reservoir Average Level.[112]

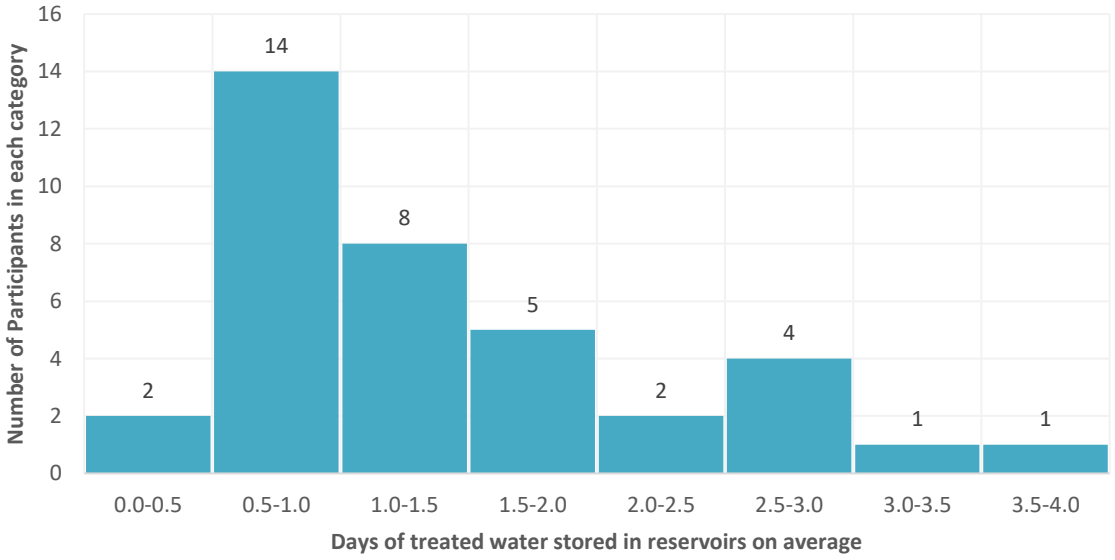


Figure 22: Days of Treated Water in Reservoirs on Average.[113]

Older pipes in NZ's water and wastewater reticulation network commonly include materials that may be considered brittle, such as asbestos cement and earthenware pipes. These materials performed poorly when subjected to ground shaking and deformation during the Christchurch and Kaikoura earthquakes. More modern materials such as PVC and polyethylene performed better but were still vulnerable to major ground movements particularly at connection points to structures such as manholes and pump stations. A learning from Christchurch was to spend time considering the performance of the ground when siting infrastructure, i.e. infrastructure in ground that liquefied performed worse than where ground shaking only occurred and damage was worse still in areas of lateral spread.

[112] Water New Zealand, *National Performance Review 2018 – 2019* (Water New Zealand, 2019), 67. https://www.waternz.org.nz/Attachment?Action=Download&Attachment_id=4271
[113] Ibid

Local authorities are systematically replacing older pipes with more resilient, ductile pipes through renewal programmes. However, progress will be slow as there is a considerable legacy of old materials and other competing demands for infrastructure investment.[114]

Water demand management is often used to gain system-wide resilience during times of water shortage. Unlike the more traditional supply-side management, which aims to increase the capacity of systems to deliver potable water, demand-side management is focussed on improving the efficient use of water. The imposition of water restrictions during summer is a common example of demand management, however there are a range of possible initiatives, such as:

- introducing water metering in order to identify leaks and to introduce a financial incentive to reduce unnecessary use
- retrofitting of houses with dual flush toilets and low flow shower heads
- installation of water harvesting tanks and the promotion of water saving education campaigns.

Water demand management has a range of benefits beyond increasing resilience. These include:

- substantial operational savings as a result of having to treat and transport less raw and wastewater
- capital cost savings from the ability to defer treatment plant expansions
- reduction in the emission of greenhouse gases.

It is generally accepted that green stormwater infrastructure can be more resilient than piped networks in terms of high flow capacity and blockage[115]. Green infrastructure also provides resilience against the phenomenon of urban heat islands, and encourages biodiversity through an increase in open channels, wetlands and raingardens. Similarly, the adaptive capacity of reticulated networks could be enhanced through the greater use of distributed and devolved systems.

[114] New Zealand Lifelines Council, *New Zealand Critical Lifelines Infrastructure - National Vulnerability Assessment* (Civil Defence , 2020), 56. https://www.civildefence.govt.nz/assets/Uploads/lifelines/nzlc-nva-2020-full-report.pdf.
[115] U.S. Environmental Protection Agency, *Green Infrastructure* (U.S. Environmental Protection Agency, December 17, 2020), https://www.epa.gov/green-infrastructure/green-infrastructure-climate-resiliency.

While the state of national preparedness is unclear (across all water types), there are some excellent examples of resilience planning. For example, Wellington Water has undertaken substantial work to understand the vulnerabilities of the region in the event of a major earthquake and to develop and communicate plans to mitigate the loss of potable water to households and resume services as quickly as possible. Figure 23 provides a good example of the work undertaken by Wellington Water to understand the vulnerability of its communities and to communicate this information in a clear and concise manner.

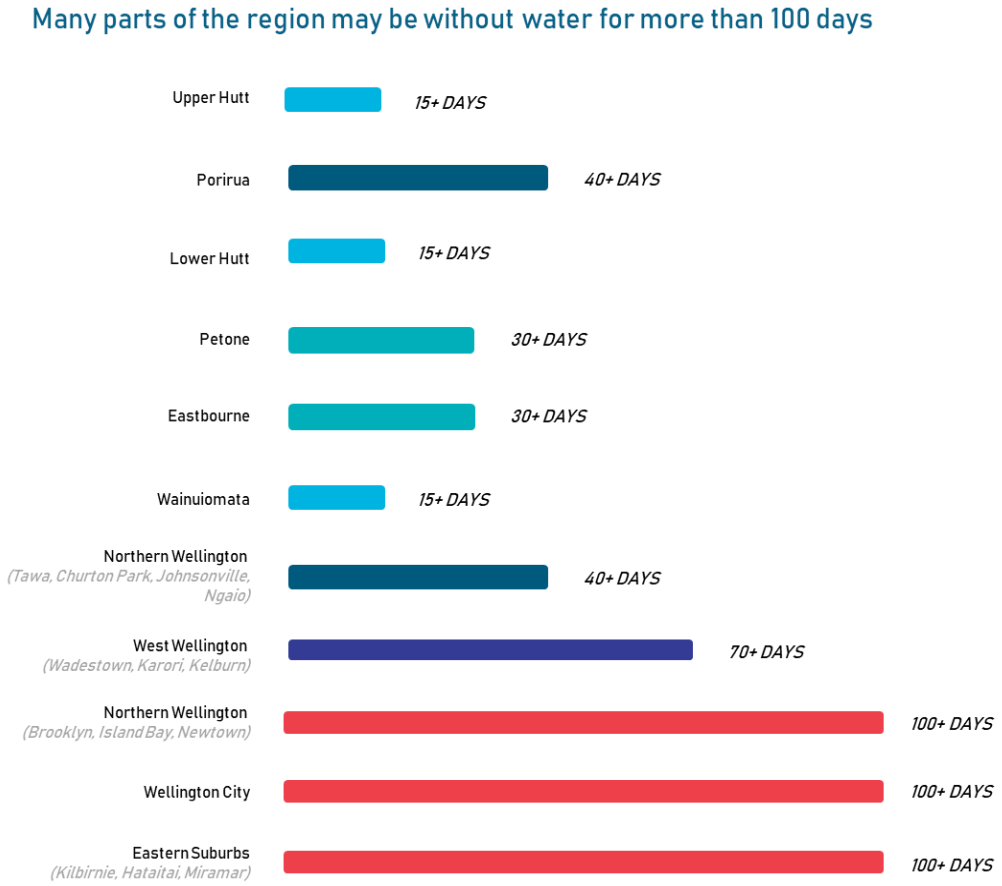


Figure 23: Wellington Water Infographic for Potential Regional Water Loss.[116]

Mitigation measures adopted by Wellington Water include[117]:

- Recommending households have access to potable water supplies for at least seven days and, in liaison with local Councils, publicising the availability of 200 litre domestic water tanks.
- In coordination with the Wellington Region Emergency Management Office, notifying residents that water collection points will be set up in easily accessible locations.
- Providing hundreds of bladders, of different sizes, which can be used to transport and store potable water at community centres.
- Establishing community water stations which can extract and treat water from above ground sources (twelve local rivers and streams) and bores (nine new groundwater bores). Provision has also been made to import desalination plants, if required.

[116] "Above-Ground Emergency Water Network." Wellington Water, accessed November 30, 2020, https://www.wellingtonwater.co.nz/your-water/emergency-water/above-ground-emergency-water-network
[117] Wellington Water, *Above*-Ground *Emergency Water Network.* (Wellington Water, 2018)

5. How is the Sector Performing?

A key emerging theme is that New Zealand's water sector suffers from a fragmented governance and regulatory environment. One of the implications is that systems needed to comprehensively measure performance across both financial and non-financial indicators are either under-developed, or absent. This makes compiling an informed assessment of performance difficult and tends to result in commentary being based on incomplete or anecdotal information. The lack of a robust performance framework is arguably compounded by the long life of reticulated assets and the long timeframe before environmental degradation becomes visible. This lack of immediacy has the potential to allow the slow erosion of natural capital and result in the need for substantial financial capital to reverse decades of under-investment.

5.1. Three Waters

There are three useful sources of comparative data for three waters in New Zealand – these are:

- Mandatory, non-financial performance standards specified by the Secretary of Local Government
- Health standards reported by the Ministry of Health
- Water New Zealand's 'National Performance Review' survey.

5.1.1. Mandatory Non-Financial Performance Standards

The Secretary of Local Government (who is also the Chief Executive of the Department of Internal Affairs) is required to set performance standards for water, wastewater, stormwater, flood protection, and roads and footpaths which each council must measure and report against in their Long Term Plans. These non-financial performance measures were introduced with the intention of enabling the public to compare the level of service provided by different local authorities.

The mandatory performance standards required to be collected and reported on by council water suppliers are outlined in Appendix A. At present, they are not collated and/or analysed and therefore are not used by the industry to evaluate and improve performance.

5.1.2. Ministry of Health – Drinking Water Compliance Reporting

Water suppliers serving populations of more than 100 people are required to provide basic data to the Ministry of Health relating to the performance of their supplies. This information is audited by drinking water assessors and is published online at https://drinkingwater.esr.cri.nz/default.asp.

The focus of the drinking water standards is on the quality of drinking water. The key findings for the most recent, 2018/19 results[118] were that:

- 97.1 percent of the report population (3,960,000 people in 405 supplies) received drinking water that complied with all the legislative requirements under the Act
- 98.9 percent (4,033,000 people in 473 supplies) received drinking water from a supply with a water service plan for which implementation had commenced

[118] Ministry of Health, *Annual Report on Drinking-Water Quality 2018 - 2019* (Wellington: Ministry of Health, June 2020). https://www.health.govt.nz/system/files/documents/publications/annual-report-drinking-water-quality-2018-2019-25june2020.pdf.

- 99.9 percent (4,074,000 people in 475 supplies) received an adequate supply of water with appropriate notification of any interruptions
- 100 percent (4,075,000 people in 479 supplies) received drinking water from a supply for which appropriate source protection activities took place
- 99.7 percent (4,066,000 people in 444 supplies) received drinking water that met all the monitoring requirements in the Standards
- 100 percent (4,076,000 people in 481 supplies) received drinking water from a supplier that recorded and investigated all complaints
- 99.3 percent (4,049,000 people in 470 supplies) received drinking water from a supplier that took adequate remedial action when required.

These are, prima facie, good results. It was significant however that the Ministry has also observed that "[a]chievement against the Standards was generally highest among the large supplies, and decreased progressively through supplies in medium, minor and small categories."[119]

While the figures noted above appear good, for overall achievement of the Standards, a supply must meet the bacteriological, protozoal and chemical requirements of the drinking water standards, which include adherence to the prescribed sampling and monitoring schedule. In the reporting period, only 76.2 percent of the report population (3,107,000 people) received drinking water from supplies that achieved all the Standards. This means that almost one million New Zealanders (970,472) received drinking water that did not reach all of the prescribed standards.

In many cases a failure to achieve the sampling and/or monitoring requirements may have been a minor instance, such as a short loss of power at a treatment station. Nonetheless a failure in the delivery of safe drinking water could have substantial consequences. The 'Swiss-cheese model of accident causation'[120] which highlights that accidents occur when multiple layers of protection are compromised, is relevant in this situation. Specifically, it highlights that accidents are more likely to occur when failures are allowed in multiple layers of safeguard.

It is also important to bear in mind that the reporting figures only include supplies that service populations of greater than 100 people. This covers 4,077,000 people meaning that in the order of 800,000 who are on small, or self-supplies are not included.

5.1.3. Water New Zealand's 'National Performance Review'

This annual survey is the premiere source of information about the performance of the three-waters sector and gathers a broad range of data from voluntary participants. The National Performance Review is a voluntary survey and only includes council-owned water assets. In 2019, the survey was completed by 42 of 64 territorial authorities, who have responsibility for delivering three waters services for 4,536,520 New Zealanders (approximately 93% of the population). The survey therefore provides a strong basis for analysis but cannot be considered to be comprehensive. There are also some concerns regarding the quality of the data supplied, which is reliant on individual councils recording systems.[121]

[119] Ministry of Health, *Annual Report on Drinking-Water Quality 2018 – 2019* (Wellington: Ministry of Health, June 2020), v. https://www.health.govt.nz/system/files/documents/publications/annual-report-drinking-water-quality-2018-2019-25june2020.pdf.

[120] The 'Swiss cheese' model is widely used in risk analysis and management. It likens safety systems to multiple slices of Swiss cheese, stacked side by side. In this model, when the holes in each slice of cheese align the potential for an accident is considered to become manifest.

[121] For example, as noted above, Water NZ has observed that councils with SCADA monitoring of overflow locations reported twice the number of incidences in comparison with councils relying on manual reporting.

Some key findings from the most recently completed (2018/19) survey include:

- Less than half (17 of 43) of participants identified the zone from which raw water was sourced for their drinking water supplies. In addition, only four of the participants indicated that they were actively engaged with their regional council to protect source water supplies. Only one, Hastings District Councils provided a comprehensive response. Water NZ's commentary is that while *"…the Havelock North enquiry findings have catalysed an improvement in that [Hastings] district, … the learnings have not translated into action in other jurisdictions"*.[122]

- Over 1,000 wet weather-related wastewater overflow events were recorded in 2019 across 28 jurisdictions, yet only seven (Auckland, Christchurch, Dunedin, Grey, Nelson, Tauranga, and Whangarei) held consents for such overflows. Water NZ also observed that councils which employed online data acquisition and control systems for monitoring overflow locations reported twice the number of incidences in comparison with councils relying on manual reporting. This suggests the incidence of wastewater overflow is likely to be appreciably higher than is being reported.

- Participants reported a total of 627 nonconformances with wastewater treatment plant consents. In the same period only eleven compliance actions were taken in relation to these consents (six abatement notices, two infringement notices, one enforcement order, and two prosecutions) indicating that formal processes to remedy non-conformance are rare. The low number of compliance actions is consistent with previous years and is consistent with the circumspect approach taken by the Ministry of Health (and criticised by the Government Inquiry panel) prior to the Havelock North water contamination event.

- Only eight of the 43 participants had all their stormwater discharges consented. Most commonly, participants had consents for less than 10% of the network, and six participants had no stormwater discharge consents whatsoever.

- Figures show that consumers in some areas are paying over three times as much ($863/year versus $262/year) for water, and over ten times as much ($1,217 versus $116/year) for wastewater services. In the most expensive jurisdiction, the average customer will have a water and wastewater bill of over $1,700. For those who depend on the single living-alone superannuation payment, the highest water and wastewater bill constitutes over 8% of their income. For those dependent on the sole parent support payment, it constitutes more than 10% of their income.[123]

5.1.4. International Comparisons

From a global perspective there is no lack of well-established, comprehensive and sophisticated performance measures for three waters services. Various organisations, such as the International Water Association, the World Bank Group and a wide pool of state and national regulators have established and published detailed lists of key performance indicators. However, the purpose of these lists often varies (they are often targeted at comparisons between individual suppliers) and the geographic, political and social circumstances of countries means that they are not readily comparable. Care also needs to be taken to ensure consistency of definitions and descriptions across Key Performance Indicators gathered in different jurisdictions. Simple comparisons, even for apparently consistent measures such as those shown below, can be fraught and unreliable.

[122] Water New Zealand, *National Performance Review 2018 – 2019* (Water New Zealand, 2019), 5. https://www.waternz.org.nz/Attachment?Action=Download&Attachment_id=4271.
[123] Ibid, 6.

The Australian Bureau of Meteorology compiles an annual performance report benchmarking a range of indicators for Australian water service providers. The report covers factors such as pricing, customer relationship, water quality and environmental performance. Some of these are also covered by WaterNZ's 'National Performance Review' survey, but care is required when interpreting results.[124]

The following graphs show a range of comparators between New Zealand and Australian States, based on data from Water NZ's 'National Performance Review', which, as noted previously, is not comprehensive, and data from the Australian Bureau of Meteorology, which also suffers from some data gaps.

Customer Service

In comparison with Australian States, New Zealand's water providers deliver drinking water with a low frequency of disruption. There is a lack of comparable data with respect to sewage discharges.

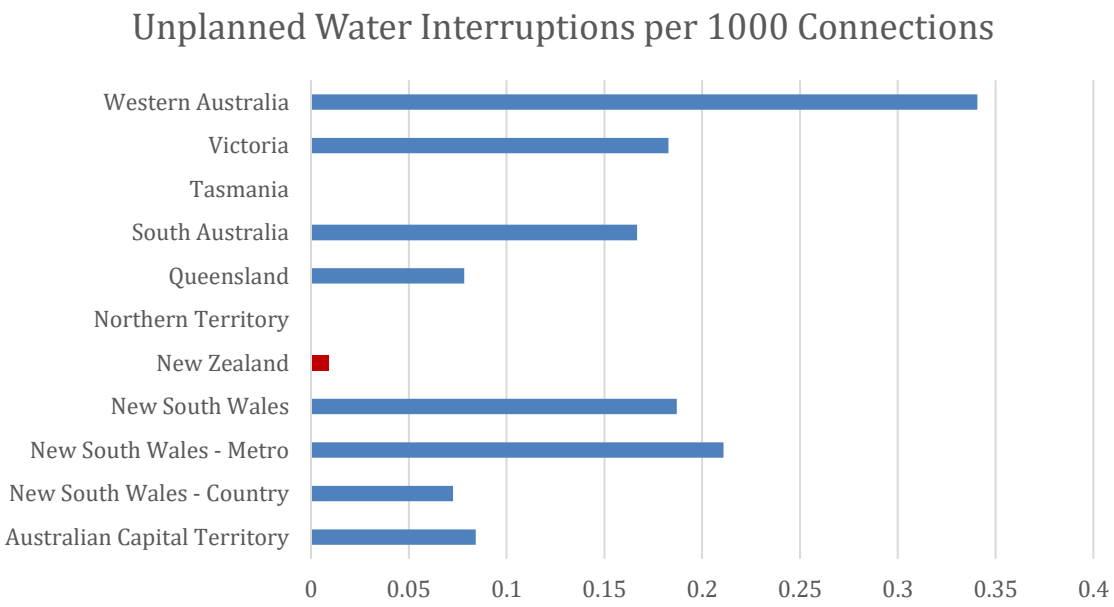


Figure 24: Unplanned Water Interruptions Per 1000 Connections.

[124] For example, Wellington Water recorded 172 wastewater overflows in the 2018/19 'National Performance Review' but has reported 2,096 overflows in their 2019/20 Annual Report.

Efficiency

Density of connections is a factor which can enable lower cost. In comparison with Australian States, New Zealand's density of connection is moderately low which (all other things being equal) would indicate higher operational costs.

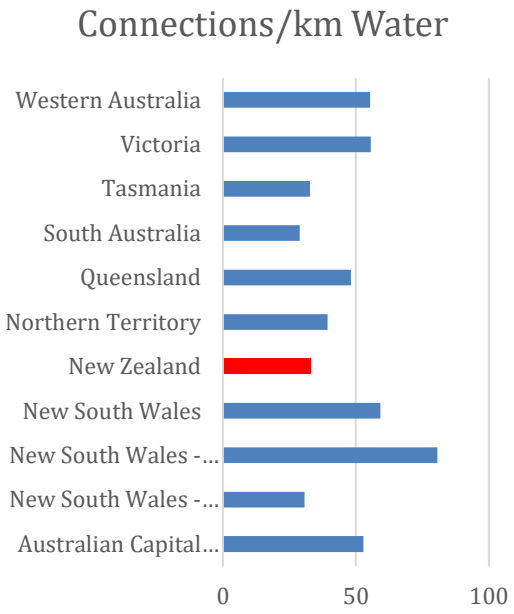


Figure 25: Connections/km Water.

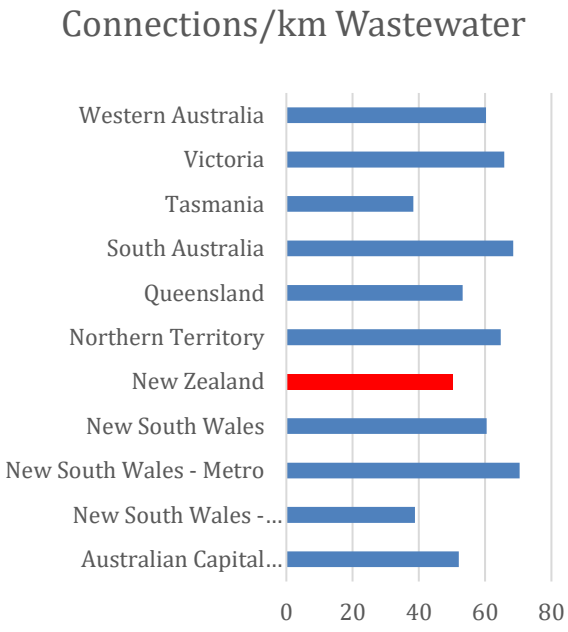


Figure 26: Connections/km Wastewater.

Capital Expenditure

New Zealand expenditure on wastewater is high, and expenditure on drinking water is also moderately high, on a per property basis.[125]

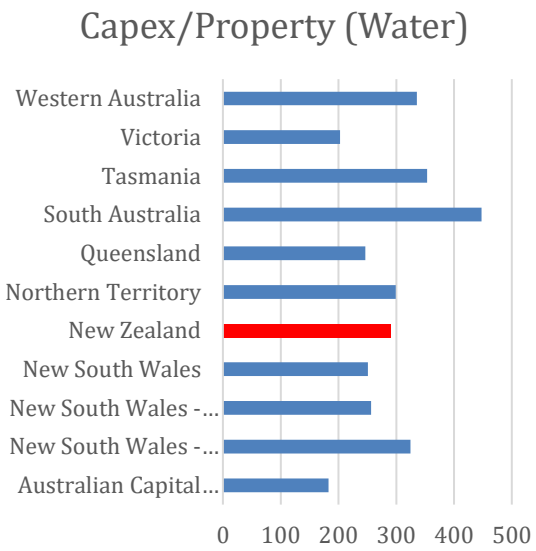


Figure 27: Capital Expenditure/Property (Water).

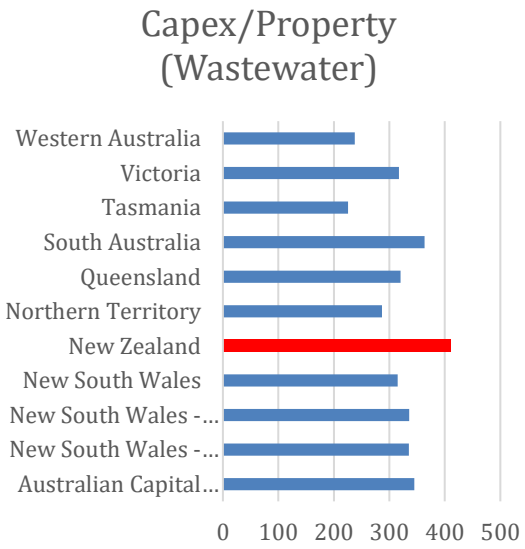


Figure 28: Capital Expenditure/Property (Wastewater).

[125] Currency conversions have been made at a factor of Aus$1 to NZ$1.05

Operational Expenditure

While capital expenditure on a per property basis is high, New Zealand's operational expenditure appears remarkably low.

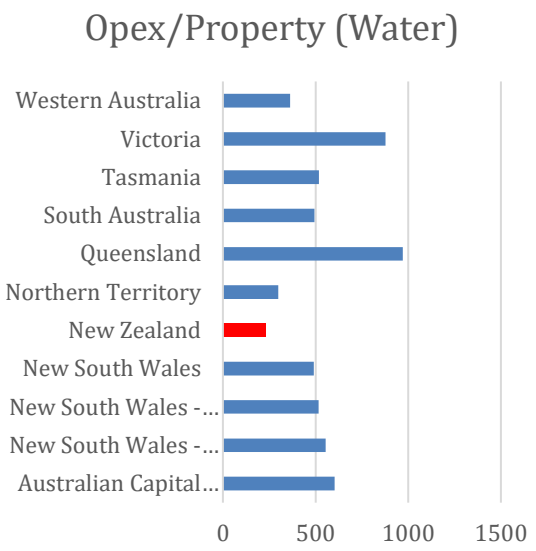


Figure 29: Operational Expenditure/Property (Water).

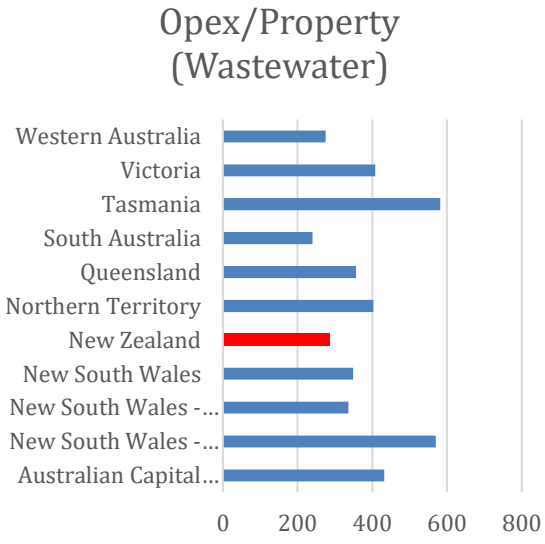


Figure 30: Operational Expenditure/Property (Wastewater).

Revenue

Water revenue is also remarkably low for New Zealand properties, and moderately so for wastewater.

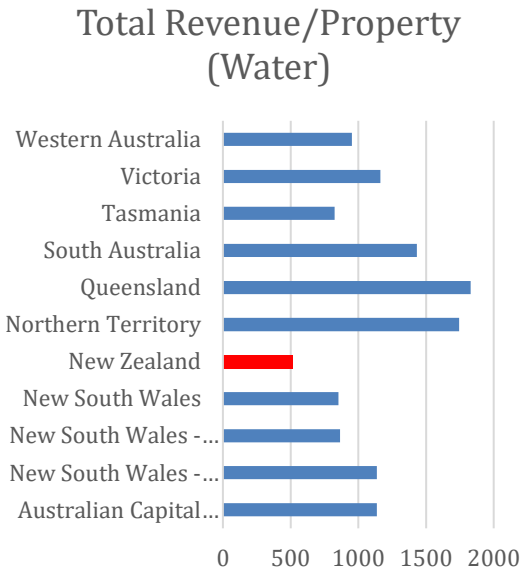


Figure 31: Total Revenue/Property (Water).

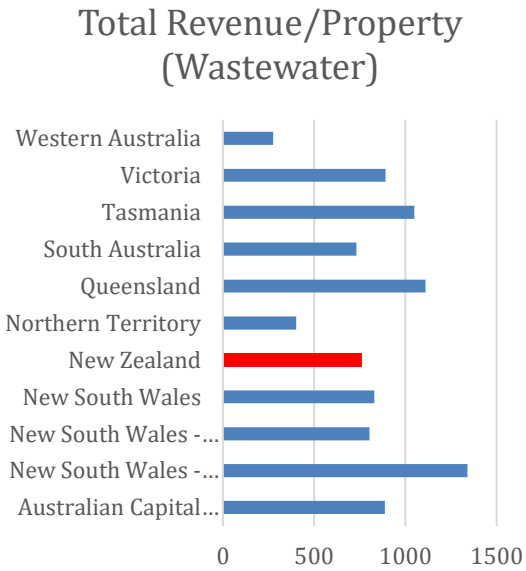


Figure 32: Total Revenue/Property (Wastewater).

5.2. Irrigation and Flood Protection

There are no centrally compiled and robust benchmarking tools for irrigation or for flood control activities. As noted above, the Secretary of Local Government specifies mandatory reporting standards for flood control (see Appendix A) however these are not compiled. In the case of flood protection schemes this is a concern, as it is possible that a lack of national standards about issues like the frequency of floods that need to be managed, may mean that some communities are more exposed to floods than they may appreciate.

6. How is the Sector Responding to What Might Come Next?

6.1. Three Waters Review

As a consequence of the findings of the government inquiry into Havelock North drinking water in 2017, a significant review into the ownership and delivery model for drinking and wastewater services has been commenced. The final shape and characteristics of any new utility organisations is still to be determined, however announced 'bottom lines' include a much smaller number (perhaps only 3 – 5 across New Zealand); councils holding ownership of the new utilities; the transfer of all drinking water and waste water assets to the new utilities, and de-coupling utility balance sheets from council balance sheets.

The government review is intended to be a substantial, systemic review which will fundamentally alter the way in which three-waters are delivered in New Zealand. It will not only address operational issues, such as asset management practices, but will also assist affordability for smaller communities which are likely to struggle with future costs.

Concerns about the performance of the three-waters sector, particularly drinking water and wastewater, are not new. Calls for reform date back to at least the late 1980's.

The possibility of reform has been considered by several independent bodies, including the Office of the Controller and Auditor General, the Government Inquiry into Havelock North Drinking Water and, more recently, the Productivity Commission. Each of these bodies has concluded that reform, including consolidation of supplies, is merited and necessary.

6.2. Climate Change and Carbon Neutrality

Local Government New Zealand, the Society of Local Government Managers, the Department of Internal Affairs and many local councils have begun to take steps to address the potential impacts of climate change on local government.

This recognises that local government is a major asset owner of essential infrastructure. A recent study by Local Government NZ identified that as much as $14 billion of local government infrastructure was likely to be at risk from sea level rise alone.[126]

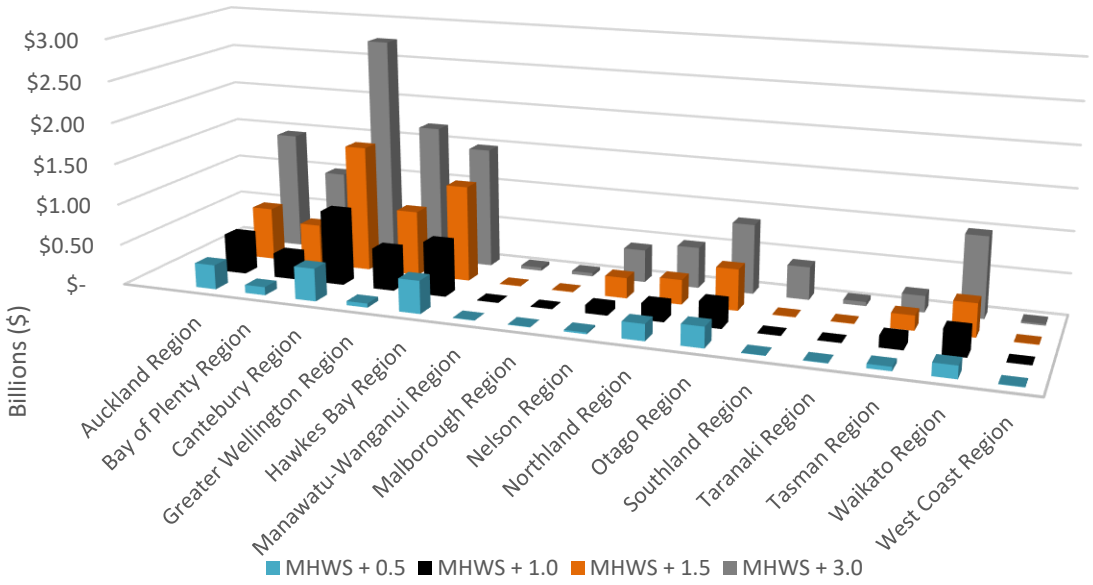
The Local Government NZ study modelled various sea level rise scenarios using LiDAR[127] and other topographical data from 62 councils and showed that $2.7 billion of roading, three waters, flood control and building infrastructure was at risk from as little as a 0.5 metre rise in sea levels. The value of at-risk infrastructure ramped up sharply at each increment of sea level rise, with the data showing:

- $5.1 billion is at risk at 1 metre
- $7.8 is at risk at 1.5 metres
- $14.1 billion is at risk at 3 metres.

[126] Tom Simonson and Grace Hall, *Vulnerable: The Quantum of Local Government Infrastructure Exposed to Sea Level Rise* (Local Government New Zealand, January 31, 2019), https://www.lgnz.co.nz/assets/Uploads/d566cc5291/47716-LGNZ-Sea-Level-Rise-Report-3-Proof-FINAL-compressed.pdf.

[127] Lidar is a method for measuring distances by illuminating the target with laser light and measuring the reflection.

Total replacement value for three waters, roading and buildings/facilities, per region



Note:
1. Data includes, three waters, buildings/facilities, transport, landfills and green spaces.
2. National DEM data was only available at the MHWS + 3.0m elevation. Those councils with DEM only data are those shown with only a single bar at MHWS + 3.

Figure 33: Total Replacement Value for Three Waters, Roading and Buildings/Facilities Per Region.[128] [129]

As a consequence of the report, Local Government NZ has called on central government to urgently develop policies to help minimise the impact of climate change on New Zealand's communities.

Many councils have adopted plans and initiatives to address climate change and most metropolitan Councils have a dedicated, internal climate response group. Climate change actions are varied but commonly focus on reducing greenhouse gas emissions, particularly carbon. For water services, there is growing momentum to consider de-centralised and green infrastructure alternatives, and an increasing focus on water conservation. Councils are also recognising that 'like-for-like' replacement of infrastructure, particularly stormwater infrastructure, may not be sufficient to cope with changing environmental and regulatory circumstances, potentially resulting in costly 'mid-life' replacement of assets.

[128] Tom Simonson and Grace Hall, *Vulnerable: The Quantum of Local Government Infrastructure Exposed to Sea Level Rise* (Local Government New Zealand, January 31, 2019), 13. https://www.lgnz.co.nz/assets/Uploads/d566cc5291/47716-LGNZ-Sea-Level-Rise-Report-3-Proof-FINAL-compressed.pdf.
[129] MHWS stands for 'Mean High Water Spring', the highest level that spring tides reach on average. 'DEM' stands for Digital Elevation Model.

7. Conclusion

7.1. The Status Quo is Unlikely to be Sustainable

The water sector is facing a growing number of challenges which are stretching their financial and human capital resources. They include:

- Providing sufficient resilience within three waters, flood protection and irrigation networks to meet the demands of climate change, including coping with more extreme weather events (ranging from severe flooding through to droughts) and the consequences of sea level rise on assets that have historically tended to be located on or near the coast. It is significant that the Ministry for the Environment considers the risk to potable water supplies (availability and quality) due to changes in rainfall, temperature, drought, extreme weather events and ongoing sea-level rise is the most significant risk facing New Zealand as a result of climate change.[130]
- Funding the cost of renewing ageing assets, many of which are now reaching the end of their serviceable lives.
- A recent business case study[131] of Hawke's Bay Councils identified that household spending on water and wastewater was likely to increase to unaffordable limits for the communities of Central Hawke's Bay and Wairoa. A recent Cabinet briefing paper prepared by the Department of Internal Affairs[132] has reinforced this finding
- Meeting increased expectations from communities that the water they receive will meet basic health needs (e.g. not require 'boil water notices'), be of sufficient volume and reliability to support productive activities, and robust enough to ensure that communities are kept safe and meet basic aesthetic standards (e.g. not have taste or odour issues).
- Meeting increasing environmental expectations not only in respect of discharges but also the impact of abstraction on minimum flow levels, Te Mana o te Wai and catchment ecologies
- Developing planning and reporting systems to deliver greater focus on wellbeing improvements including alternative approaches such as water sensitive urban design and multiple outcome green infrastructure
- Councils with high and growing population growth face significant costs extending reticulated networks and/or retrofitting existing plant and networks to cope with increasing demands for housing
- For non-growth councils, the challenge is coping with funding expensive three waters and flood protection networks with a declining rating base
- Accessing technical skills, both specialised human capital and new technologies, for providing water services to the standards expected by the community and to the level likely to be required by the regulators.

[130] Ministry for the Environment & Stats NZ, *New Zealand's Environmental Reporting Series: Our Freshwater 2020* (Ministry for the Environment, April 2020), 71. https://www.mfe.govt.nz/sites/default/files/media/Environmental%20reporting/our-freshwater-report-2020.pdf.

[131] Morrison Low and WSP Opus, *Hawke's Bay Three Waters: Business Case of Three Waters Service Delivery Options* (Hawkes Bay Regional Council, July 2020), https://www.hb3waters.nz/assets/Uploads/HB-3-Waters-Delivery-Detailed-Analysis-29.07.20-Full-Report.pdf.

[132] Department of Internal Affairs, *Three Waters Review: Preliminary Analysis of the Economic Impacts of Water Services Aggregation*, (Department of Internal Affairs, December 2020), https://www.dia.govt.nz/diawebsite.nsf/Files/Three-waters-reform-programme/$file/Analysis-of-economic-impacts-of-water-services-aggregation-Briefing-to-Minister.pdf.

- Facing increasing renewals and upgrade backlog due to historic under-investment in water infrastructure.
- Managing affordability within existing funding mechanisms and in an environment where rate increases are highly visible and often contentious.
- Developing effective policy and private asset management systems to complement public infrastructure and provide for increasing opportunities for smart, resilient distributed infrastructure systems.

These challenges are unlikely to be resolved without substantial sector reform.

8. Appendix 1 – Mandatory Reporting Standards

WATER SUPPLY

Safety of drinking water

The extent to which the local authority's drinking water supply complies with:

(a) part 4 of the drinking-water standards (bacteria compliance criteria), and

(b) part 5 of the drinking-water standards (protozoal compliance criteria).

Maintenance of the reticulation network

The percentage of real water loss from the local authority's networked reticulation system (including a description of the methodology used to calculate this).

Fault response times

(a) Where the local authority attends a call-out in response to a fault or unplanned interruption to its networked reticulation system, the following median response times measured:

(b) attendance for urgent call-outs: from the time that the local authority receives notification to the time that service personnel reach the site, and

(c) resolution of urgent call-outs: from the time that the local authority receives notification to the time that service personnel confirm resolution of the fault or interruption.

(d) attendance for non-urgent call-outs: from the time that the local authority receives notification to the time that service personnel reach the site, and

(e) resolution of non-urgent call-outs: from the time that the local authority receives notification to the time that service personnel confirm resolution of the fault or interruption.

Customer satisfaction

The total number of complaints received by the local authority about any of the following:

(a) drinking water clarity

(b) drinking water taste

(c) drinking water odour

(d) drinking water pressure or flow

(e) continuity of supply, and

(f) the local authority's response to any of these issues

expressed per 1000 connections to the local authority's networked reticulation system.

Demand management

The average consumption of drinking water per day per resident within the territorial authority district.

SEWERAGE AND THE TREATMENT AND DISPOSAL OF SEWAGE

System and adequacy

The number of dry weather sewerage overflows from the territorial authority's sewerage system, expressed per 1000 sewerage connections to that sewerage system.

Discharge compliance

Compliance with the territorial authority's resource consents for discharge from its sewerage system measured by the number of:

(a) abatement notices

(b) infringement notices

(c) enforcement orders, and

(d) convictions,

received by the territorial authority in relation those resource consents.

Fault response times

Where the territorial authority attends to sewerage overflows resulting from a blockage or other fault in the territorial authority's sewerage system, the following median response times measured:

(a) attendance time: from the time that the territorial authority receives notification to the time that service personnel reach the site, and

(b) resolution time: from the time that the territorial authority receives notification to the time that service personnel confirm resolution of the blockage or other fault.

Customer satisfaction

The total number of complaints received by the territorial authority about any of the following:

(a) sewage odour

(b) sewerage system faults

(c) sewerage system blockages, and

(d) the territorial authority's response to issues with its sewerage system,

expressed per 1000 connections to the territorial authority's sewerage system.

STORMWATER DRAINAGE

System adequacy

(a) The number of flooding events that occur in a territorial authority district.

(b) For each flooding event, the number of habitable floors affected. (Expressed per 1000 properties connected to the territorial authority's stormwater system.)

Discharge compliance

Compliance with the territorial authority's resource consents for discharge from its stormwater system, measured by the number of:

(a) abatement notices

(b) infringement notices

(c) enforcement orders, and

(d) convictions,

received by the territorial authority in relation those resource consents.

Response times

The median response time to attend a flooding event, measured from the time that the territorial authority receives notification to the time that service personnel reach the site.

Customer satisfaction

The number of complaints received by a territorial authority about the performance of its stormwater system, expressed per 1000 properties connected to the territorial authority's stormwater system.

FLOOD PROTECTION AND CONTROL WORKS

System adequacy and maintenance

The major flood protection and control works that are maintained, repaired and renewed to the key standards defined in the local authority's relevant planning documents (such as its activity management plan, asset management plan, annual works program or long term plan).

9. Appendix 2: Process, Assumptions, and Limitations

9.1. Our process

This State of Play was developed between August and November 2020 drawing on publicly available information.

A full list of all literature cited can be found in the reference list (Appendix 3).

Findings were cross-checked against the results of a survey of infrastructure asset owners, carried out by Mobius Research and Strategy Limited on behalf of Te Waihanga between September and October 2020, which asked about the issues, risks, and opportunities as perceived by asset owners across the sector.

On completion of the initial draft, we met with individuals from a range of organisations across the sector to get their views on a high-level summary of our findings, and to understand their thoughts on current challenges. We gratefully acknowledge the assistance provided by Water New Zealand, the Regional Council Water Manager's network and the Ministry for Primary Industries, whose commentary and guidance has been invaluable.

A draft of the complete report was independently peer reviewed by WSP New Zealand Ltd and Morphum Environmental Ltd.

Limitations

While every effort is made to ensure the accuracy of the information contained herein, Te Waihanga, its officers, employees and agents accept no liability for any errors or omissions or any opinion expressed, and no responsibility is accepted with respect to the standing of any firms, companies or individuals mentioned. Te Waihanga reserves the right to reuse any general market information contained in its reports.

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