water NEW ZEALAND
The New Zealand Water & Wastes Association Waiora Aotearoa
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National Performance Review

2020 – 2021

Foreword

This report comes at a time of change for the New Zealand water sector, one that will have wide reaching consequences for both how we manage services and how we report on them. For over a decade, the water sector has been refining performance reporting established through the National Performance Review. It has enabled us to shine a spotlight on the significance of the sector and the value of the services delivered, as well as focus on the challenges and opportunities to lift the bar and improve the way our services are delivered.

With the passing of the Water Services Bill 2021, we will see aspects of performance reporting shift from the voluntary process established in the National Performance Review to a regulated regime overseen by Taumata Arowai. Water New Zealand has been working closely with our counterparts in Taumata Arowai, and in consultations on the shape and form of future economic regulation, to ensure the learnings captured through this process are not lost. We anticipate the National Performance Review will play a role in developing a foundation for the new regulators to establish data collection processes of their own and ensuring that there is not an information gap during their establishment.

The introduction of a regulatory regime provides the opportunity to lift our sights and extend both the breadth and depth of information on performance of water services. A mandated approach will ensure all New Zealand is represented in data, and that trends over time are comprehensive. Regulatory powers also provide the opportunity to develop new standards that drive improvement, and spotlight areas of performance not previously addressed at a national level; for example, the capacity of water supplies to withstand drought and stormwater networks to prevent flooding, and the effectiveness of wastewater networks in protecting the environment.

A unique feature of the National Performance Review is that it has been established and managed by the participants themselves. While pandemic restrictions have prevented the advisory group from convening face to face, input and support has been provided by the following individuals: Amanda Smith of Marlborough District Council, Darrin Lane of Dunedin City Council, Gisselle Montes of Clutha District Council, Joyce Thomas of Central Otago District Council, Lynne Adams of Napier District Council, Mark Baker of Queenstown Lakes District Council, Mike Schruer of Tasman District Council, Sam Ng of Watercare, and Sally Millar, Robert Blakemore, and Mathew Hall of Wellington Water. Our thanks to these individuals for their time and advice. Thank you also to the photographers who entered Water New Zealand's 2020 photography competition, and whose pictures adorn this report.

We look forward to the next chapter in protecting the people and places served by New Zealand's water sector.

Gillian Blythe, Chief Executive, Water New Zealand

Disclaimer

Water New Zealand endeavours to provide data that is as consistent and accurate as possible. Our quality review process is outlined in the companion document *National Performance Review: Quality Assessment Process* (Water New Zealand, 2021). Reliability is limited by the data that individual participants have made available.

Performance outcomes for water services are subject to influences outside of an organisation's control. Influencing variables that should be considered when evaluating performance include:

- Service area characteristics (density of connected properties, the split of residential versus non-residential users)
- Environmental factors (including topography, quality of source water and receiving environments, and soil types)
- Weather conditions
- Historic design practices

Performance outcomes are also influenced by data collection and reporting systems. Service providers' systems range from pen-and-paper-based data collection to comprehensive data management technologies. This can mean participants with robust reporting methods rank comparatively poorly against those with less sophisticated methods. For example, a comprehensive customer complaints management system is likely to record more complaints than a pen-and-paper-based system, due to more accurate data capture.

Contacting water service managers to understand data limitations or performance drivers is recommended when making decisions based on information contained in this report.

Executive Summary

The National Performance Review (the Review) is a voluntary performance reporting exercise for drinking water, wastewater, and stormwater services. The Review aims to provide accessible and transparent information to inform service delivery improvements.

A pilot Review was undertaken in the 2008 fiscal year. Since that time, the number of participants and maturity of performance measures in the review has expanded. This year's Review covers 38 (of 64) service providers, with jurisdictions covering 87% of New Zealand's population. Participants in the Review voluntarily provide their time, expertise, and information to enable its delivery.

Since the last Review was published, New Zealand's water services have begun a process of radical transformation. Changes have included the Three Waters Reform Programme, the proposed introduction of economic regulation, the passing of the Water Services Act 2021, commencement of Taumata Arowai as New Zealand's first dedicated water services regulator, and the commitment of $523 million of central government funds to "shovel ready" projects.

In addition to the funding boost for our water services, COVID also appears to have left a mark on service delivery. For the first time in four years, water abstraction showed a declining trend, driven largely by reductions in water use in Auckland. While drought restrictions and the associated water efficiency initiatives would have been a primary driver, lockdowns and below-usual commercial activity would no doubt have played a part in altered water use patterns.

It also appears that COVID-related behaviour changes have left their mark on wastewater networks. Blockages were the leading cause of wastewater overflows and wastewater complaints, a perhaps unsurprising result in a popular year for personal hygiene products, which are often incorrectly disposed of into the sewerage system.

The last year also saw the introduction of the Water Services Act 2021. The Act introduces new requirements for Taumata Arowai to monitor and report on the environmental performance of drinking water, wastewater, and stormwater networks. In time, this requirement will subsume much of the content and need for the National Performance Review, as performance reporting is gradually transferred to a regulatory regime. The Review provides a solid foundation for informing the new regulations. It is our intention to work with Taumata Arowai to ensure reporting practices, definitions, and lessons learnt throughout the Review inform the new regulatory requirements.

To this end, this year's Review reflects not only on performance reporting, but also common information limitations in where the information base could be strengthened. Assessing condition and performance of assets buried under ground is both technically challenging and resource intensive. Priorities of maintaining assets and servicing growth compete for resources with the need for asset inspections and condition assessment. This limits the availability and quality of data that available on our assets.

Service providers include self-assigned data confidence ratings to reflect their confidence in data. Our report summarises these in areas where data confidence is low, and provides commentaries on common information quality limitations. In this Executive Summary, we reflect on some of the cross-cutting opportunities to improve our information base. Limitations aside, there is much that the National Performance Review can tell us. This Executive Summary reflects on some of these key themes impacting on the large, growing, and critically important water sector.

The water sector continues its growth trajectory

Over the past four years, the number of properties receiving water and wastewater has grown by 8%. The number of staff employed directly by water service providers has expanded by 6%, growing to 2,842 employees, supported by an additional 1,067 contractors working exclusively on service delivery. Operational expenditure grew by 23% over the same period, and capital expenditure was 67% higher than four years ago.

Multiple drivers for increasing capital expenditure

Capital expenditure amongst all participants grew to $1.8 billion this year, an increase of 14% on last year for those supplying data. Central government three waters reform stimulus funding provided a boost to this expenditure, with a reported $136 million in grants being received by participants. Much of the growth in expenditure was driven by increased spending on Auckland's water supply to meet growth. Watercare's reported capital expenditure on water supply grew from $192 million in the 2020 fiscal year to $406 million.

Growth is putting pressure on service delivery

Only 83% of capital expenditure budgeted for was delivered. This continues a trend noted in previous years, which previous Reviews found attributable to a combination of pressures, amongst them internal delivery of resources. Finding staff continues to be a challenge, with over 10% of all listed roles being vacant.

Service delivery costs are driving increases in water and wastewater charges

Operational and capital expenditure on water supply, wastewater, and stormwater services has increased by 7% and 16% respectively. Operational expenditure in the 2021 fiscal year totalled $958 million, and capital expenditure $1.8 billion. Increased costs were reflected in increased charges. The average residential water charge increased by 7% last year to $471, and the average wastewater charge by 8% to $522.

Revenue and expenditure are insufficient to cover depreciation in some service districts

For some service providers, revenue was insufficient to cover operating, interest, and depreciation costs. Water supply revenue fell short of these costs in 16 of 34 (47%) water service districts, 20 of 37 (54%) wastewater service districts, and 18 of 37 (48%) stormwater service districts. This suggests revenue in these districts is insufficient to keep pace with asset depreciation. Over the past four years, expenditure on existing assets has not exceeded depreciation for nine water, 14 wastewater, and 15 stormwater service districts. If the trend persists, levels of service in these districts would be expected to decline.

It would be timely to revisit design standards for growth

Design practices vary around New Zealand. Seventeen service providers employ bespoke inhouse approaches for designing sewer capacity, and a further 13 rely on the *New Zealand Standard 4404:2010, Land Development and Subdivision Infrastructure* (Standards New Zealand, 2010). NZS4404:2010 specifies an infiltration factor of 2 for peak wet- to average dry-weather inflows. The infiltration factor was exceeded during the reporting period in nearly 80% of the networks feeding wastewater treatment plants (93 out of 119). When sewerage system capacity is exceeded, wastewater overflows from the sewerage network into the external environment. Daily water consumption design specifications also fall short of average residential use. The average water use across districts in the Review of 281.1 significantly exceeds the 250 litres/person/day specified in the design standard.

There is large variation in water charges around New Zealand

An average New Zealand residential property pays $960.46, less than half the average electricity bill of $2,110 per year (MBIE, 2022). However, charges around New Zealand vary significantly. While charges are generally collected through targeted rates, there is a broad range of approaches to levying water charges across and within districts. The highest average residential charges in the country ($2,237) would take a worker on the minimum wage nearly three weeks' work (131 hours) to pay at the time of publishing.

Water use could be reduced

Residential water consumption averages 281.8 litres/person/day across districts. Water use is significantly exceeded in some un-metered districts, with reported averages of more than 800 litres/person/day. The Infrastructure Leakage Index (the benchmark recommended by international water loss experts) indicates most service districts (25 of 30) have economic opportunities to reduce water loss. Total water losses currently comprise around 20% of overall water supplied to networks but reach as high as 55%.

There is more to learn about the resilience of our water networks

Assessing water supply, wastewater, and stormwater resilience requires an assessment of the ability of the network to respond to risk. Current performance metrics in this Review largely reflect performance outcomes after a hazard has occurred. Flooding performance is reported based on the number of floods and habitable floors impacted, and water supply capacity in terms of available drinking water storage. Such metrics do not tell us about risks such as the level of flood protection provided to a service district, or the level of drought a network can withstand. These questions require new levels of service, derived from network models assessing the resilience of water, wastewater, and stormwater networks. Obtaining a national picture relies on service standards and models being applied in a consistent manner.

Water service providers are using their assets to generate renewable energy

In the 2021 fiscal year, the wastewater network produced 291,264 gigajoules of energy . This was generated using biogas derived from wastewater treatment plants in Whangārei, Auckland, Hamilton, Palmerston North, and Christchurch, and from solar panels on the Rosedale Wastewater Treatment Plant. A further 8,581 gigajoules of energy was produced from the water networks of Auckland, Palmerston North, Tasman, and Wellington Water using microturbines. This leaves a further 30 service districts yet to capture any of the latent energy within their networks, the potential of which is yet to be assessed.

Untapped opportunities exist for wastewater by-products to contribute to a circular economy

Collectively, participating wastewater treatment plants treated 434,944,945 cubic meters of wastewater, roughly the same volume of water contained in lake Rotorua (Ellery, 2004). This is a largely untapped resource that could be reused to reduce pressure on water supplies. Wastewater sludges (the solid fraction of sewage remaining after treatment) is also a largely untapped source of carbon and nutrients. Examples of resource recovery include use as Bioboost fertiliser in New Plymouth, vermicomposting in the central North Island, and use in mine rehabilitation. An additional 144,361 tonnes of sludges currently go to landfill or are stockpiled.

Strengthening the sector's information base could improve environmental performance outcomes

It is not currently possible to build a national picture of the water sector's environmental performance in several areas. Information on wastewater overflows, wastewater discharges, stormwater quality, greenhouse gas emissions, and energy use is patchy and of variable quality. Performance in these areas is challenging to quantify because of issues with reporting, boundaries, definitions, and measuring approaches. Focused investigation and/or benchmarking is needed to build an accurate understanding of performance and improvement opportunities.

Regulation of stormwater and wastewater overflow discharges is piecemeal

Much of the country does not have resource consents for wet-weather-related overflows or stormwater discharges. Wet-weather overflows were consented in only seven of 37 districts. Three other districts treat wet-weather overflows as emergency discharge events. The remainder of New Zealand has no consenting framework in place, despite widespread occurrence of wet-weather overflows, which occurred at least 2,754 times last year. Stormwater discharge consents are similarly piecemeal. Eight participants have universal discharge consents which apply to the whole network, ten reported no consents whatsoever, and others reported a range of different consenting arrangements.

Enforcement of resource consent non-compliance is rare

Formal responses to non-compliance with discharge consents is rare. Eighteen formal actions were taken in response to stormwater discharge non-conformance, and 37 actions related to wastewater discharges. This compares with 553 instances of wastewater discharge non-conformances.

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1. Introduction

1.1 Information covered by the review

Data in this Review has been collected during the period 1 July 2020 to 30 June 2021, referred to as FY 2021 throughout this report. Where available, trended data is shown back to the 2017 fiscal year. Reporting prior to this period was less widespread, and several of the previous data definitions have since been refined.

The National Performance Review comprises voluntary performance reporting, with participants committing their time, information, and expertise to enable its delivery. This year's Review covers 38 (of 64) service providers, with jurisdictions covering 87% of New Zealand's population.

A list of participants in this and previous years' Reviews is shown in Appendix I: Review participants. The proportion of New Zealand's population covered by annual data in this Review is illustrated in Figure 1, and trended data in Figure 2.

Figure 1: Percentage of the population covered by this year's Review

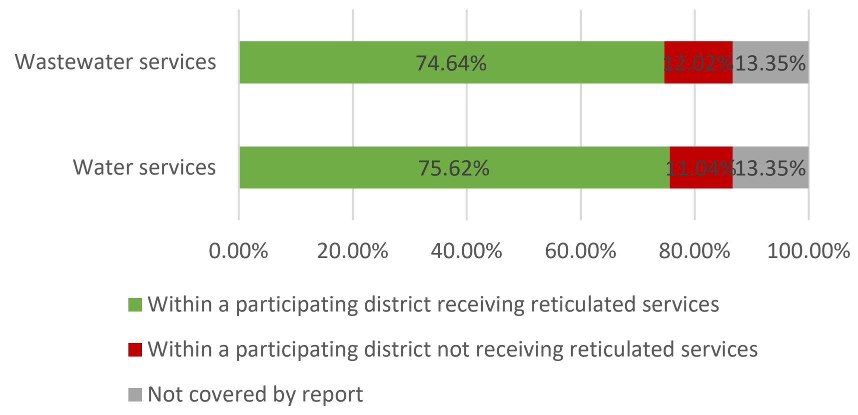
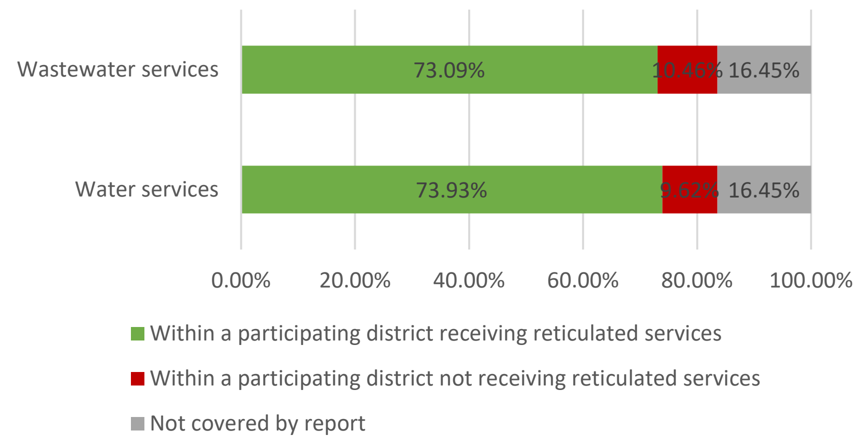


Figure 2: Percentage of the population covered by trended data



Most of the water suppliers participating in the Review are territorial councils with responsibility for the supply of drinking water, wastewater, and stormwater services. Exceptions are in Auckland and Wellington.

In Auckland, Auckland Council supplies stormwater services, and the Council Controlled Organisation Watercare provides drinking water and wastewater services.

In the Wellington region, Wellington Water services six councils: Greater Wellington Regional Council (which owns bulk water assets), Porirua City Council, Wellington City Council, Hutt City Council, Upper Hutt City Council, and South Wairarapa District Council. Wellington Water's control of the South Wairarapa water schemes commenced in October 2019, and data for this jurisdiction has been reported separately.

The quality of drinking water and freshwater is of fundamental importance to water service provision, however it is not addressed in this Review. Taumata Arowai and the Ministry for the Environment are responsible for provision of information in each of these domains respectively. Drinking water quality information can be found in the *Annual Report on Drinking Water Quality* (Ministry of Health, 2021). Freshwater quality information can be found in *Our freshwater 2020* (Ministry for the Environment, 2020).

Participant trends and

individual performance data

DATA PORTAL

Performance information in the Review is broken into eight focus areas, which form the chapters of this report.

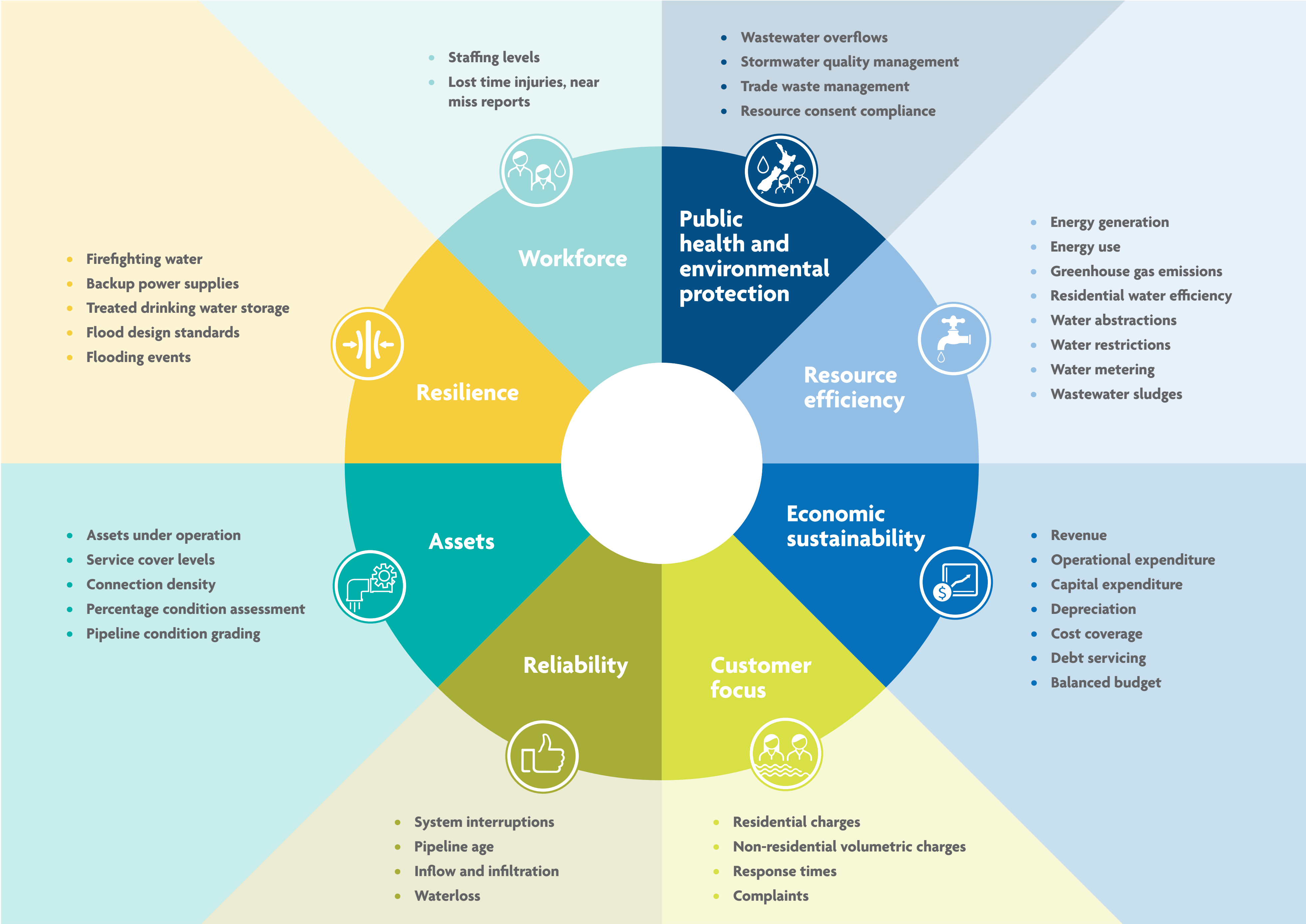
Related performance measures and trends can be accessed online at this web link:

https://www.waternz.org.nz/NPRdashboard

Dashboards corresponding with each chapter of this report can be accessed from this link, or directly using the hyperlinks shown on the associated chapter headings.

Each dashboard provides information on performance in individual districts and trends over time.

Performance measures



1.2 Data quality and consistency

The National Performance Review collects information on 279 discrete data points. Definitions for these are provided in the *National Performance Review 2020/21 Definition Guidelines* (Water New Zealand, 2021).

Compliance with data definitions is reviewed by an external auditor, whose recommendations are used to refine definitions for future years' reporting. The external audits focus on new data points or those that have previously been identified as problematic. Twenty percent of participants are covered by the audits. Audit participants include all those completing the Review for the first time, with others selected to provide a nationally representative sample (of both entity size and location).

In reporting on the data quality of information reviewed this year, the auditor commented:

> the number of corrected data values ranged from a minimum of three values (6%) to a max [sic] of 19 values (38%) with an overall average of 17%... if some of these organisations had not been audited, it is possible there would have been no data changes, which would have lessened the data confidence needed when making use of the NPR results.

Other external audit findings are available in the Audit Report for Water New Zealand's *2020/2021 National Performance Review* (AECOM, 2022), available from: www.waternz.org.nz/NationalPerformanceReview.

External audits are one important component of ensuring data is reported accurately. Other mechanisms in place to ensure data quality are outlined in the Review's *Quality Assessment Process* (Water New Zealand, 2021). Data quality is limited by the information participants have available. A self-assigned quality rating is assigned to data points to provide an indication of their reliability. Data confidence gradings are shown in areas of this report where data confidence is commonly rated as less reliable. These are illustrated using figures which draw on a composite of relevant data confidence metrics. Metrics indicating the completeness and quality of each participant's data are included in Appendix I: Review participants.

References to definition guidelines are provided in figures and tables using indicator codes delineated with brackets. Codes relate to the data definition guidelines, and adhere to the following format:

- Characters 1-2: Denotes whether the data is related to Water Supply (WS), Wastewater (WW), or Stormwater (SW).
- Character 3: Denotes whether information refers to Background (B), Asset (A), Social (S), Environmental (E), or Financial (F) characteristics.
- Characters 4-5: Delineates between the different data points. For example, indicator SWB1 relates to stormwater background data, and is the first data point listed in the definition guidelines.

Assets

www.waternz.org.nz/assets

Pukete wastewater treatment plant in Hamilton
Photo by Martin Scott of Hamilton City Council

2. Assets

2.1 Asset overview

The 38 entities participating in this Review collectively manage assets worth over $40 billion. A breakdown of assets managed and their value is shown in Table 2.

Table 2: Assets under management

	Water	Wastewater	Stormwater
Treatment plants (WWA7, WSA4)	339	193	
Network length in kilometres (WSA1a, WWA1a, SWA1a)	42,559	26,309	18,452
Combined Wastewater and Stormwater Pipelines (WWA8)		243	
Pump Stations (WSA5, WWA5, SWA7)	817	2,942	213
Facility value at end of reporting year (WSF23a, WWF24a)	$2,774,342,309	$3,307,673,568	
Other asset value (WSF23b, WWF24b, SWF20)	$9,582,123,984	$13,171,072,457	$11,860,854,098

2.1.1 Limitations with information on the volume of assets under management

Network length is not always directly comparable between service providers. Data definitions specify that data should be included up to private property boundaries. Previous audits found seven of 10 organisations were counting the pipe length up to property boundaries, and three organisations were not. The audits also found that at least one organisation operating a rural network overlooked a small scheme in reporting.

Reporting on stormwater network lengths varies based on interpretations of the definition of a stormwater network. Definition guidelines specify that this should include all pipes, culverts, and lined channels that form part of the primary stormwater network, but not ditches, unlined channels, swales, and streams (which in the past have proven difficult to consistently quantify). Previous audits found two out of 10 organisations deviating from this definition.

Variations in network length data introduce uncertainty into performance benchmarks normalised by pipe length. This includes wastewater overflows and some water loss performance metrics.

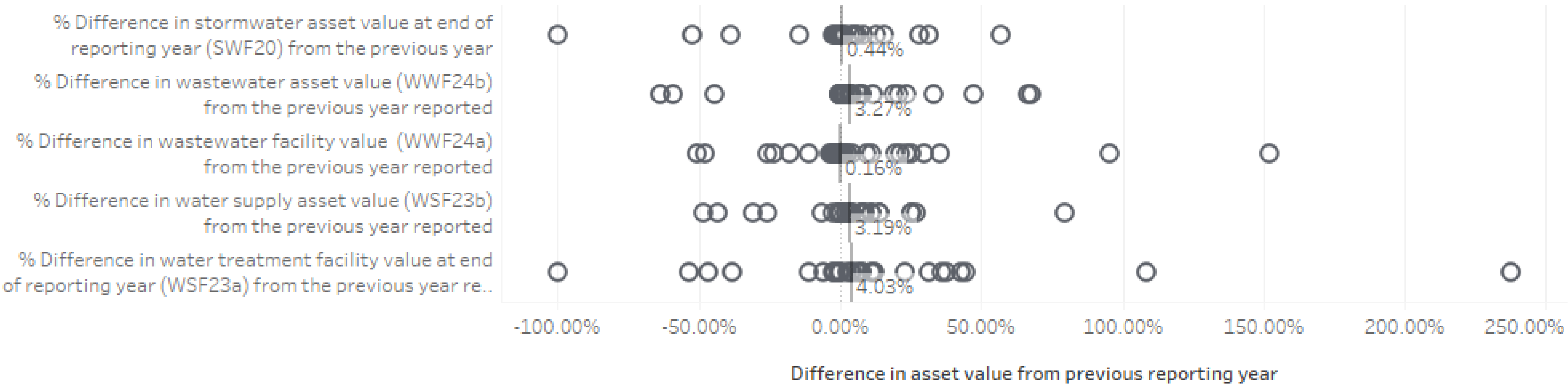
2.1.2 Limitations with information on the value of assets

Asset values are reported as the closing book value of water supply treatment plants and facilities. Variations in year-on-year data suggest that there is variation in the assumptions and methods used to determine this. At a gross national level, the year-on-year percentage change for each asset class has varied between -9.39% and 16.58%.

Annual variation for those providing information to this and the previous year's Review are shown in Figure 3. This figure represents the reported change in asset value for each district as a circle. The median variation for each asset class is shown as a dashed line.

Some variation in asset value year on year is to be expected. This could be due to capital invested in assets, depreciation, or changes in the anticipated useful life of assets, which may vary for a variety of reasons. However, where outliers are large, these suggest major changes in either the approach, method of determining asset values, or problems with the underlying data being used to determine the valuation.

Figure 3: Variation in asset values reported in 2019-2020 versus 2020-21



2.2 Properties receiving services

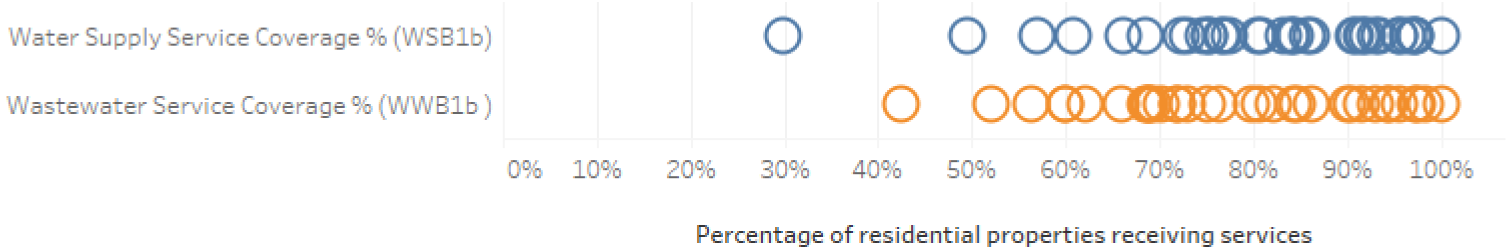
2.2.1 Service coverage

Properties serviced by participants in the Review is shown in Table 3. This shows that within the districts covered by the National Performance Review, 86% of residential properties are connected to the water network, and 85% connected to wastewater networks. The proportion of residential properties connected to services varies from 30% water services and 42% wastewater services in the Kaipara District, to 100% in Hamilton City. Figure 4 indicates the spread in service coverage, with each reporting participant represented as a circle.

Table 3: Population and properties serviced by participants' networks

	Water service provision	Wastewater service provision	Stormwater service provision	Total properties in districts covered by the review
Residential properties	**1,348,563 (86%)**	**1,332,647 (85%)**	**1,352,295**	**1,574,261**
Non-residential properties	**125,924**	**94,708**	**113,390**	**158,667**

Figure 4: Proportion of residential properties connected to drinking water and wastewater networks



2.2.2 Trends

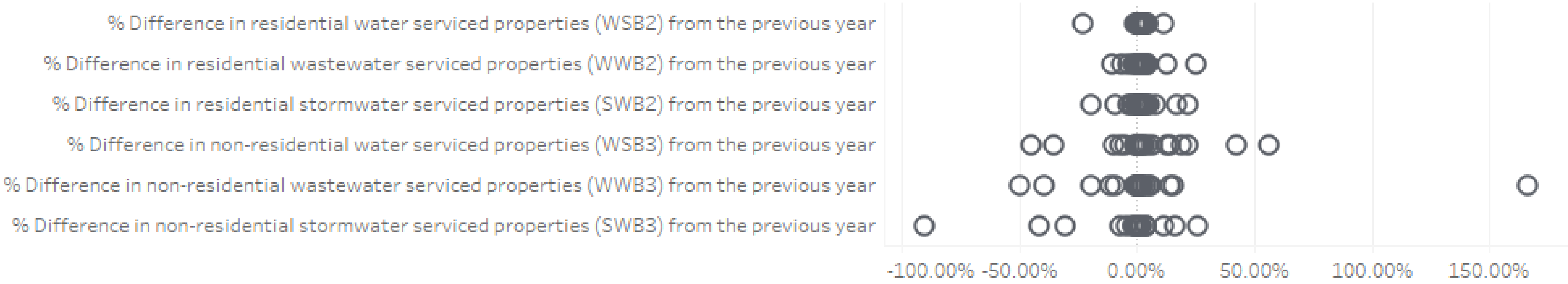
The number of properties connected to water and wastewater supply has been gradually growing, outpacing population growth during the same period. Between 2018 and 2021, total properties connected to water and wastewater networks in districts continually supplying data to the Review grew by 8.0% and 8.1% respectively. This compares with population growth of 4.8% in these districts during the same period.

2.2.3 Limitations with information on the number of serviced properties

Year-on-year variations in data are illustrated in Figure 5 with each district represented as a circle. Changes are generally modest, and could be expected to align with district growth, indicating that properties data is generally reliable. However, the presence of some large variations speak to the challenges of providing an accurate assessment of property connections. Some of the challenges include:

- Accounting for multi-unit dwellings. The definition of a property requires multi-unit dwellings with a single connection to the water/wastewater network to be accounted for separately. The ability to report on multi-unit dwellings depends on whether such occurrences are identified in participants' rating systems. Previous audits found only six of ten organisations were accounting for multi-unit dwellings in line with the definition.
- Accounting for properties not connected to the network can be problematic for CCOs without direct access to rating databases. This information can be sourced through GIS software, requests of rating database extracts, or through Statistics New Zealand. Participants have commented anecdotally that these information sources do not always reconcile with each other.
- A number of jurisdictions around New Zealand which maintain reticulated stormwater networks do not have direct residential property connections, for example in Taupō and the South Wairarapa. A stormwater service property is therefore defined as a property which contributes to stormwater network maintenance through its rates bill. This provides an inexact representation of stormwater services.

Figure 5: Percentage difference in properties data from the previous year for repeat participants



2.3 Pipeline condition assessments

2.3.1 Pipeline condition grades

Pipeline condition is assessed to inform asset management and renewal planning. Pipelines are generally assigned a grade on a one to five scale based on their condition. The proportion of pipelines receiving a poor or very poor grading in each service district is illustrated in Figures 6, 7, and 8.

Figure 6: Water supply pipeline condition grading

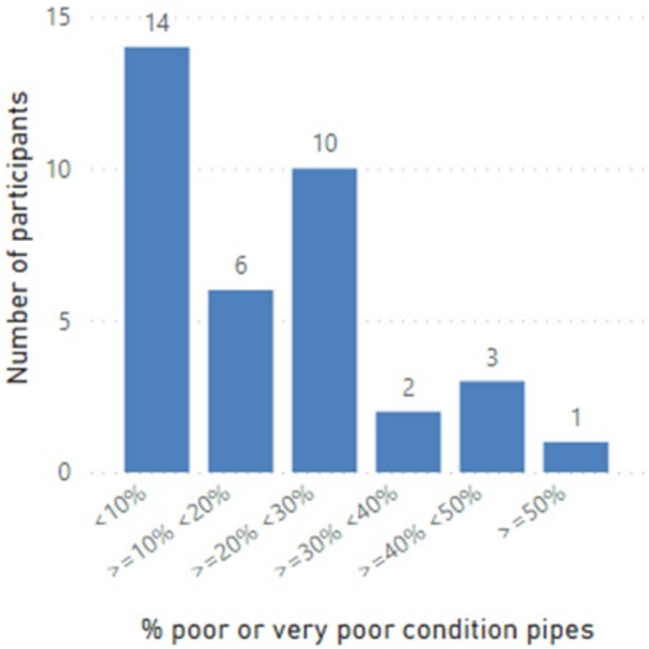


Figure 7: Wastewater pipeline condition grading

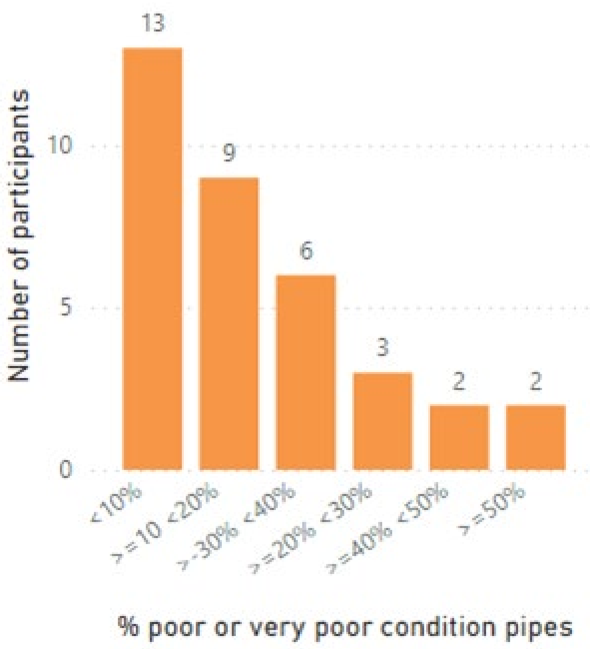
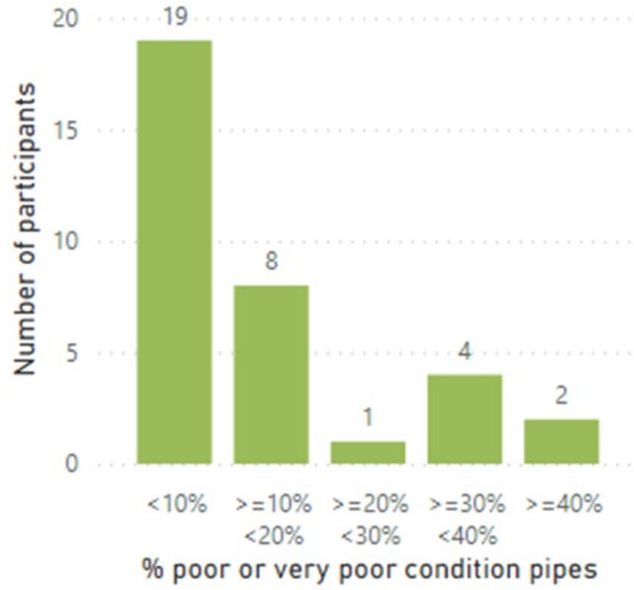


Figure 8: Stormwater pipeline condition grading



2.3.2 Limitations with pipeline condition information

The comparability of pipeline condition data is limited, as a variety of approaches are used for assessments. Approaches used, and the number of service districts employing them, is shown in Table 4.

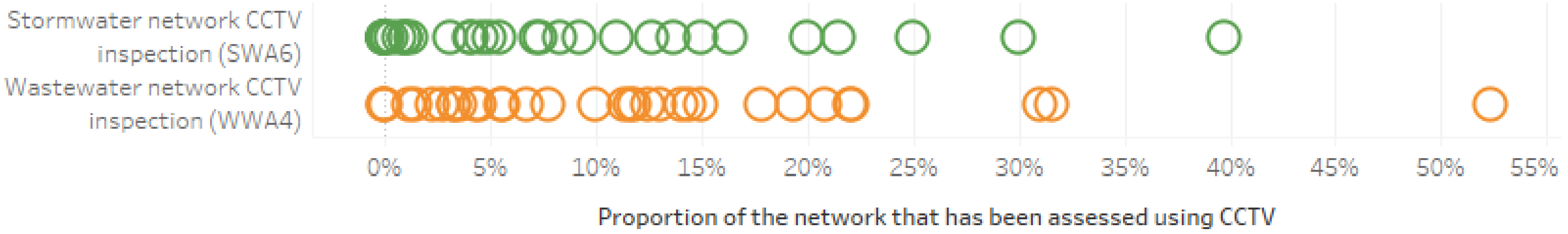
Table 4: Pipeline condition grading approaches

Condition assessment approach	Water supply	Wastewater	Stormwater
New Zealand Infrastructure Asset Grading Guidelines	**1**	**3**	**1**
New Zealand Pipe Inspection Manual	**2**	**17**	**13**
IPWEA Practice Note 7: Water Supply and Sewerage	**0**	**1**	**1**
Inhouse	**11**	**7**	**11**
Informal	**5**	**1**	**1**

The quality of condition data also varies based on the method used to assess condition. Direct inspection methods, such as Closed Circuit Television (CCTV), are rarely economically feasible for inspecting all assets, so condition is often inferred based on other metrics, such as pipe age.

CCTV is the most common way of inspecting wastewater and stormwater (not water supply or other pressure pipes) networks. The proportion of wastewater and stormwater networks surveyed using CCTV is shown in Figure 9.

Figure 9: The proportion of the network surveyed using closed circuit television (CCTV)



Confidence ratings participants have assigned to their data is available via the data portal.

In some networks, pipeline condition gradings are not available for the entire network. The proportion of water supply, wastewater, and stormwater networks that have been assigned a condition grading is illustrated in Figure 10, Figure 11 and Figure 12.

Figure 10: Proportion of districts' water supply pipelines that have not been assigned a condition grading

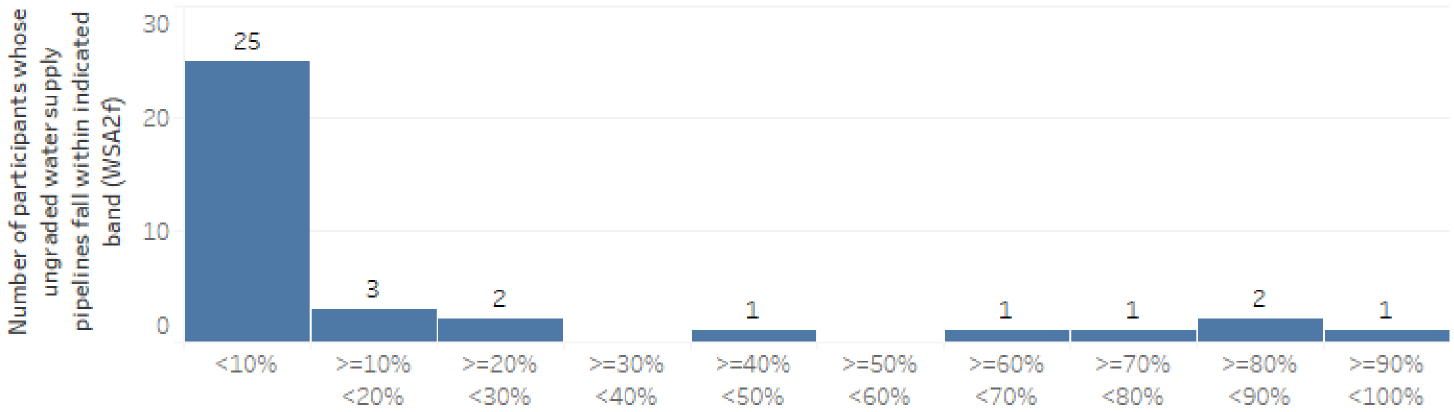


Figure 11: Proportion of districts' wastewater pipelines that have not been assigned a condition grading

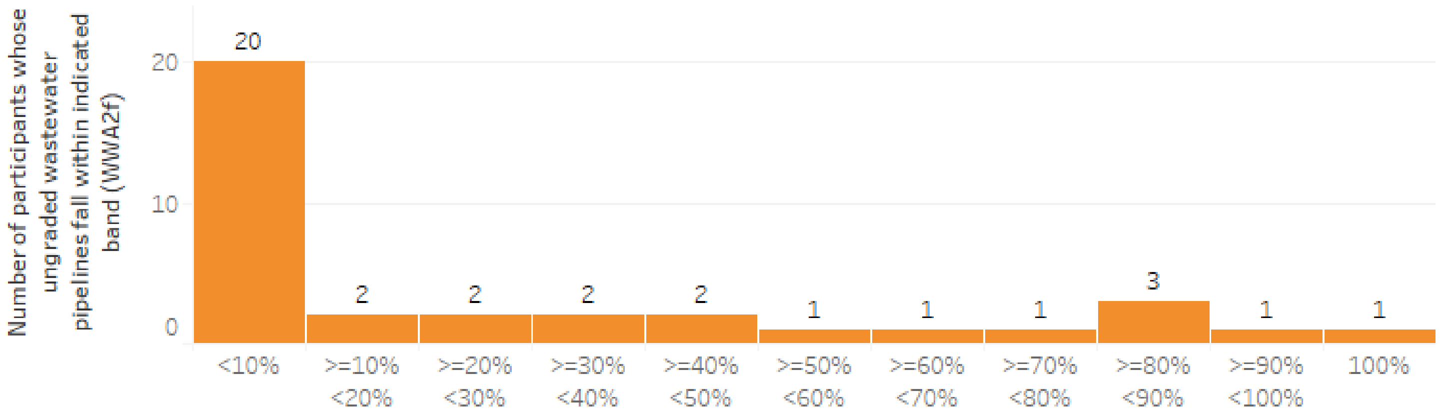
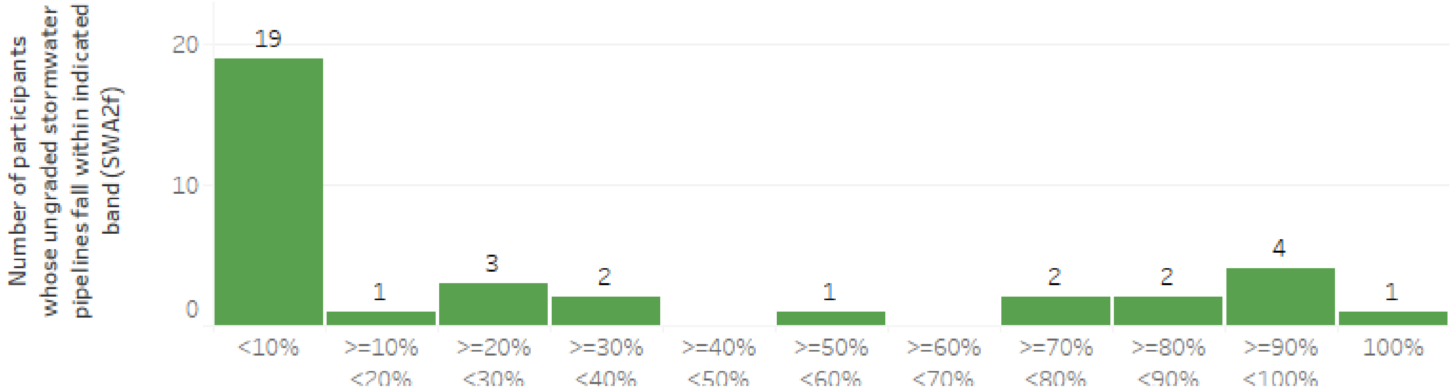


Figure 12: Proportion of districts' stormwater pipelines that have not been assigned a condition grading



2.4 Above-ground asset condition assessments

Above-ground assets include treatment plants, pump stations, and telemetry units. As with pipelines, many service providers have a formalised condition inspection programme to assist with asset management and renewal planning.

The proportion of service providers with a regular inspection programme for above-ground assets in place is shown in Figure 13. The proportion of assets that are assessed as part of that inspection programme are shown in Figure 14, Figure 15 and Figure 16.

Figure 13: Proportion of service providers with a regular condition inspection programme for above-ground assets

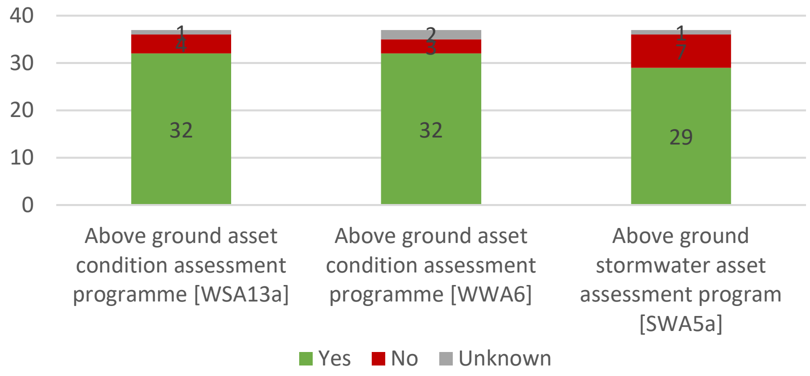


Figure 14: Proportion of above ground water supply assets assessed every three years

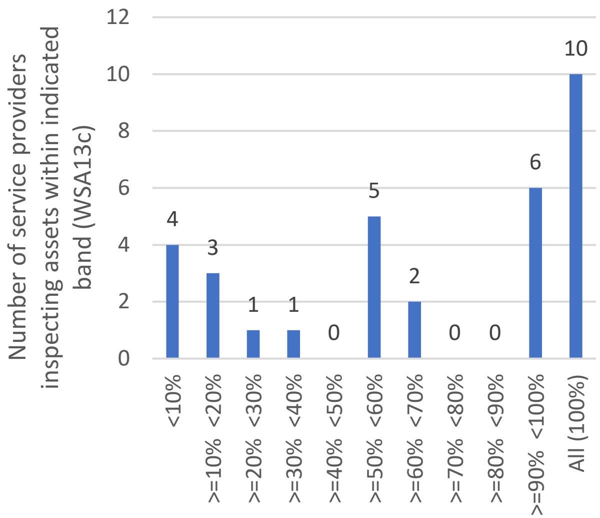


Figure 15: Proportion of above ground wastewater assets assessed every three years

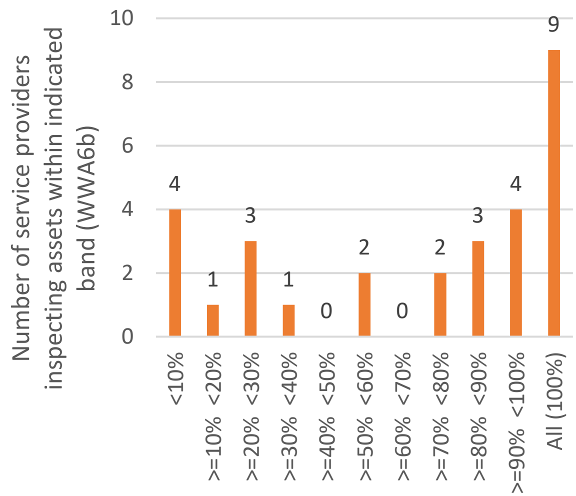
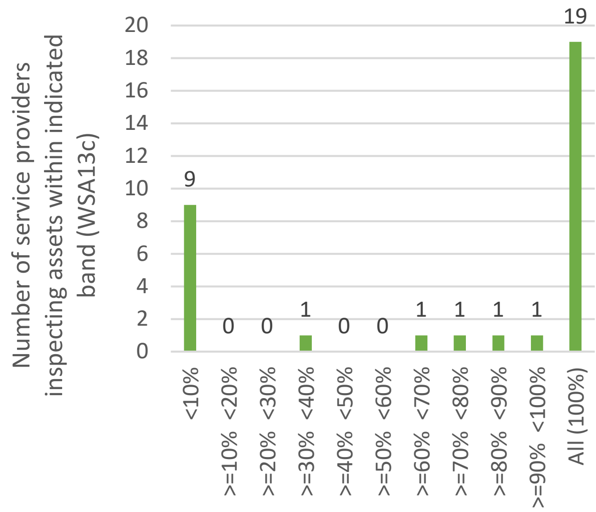


Figure 16: Proportion of above ground stormwater assets assessed every three years



2.4.1 Limitations with information on above-ground asset condition assessments

As with pipelines, there is a variety of approaches used for inspecting above-ground assets. Approaches used, and the number of service providers using them, are listed in Table 5.

Table 5: Approaches in use for inspecting above-ground assets

Condition Assessment Approach	Water Supply	Wastewater	Stormwater
NAMS International Infrastructure Management Manual	3	5	1
Visual Assessment Manual for Utility Assets	1	2	3
IPWEA Condition Assessment and Asset Performance Guidelines	3	3	4
New Zealand Infrastructure Asset Grading Guidelines	7	6	4
Inhouse	8	7	10
Informal	7	5	2
Other	1	1	1

Watercare listed its above-ground asset assessment for water and wastewater in the “Other” category, commenting that it has in place scheduled planned preventive maintenance (PPM) inspections for water and wastewater assets.

Waipā listed its stormwater above-ground assessment approach as “Other”, commenting that its contractor undertakes a regular inspection of rural drains.

Two participants commented that their stormwater network does not have above-ground infrastructure, and that inlets, outlets, and outfalls are defined as below-ground structures.

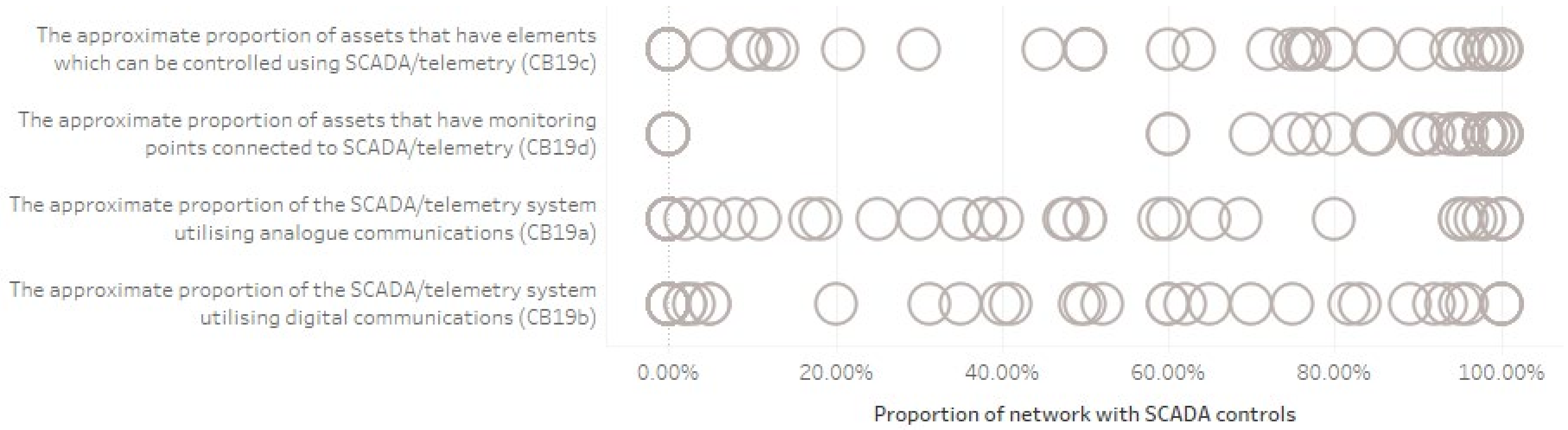
2.5 Technology adoption

2.5.1 Supervisory control and data acquisition systems

Supervisory Control and Data Acquisition (SCADA) systems consist of software and hardware that can control processes locally or at remote locations. The deployment of SCADA within participant networks is indicated in Figure 17, with each service provider represented as a circle. Some service providers have no SCADA systems in place, however it is more common to have full or near full control of the network.

Older SCADA systems transmitted over analogue communication systems, such as radio, modem, or dedicated serial lines. Today, it is much more common for SCADA communications to transmit over digital local area networks. Measures CB19a and CB19b provide an estimated proportion of the network using analogue and digital communication modes respectively. This provides a rough indication of how modern the SCADA systems are. As illustrated in the figure, there is a broad spread across both metrics, suggesting wide variation in the sophistication of SCADA systems.

Figure 17: The proportion of participant networks that can be controlled or monitored using SCADA



2.5.2 Internet of things

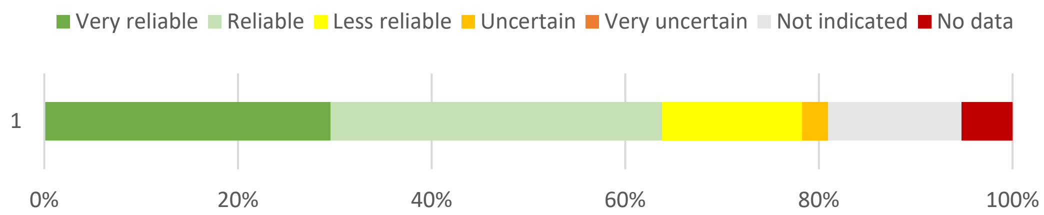
The Internet of Things (IoT) refers to a system of internet-connected objects that can collect and transfer data over a wireless network without human intervention, such as smart meters and water sensors. Sixteen of the 38 participants indicated that they had employed devices connected to the internet of things. Participants who provided comments on the devices in use were:

- Marlborough District Council, which has IoT connected water meters;
- Tasman District Council, which has 14 level sensors mounted in wastewater manholes in the Richmond network;
- Taupō and Timaru District Councils, which have IoT connected flow meters within the reticulation network; and
- Whakatāne District Council, which has a project underway to implement water, wastewater, and stormwater network monitoring devices across its network.

2.5.3 Limitation with information on SCADA systems

Reporting on SCADA and internet of things generally relies on expert judgement rather than quantitative figures that can be extracted out of an asset management database. This was confirmed in previous audits of the SCADA performance measure, which noted that the accuracy of data does vary, with some organisations making estimates rather than doing actual counts.

Figure 18: Confidence in SCADA data



Workforce

www.waternz.org.nz/workforce

Workers tag in for work during construction of Watercare's Hunua 4 watermain project
Photo courtesy of Watercare and McConnell Dowell

3. Workforce

3.1 Staffing and vacancy levels

Participants in this review had 2,842 full-time employees on their payrolls, and employed a further 1,067 contractors who were exclusively involved in water service delivery. A further 298 roles were vacant at the time of reporting. Both the number of direct employees and the number of vacancies have been steadily increasing over the last four years.

Figure 20: Internal employees and contractors (over the past four years)

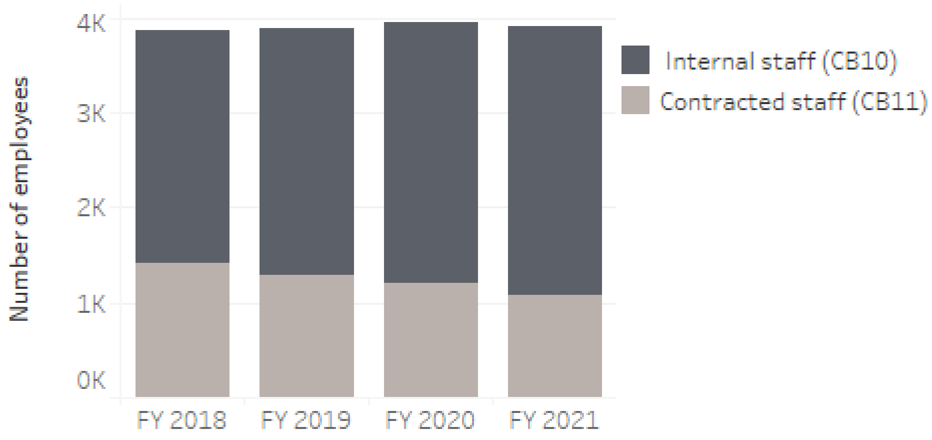
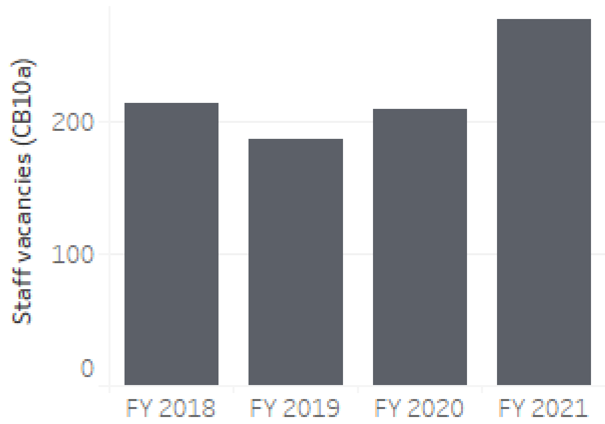


Figure 19: Staff vacancies (over the past four years)



The number of staff employed by water service providers varies significantly. Total employees and contractors delivering water services range from 10 at Stratford District Council to 1,081 at Watercare. Comparative information of staff per serviced connection is available via the data portal.

Figure 21: Total number of internal and contracted staff per service provider

3.3.1 Limitations with information on staffing numbers

The definition of internal staff includes functions such as accounting, administration, asset management, billing, communications/public relations, customer service, GIS, human relations/training, legal assistance, planning, and strategy. According to the definition, overheads need only be apportioned to staff who spend greater than 50% of their time supporting water service delivery. It was noted during external audits of this year's data (AECOM, 2022) that participants "seemed to have difficulty counting internal staff who are not fulltime but spend greater than 50% of their time supporting the delivery of three waters services."

Previous audits found that the accuracy or completeness of internal staff counts varies based on organisation structure. Organisations with specific business units set up to manage water services tended to confine reported numbers to those units, and not include support roles outside of the business unit. It would be doubtful, though, if those staff outside of the business units met the threshold of spending more than 50% of their time supporting three waters. Organisations without dedicated water units tended to base reporting on their HR/payroll system, and encompassed all roles. Wellington Water and Watercare are the main exceptions. Their sole business is water service provision, so it is straightforward for them to report a total number.

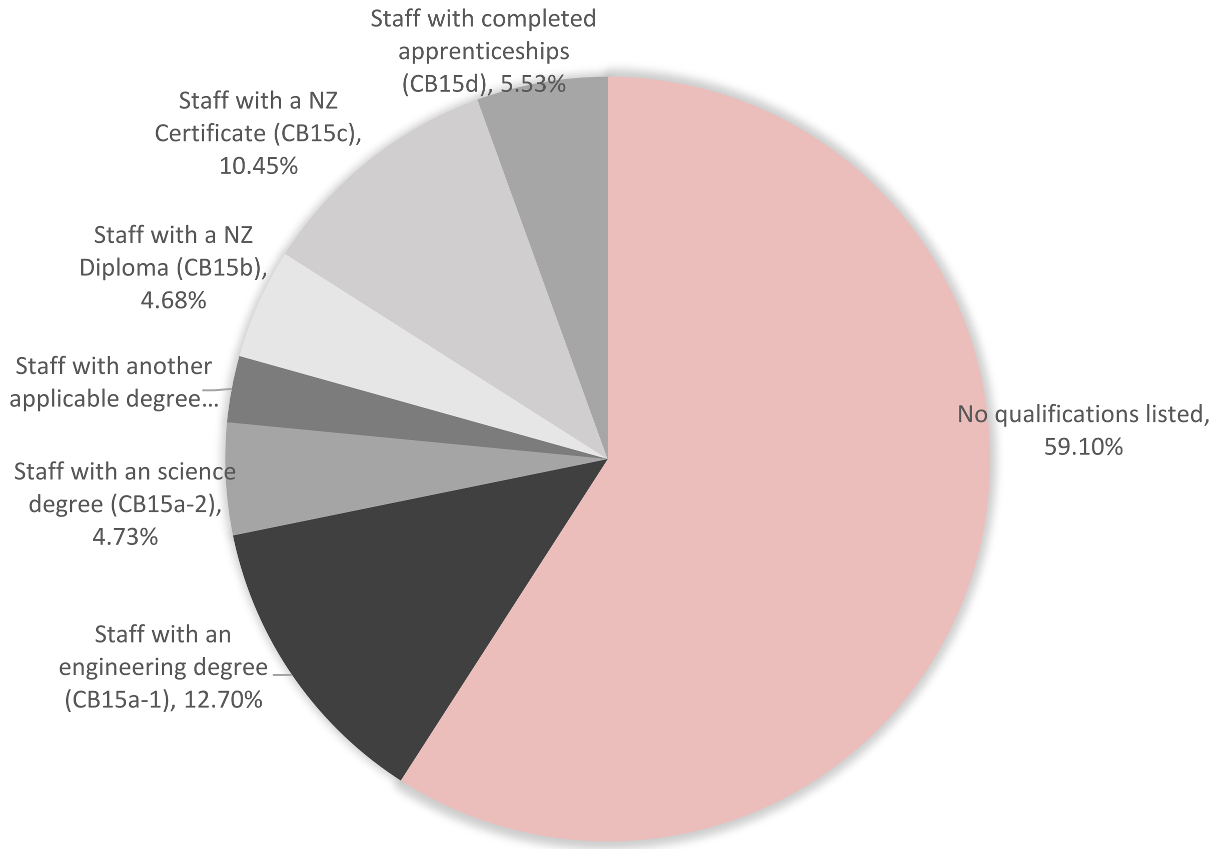
The definition for contracted staff includes employees undertaking functions such as system maintenance repairs, CCTV/condition inspections, construction, distribution system maintenance repairs, engineering design renewals, lab services (sample collection/analysis), reticulation operation, pipe/reservoir cleaning, and treatment plant operation and maintenance. Comments, anecdotal evidence, and significantly higher contractor numbers reported for COVID response planning suggest that the definitions are often not adhered to.

3.2 Training

3.2.1 Qualifications

The highest level of qualification of employees reported is shown in Figure 22. Where possible, contractor qualifications have been included in this figure.

Figure 22: Qualifications of water service personnel



3.2.2 Training

At the time of reporting, 645 staff (among the 29 participants providing this information) were enrolled in training towards the qualifications listed in Figure 22.

Twenty three of the 38 participants reported information on the number of hours staff were trained for, and 24 on the number of hours training was undertaken (not always the same participants). On average, these organisations allocated 36 hours per staff member towards training, and on average 34 hours were undertaken.

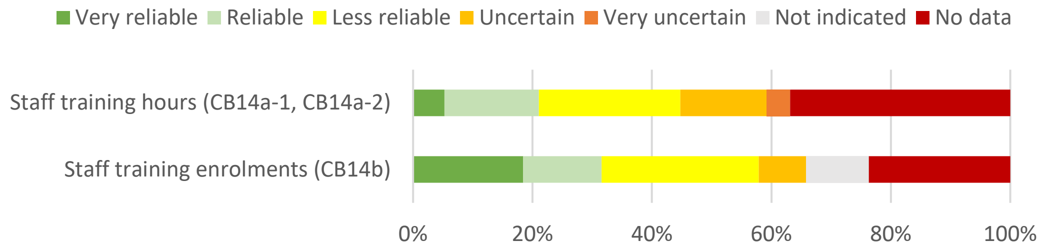
Among 30 participants providing data, 252 staff were enrolled in formal continual professional development programmes. Programmes sited were Chartered Institute of Water and Environmental Management, Engineering New Zealand, The Water Industry Professionals Association (WIPA), The Institute of Public Works Engineering Australasia (IPWEA), and the Engineering Council of South Africa.

3.2.3 Limitations with training information

Previous audits found many organisations have no formal systems for recording staff qualifications. It is not possible to determine, for staff with no reported qualifications, whether this is attributable to gaps in information or the absence of qualifications. Less than a third of the information provided on training hours was rated as reliable, illustrated in Figure 23. The auditor described staff training and qualifications information as problematic, explaining:

> The main reason seems to be that organisations don't have good systems for recording the information that the NPR is asking for… the lack of information on staff training and qualifications is quite surprising and possibly, [sic] quite concerning.

Figure 23: Confidence in training data

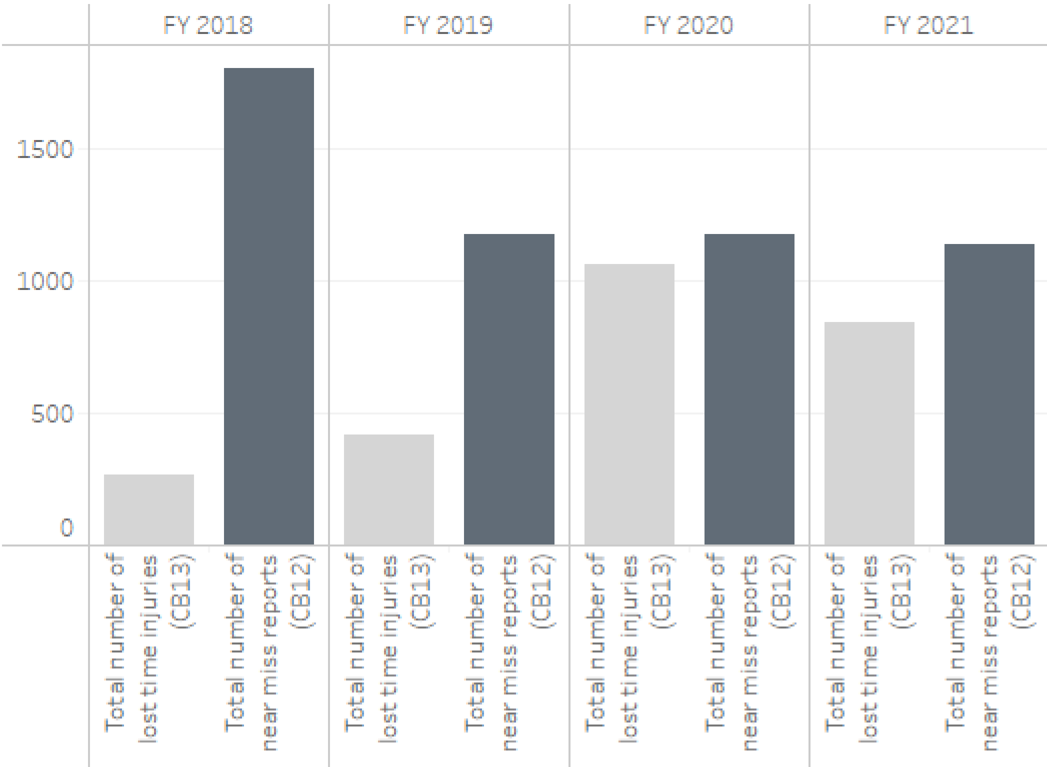


3.3 Health and safety

Ten participants reported lost-time injuries, with 838 days of work lost as a result. Two separate incidents were identified that resulted in more than 100 days of lost-time injuries, one at a wastewater treatment plant in which two operators were injured.

In the 2021 fiscal year, a total of 2,101 near misses were reported. New participants Thames-Coromandel and Central Hawkes Bay contributed many of these, reporting 428 and 452 near misses respectively. For participants providing data in previous years, there was a slight downward trend, illustrated in Figure 24.

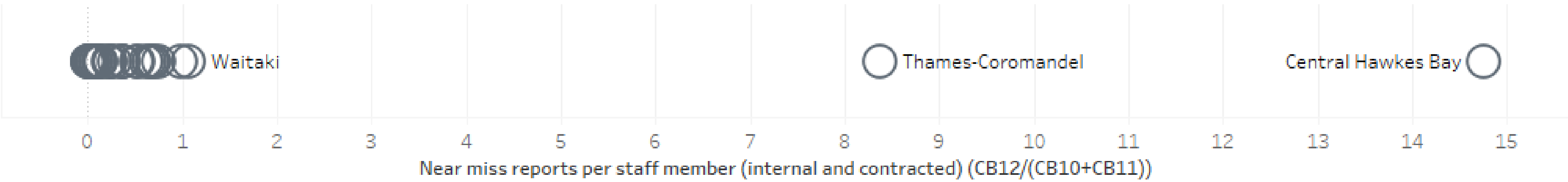
Figure 24: Trend in number of near misses and days of lost-time injuries



3.3.1 Limitations with health and safety information

Health and safety information was provided by 34 of the 38 participants. Four organisations recorded 0 near misses, and there was a broad spread in the number of near misses recorded per staff member, illustrated in Figure 25. It is likely that organisations recording high numbers of near misses have more sophisticated reporting systems for capturing these. It is unclear whether downward trends in near misses relate to improved health and safety practices or a decline in near miss reporting.

Figure 25: Near miss reports per staff member



Public health and environmental protection

www.waternz.org.nz/publichealthandenvironment

The Maharahara Swimming Pool

Photo by Leilani Gundry of Tararua District Council, winner of the 2021 Water New Zealand photo competition

4. Public Health and Environmental Protection

4.1 Wastewater overflows

The primary function of wastewater networks is to protect public health and the environment from untreated sewage. A wastewater overflow occurs when untreated sewage spills, surcharges, or is otherwise discharged from the wastewater network. The total number of overflows reported by participants this year is shown in Table 6.

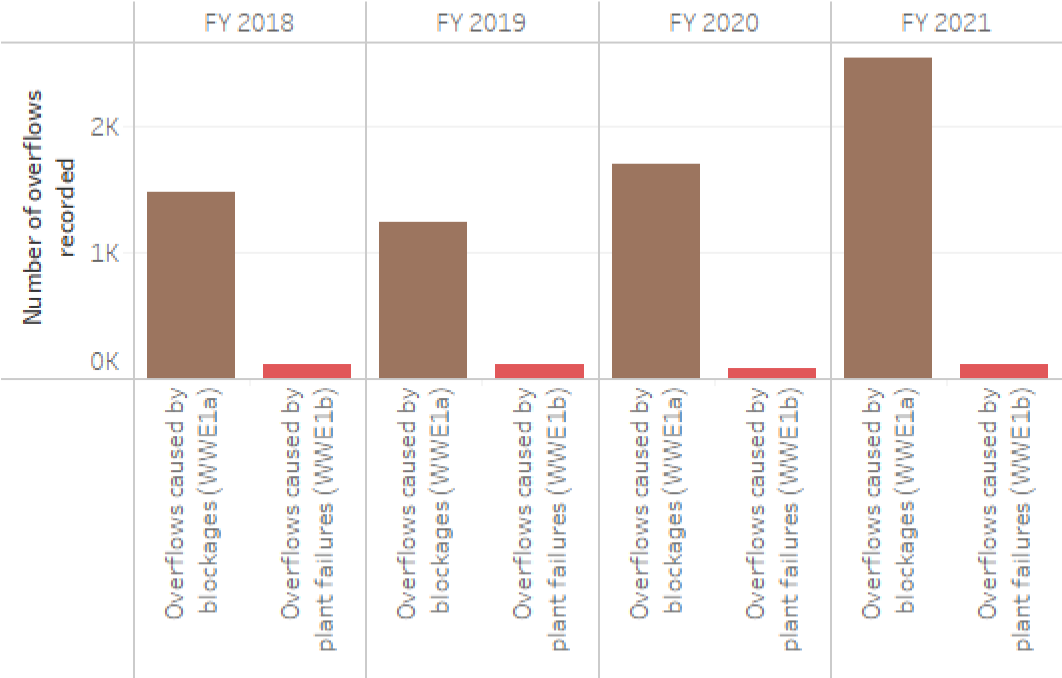
Table 6: Wastewater overflows

Overflows by cause	FY 2021
Total dry-weather wastewater overflows (WWE1)	2,754
Overflows caused by blockages (WWE1a)	2,630
Overflows caused by plant failures (WWE1b)	119
Wet-weather overflows from the wastewater network (WWE2a)	1,159
Wet-weather overflows from combined stormwater and wastewater networks (WWE2b)	355

4.1.1 Dry-weather wastewater overflows

Dry-weather wastewater overflows (i.e. wastewater overflows not related to the system's capacity being exceeded during rainfall) can be caused by network pump failures or network blockages. Plant failures can be caused by pump station ragging, failure of mechanical equipment, or power station failures. Blockages can be caused by build-up of fats, oils, and grease, foreign bodies such as wet-wipes and sanitary items or tree root intrusions, or pipeline collapse. Blockages remain the leading cause of wastewater overflows, with the total number around New Zealand 50% higher than the previous year.

Figure 26: Dry-weather overflow trend

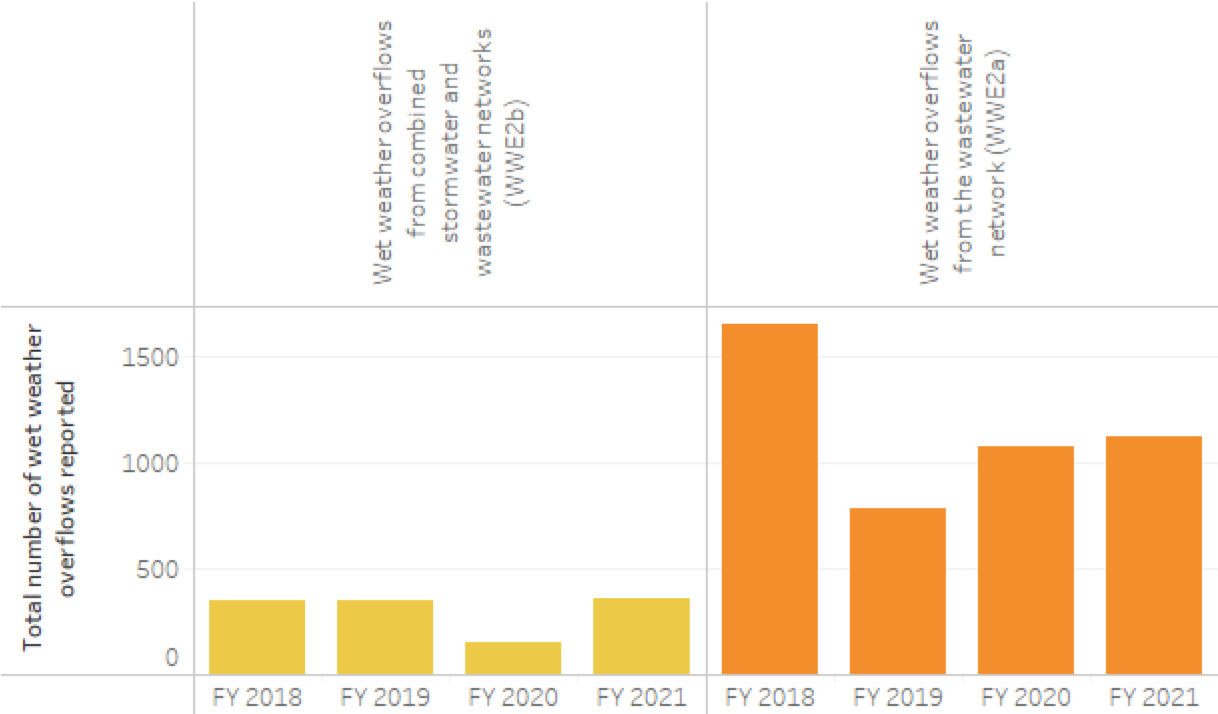


4.1.2 Wet-weather wastewater overflows

Wastewater overflows can occur during wet-weather events when rainfall that makes its way into the sewers exceeds the capacity of the network. This forces diluted wastewater to escape into the external environment at either constructed overflow locations or other uncontrolled points in the network such as manholes and gully traps, which in turn release diluted sewage to the stormwater network or other water courses such as streams, rivers, or ocean.

In some parts of New Zealand, historic design practices have meant wastewater and stormwater are conveyed through the same pipes. As a result, wastewater overflows from these networks are significantly more common, and are therefore accounted for separately in this report. Participating service districts with combined wastewater and stormwater pipelines were Auckland, Gore, and Whanganui, which reported 196, 40, and 7km of combined pipelines respectively. Whanganui did not have a record of the number of overflows attributable to this section of network.

Figure 27: Wet-weather overflow trend

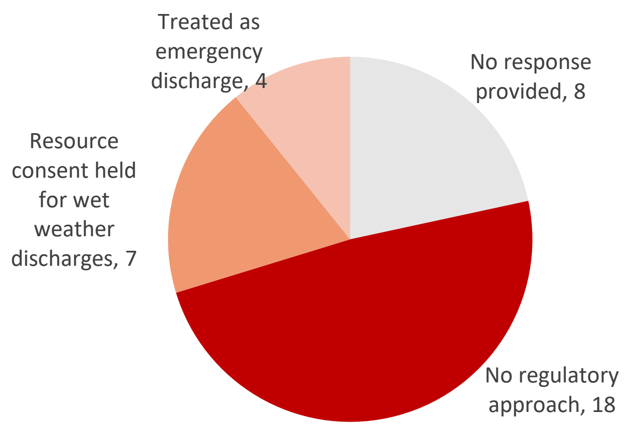


4.1.3 Regulatory approaches to wet-weather overflows

For much of New Zealand, there is no regulatory approach for managing wet-weather overflows from the wastewater network. Figure 28 shows the approaches in place. Resource consents for wet-weather related network discharges were reported in Whangarei, Auckland, Whanganui, Wellington, Christchurch, Dunedin, and Invercargill.

The multiple routes by which rainwater can enter the sewerage network means complete elimination of wet-weather related wastewater overflows is often unlikely to be a realistic expectation. However, several interventions can be applied to reduce and/or ensure their safe management. The absence of regulatory frameworks reduces drivers for implementing these.

Figure 28: Regulatory approach for wet-weather related wastewater overflows



4.1.4 Sewage containment standards and levels of service

Service providers commonly have in place a prescribed set of design standards for specifying sewage containment. Standards in place are illustrated in Figure 30. Less common are levels of service for containing wastewater within the existing network. The *2019-20 National Performance Review* (Water New Zealand, 2021) provides a fuller discussion of levels of service and containment standards in place.

Figure 29: Sewage containment design standards

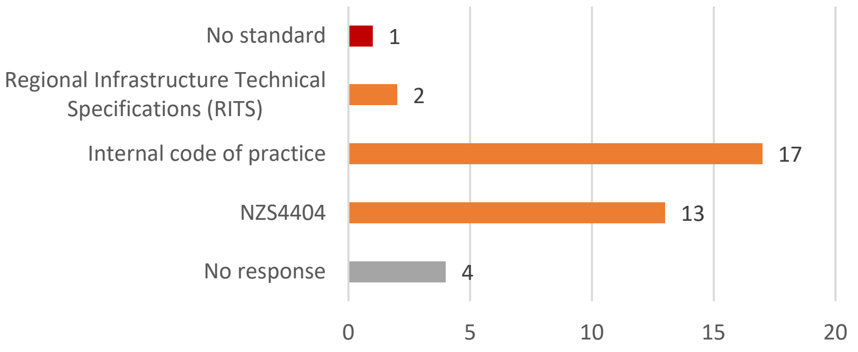
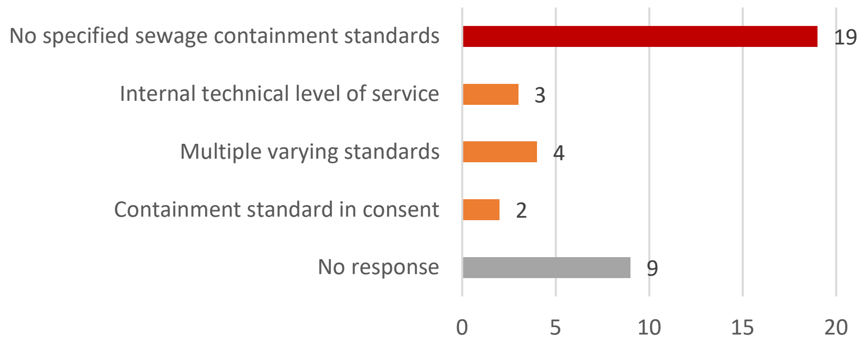


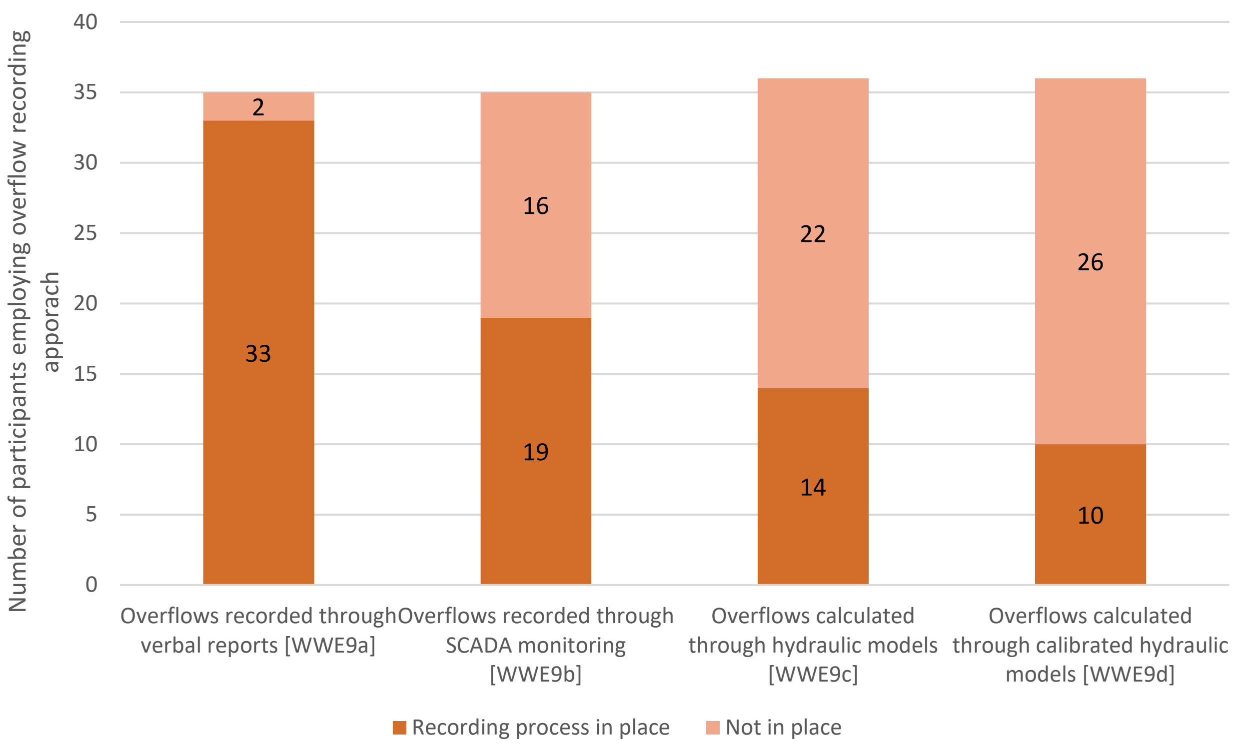
Figure 30: Sewage containment levels of service for the existing network



4.1.5 Limitations with wet-weather overflow information

The accuracy of wastewater overflow reporting depends on the monitoring approaches in place. Approaches employed are shown in Figure 31. Verbal reports are unlikely to capture all overflow events, for example those occurring at night. SCADA monitoring will not capture uncontrolled wet-weather overflow events. Hydraulic models facilitate an accurate understanding of where and when overflow events will occur. Calibrating such models improves their accuracy.

Figure 31: Number of participants employing various reporting approaches for wastewater overflows



4.2 Wastewater treatment

Participating wastewater service providers manage 193 wastewater treatment plants. Information on these treatment plants is collated via the New Zealand Wastewater Treatment Plant Inventory.

The inventory also records information, shown in Table 7 on all New Zealand's 329 municipal treatment plants. Records shown in blue have been updated for treatment plants in the Review (with the exception of Tararua) and Masterton District Council wastewater treatment plants.

The records have been supplemented with information obtained from the *National Stocktake of Municipal Wastewater Treatment Plants* (GHD, Boffa-Miskell, 2019).

Table 7: Information recorded in the wastewater treatment plant inventory

Treatment plant name	Managing organisation	Location	Backup generation
Volume of wastewater treated	Discharge flow rate (m^3/day)	Population served	Proportion of trade waste
Sludge production	Sludge disposal location	Percentage of dry solids	Receiving environment
Level of treatment	Number of related consents	Consent status	Consent expiry date
Last year desludged	Treatment type	Peak wet- to dry-weather flow ratio	

The New Zealand Wastewater Treatment Plant Inventory

www.waternz.org.nz/WWTPInventory

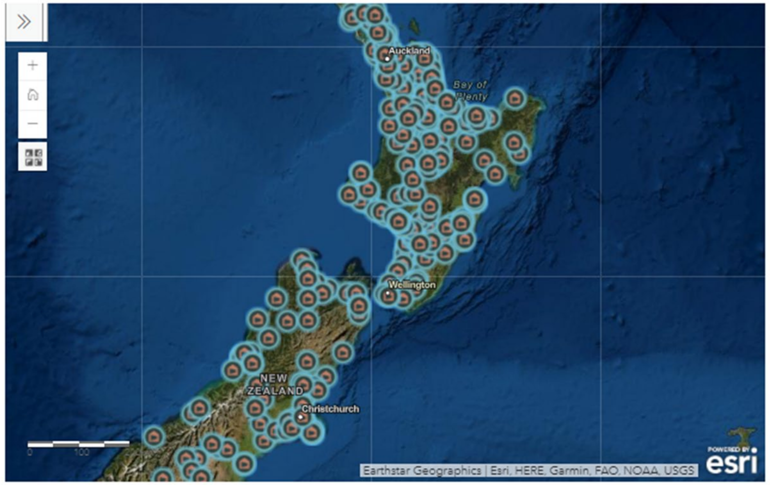
NEW ZEALAND WASTEWATER TREATMENT PLANT INVENTORY

The inventory records data about New Zealand's publicly owned wastewater treatment plants. It replaces the Wastewater Information Database (WINFO).

The National Performance Review is used to update New Zealand's wastewater treatment plant inventory.

It is the largest publicly available collection of information on New Zealand's estimated 323 publicly owned wastewater treatment plants.

WASTEWATER TREATMENT PLANT LOCATIONS



This map was produced with the assistance of Eagle Technology using the Esri platform. More information on Esri 2019-2020 is available here.

WASTEWATER TREATMENT PLANT DATA

More information on WWTPs in New Zealand is available by downloading the Excel file below.

2019-2020 Combined WWTP Data.xlsx - Updated 28/01/2021

Collectively, wastewater treatment plants in this Review treated 434,944,945 cubic meters of wastewater - roughly the same volume of water contained in lake Rotorua (Ellery, 2004). Receiving environments and levels of treatment are shown in Figure 32 and Figure 33. Comprehensive reporting on all New Zealand's wastewater treatment plants is provided in the *National Stocktake of Municipal Wastewater Treatment Plants* (GHD, Boffa-Miskell, 2019) and the New Zealand Wastewater Sector Report (Beca, GHD, Boffa Miskell, 2020).

Figure 32: Receiving environments for wastewater discharge

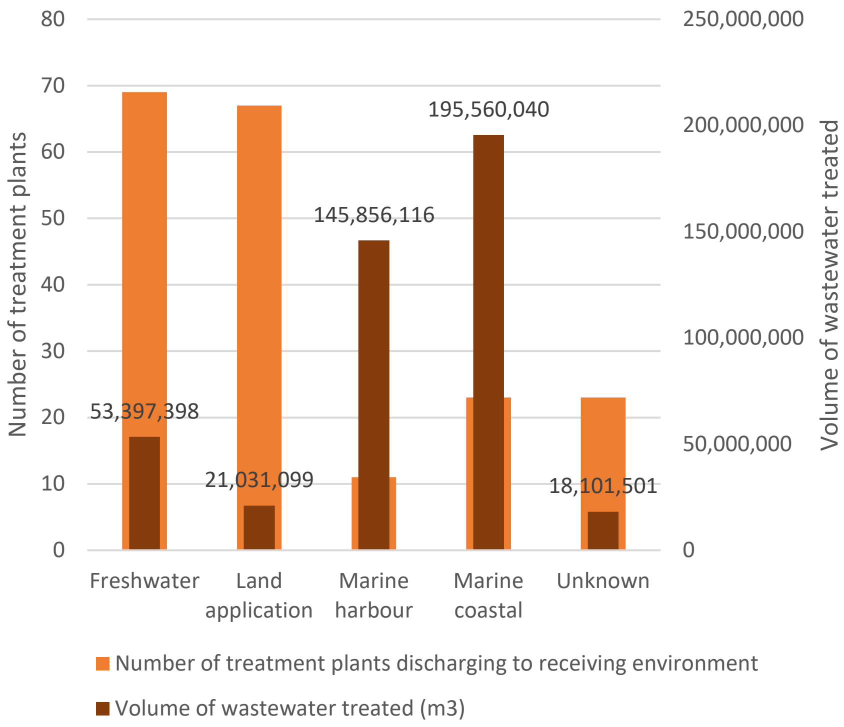
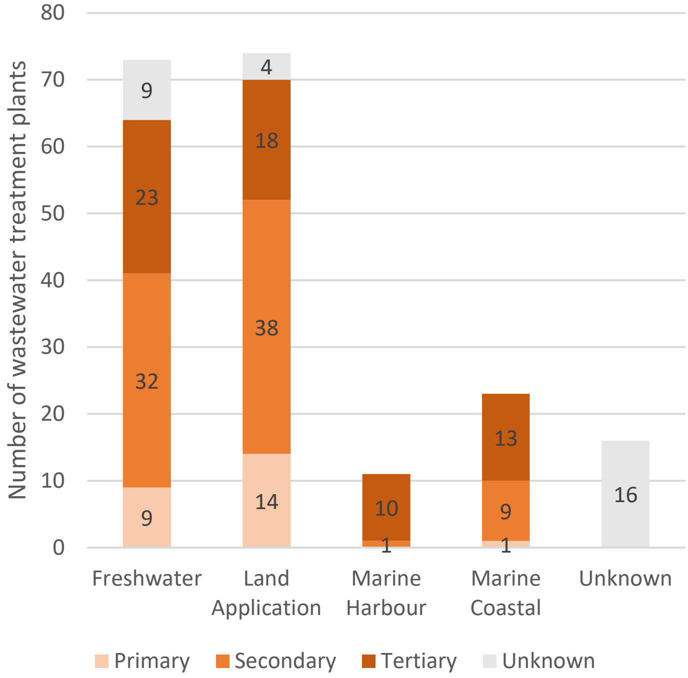


Figure 33: Level of treatment employed for different receiving environments



4.3 Trade waste management

Trade waste is the liquid waste that businesses discharge into the wastewater system. Because trade waste can contain a range of contaminants not present in residential sewage, additional controls are often used to protect wastewater assets and the environment. Trade waste controls are specified in bylaws and/or individual trade waste agreements. The approaches service providers have in place are shown in Figure 34.

Trade waste officers are responsible for ensuring compliance with trade waste consents. The number of trade waste officers employed compared with the volumes of trade waste managed is shown in Figure 35.

Figure 34: Trade waste management approaches

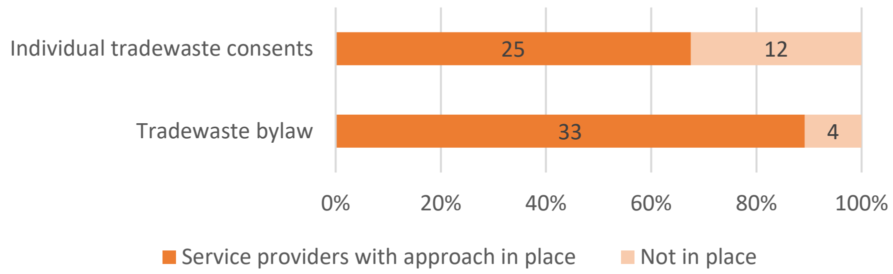
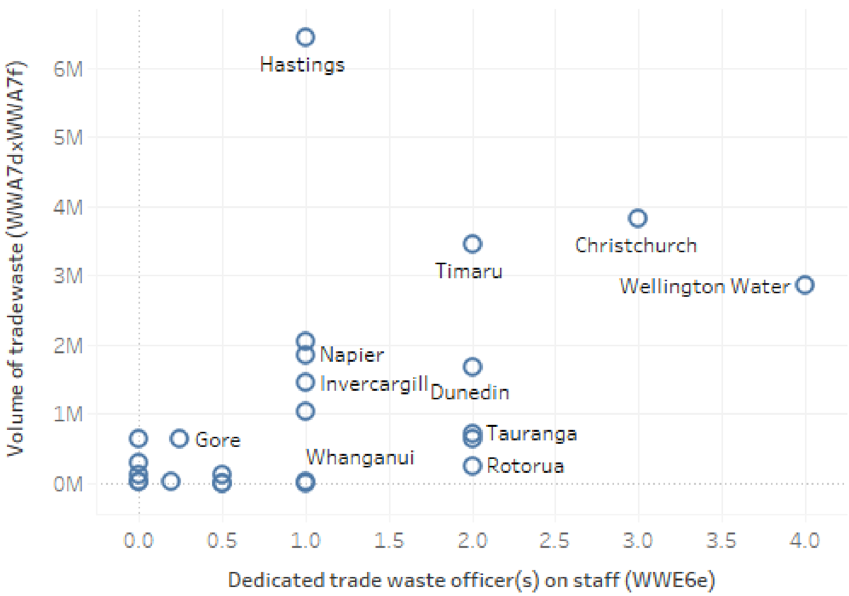


Figure 35: Number of trade waste officers versus cubic meters of trade waste



4.3.1 Trade waste non-compliance

Trade waste non-compliance was the subject of an in-depth media investigation in 2021 (Bradley, 2021), prompting additional measures to be introduced to the Review. In total, 14 wastewater service providers reported a total of 310 breaches of their trade waste consents. Figure 36 shows service providers reporting five or more breaches.

Consent breaches were also recorded in other jurisdictions too small to show on a scaled map: 5 in Gore and Palmerston North, 2 in Tauranga, and 1 each in Hauraki, Invercargill, Whanganui, Selwyn, and Rotorua.

Reported steps taken in response were:

- Increased monitoring (Dunedin).
- Cost recovery for damages (Dunedin).
- Penalty fees (Palmerston North).
- Performance management measures (Tauranga and Waipā).
- Notification of breach (Gore, Hamilton).
- Liaison with companies (Timaru).
- Monthly follow up on servicing of pre-treatment devices when identified as overdue, as well as review of the frequency of servicing of pre-treatment devices where problems had been experienced, and adjustment of the trade waste consent accordingly (Whakatāne).

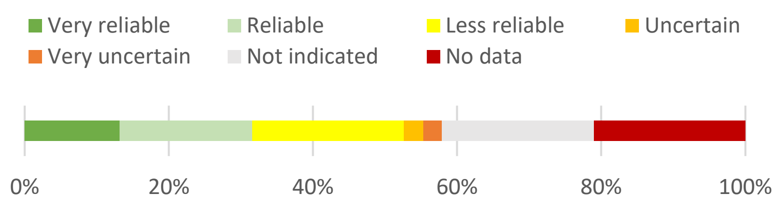
Figure 36: Number of companies breaching their trade waste consents per district

4.3.2 Limitations with trade waste information

Only a minority of participants rated their information on trade waste as reliable. The range of data confidence provided (including information gaps) is shown in Figure 37.

Auckland, Central Otago, Napier, Taupō, and Thames-Coromandel districts did not provide data on consent breaches.

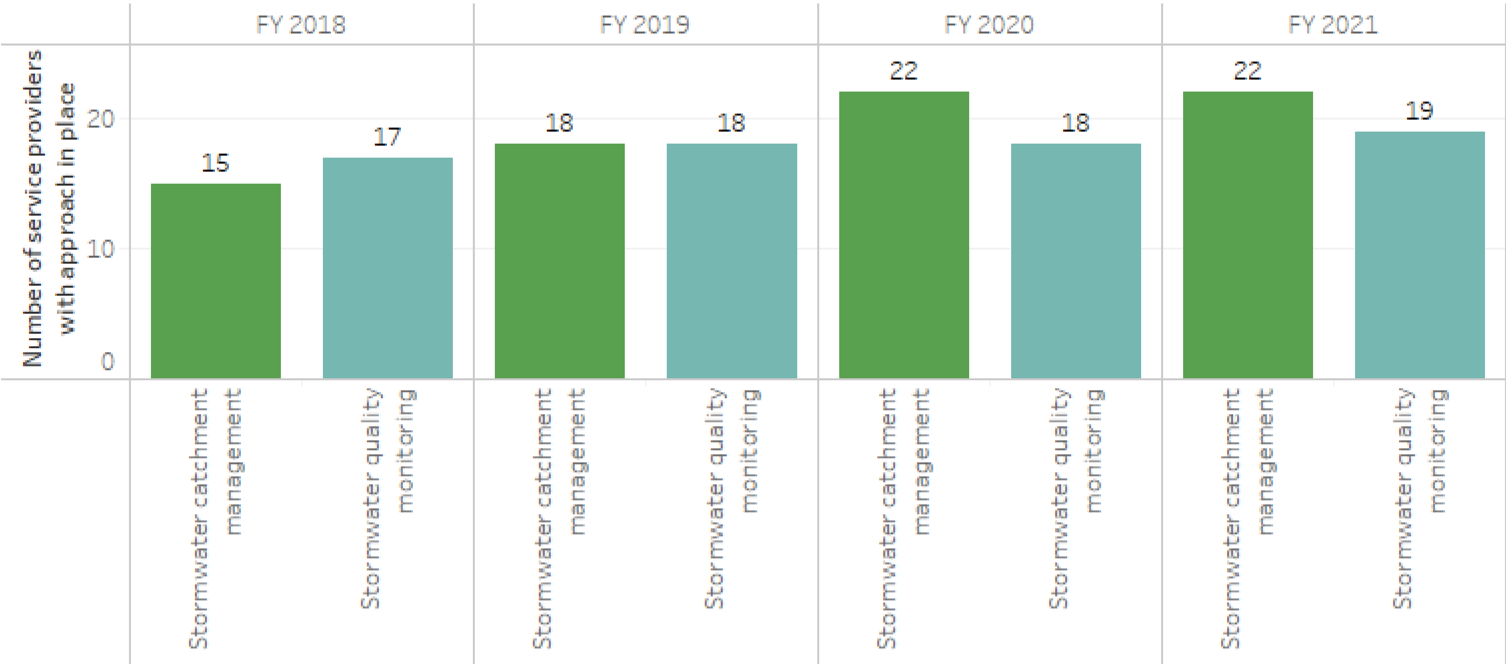
Figure 37: Confidence in trade waste flow information



4.4 Stormwater quality management

Aquatic environments are impacted by stormwater runoff, which can contain elevated levels of nutrients, metals, pesticides, plastics, and other organic contaminants. Catchment plans and monitoring are put in place to minimise impacts. There is a slowly growing trend to employ these approaches, boosted by Tasman District Council which reported stormwater quality monitoring being undertaken in its district for the first time in the 2021 fiscal year.

Figure 38: Number of service providers with stormwater catchment and monitoring in place



4.4.1 Limitations with stormwater quality information

Management of stormwater quality involves a broad range of interventions, ranging from pollutant and litter prevention strategies to water-sensitive urban design. The performance measures here provide a rough indication of whether such practices are in place. The presence of stormwater network catchment management plans and monitoring does not guarantee the success of stormwater quality management practices. Conversely, organisations which do not have quality monitoring or catchment plans in place may take practical steps to manage quality. Improved performance measures are needed to assess the efficacy of stormwater quality management.

4.5 Stormwater resource consents

The extent to which stormwater discharges are consented varies around New Zealand. Eight service providers have universal discharge consents which apply to the whole network. Ten reported no consents whatsoever, and others reported a range of different consenting approaches. These are listed in Table 8.

4.5.1 Limitations with information on stormwater networks

The piped stormwater network is only one component of the urban water cycle. Ring-fencing stormwater discharges to fit within neat definitions is challenging. The challenges are suggested in these participant responses to a question on the number of stormwater discharges in their districts:

- Auckland Council estimated 32,164 stormwater discharges from ongoing surveys.
- Ashburton District Council has 37 "formal" discharge points to rivers/creeks or basins, but a majority of stormwater is discharged to ground via soak pits (~500).
- Napier City Council has over 650 outfalls which discharge during wet weather and, on occasion, dry weather.

Figure 39: Areas of New Zealand with stormwater discharge consents

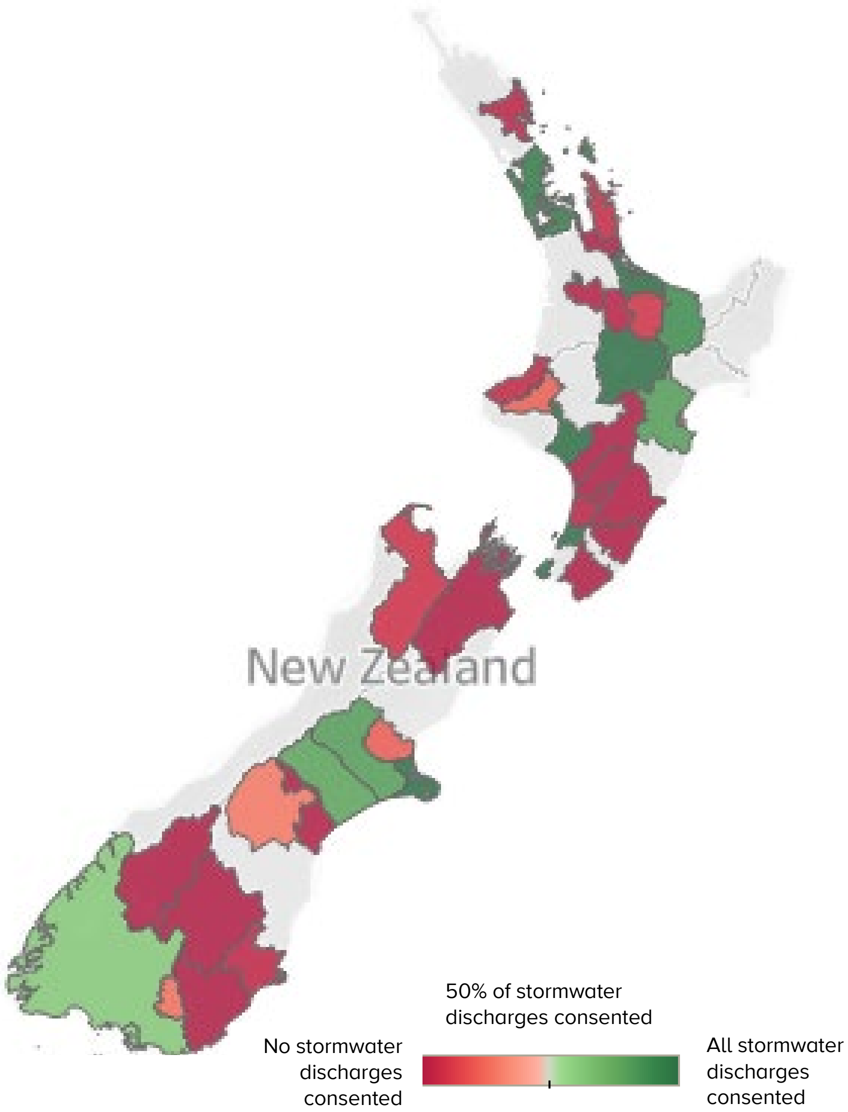


Table 8: Stormwater discharge consents

Participant	Percentage of discharge locations consented (SWE1b/SWE1a)	Number of stormwater discharges with resource consents (SWE1b)
Ashburton	72.97%	Has 27 stormwater discharge locations consented covered by a number of consents.
Auckland Council	100.00%	The regionwide network discharge consent covers stormwater discharges for the whole region. There are various legacy network discharge consents covering multiple discharges.
Gore	100.00%	Has 15 discharge locations covered under four resource consents.
Marlborough	0.20%	One resource consent for discharge of the Springlands Stormwater Management Area covers multiple discharge locations.
Napier	Unknown	Consents are held for the CBD, Cross Country, West Shore Tidal Gates, Thames Tyne, Iron Pot, and a series of smaller ones.
Rotorua	9.63%	Currently there are 29 stormwater discharge consents. Of these, 22 have expired, however Section 124 of the Resource Management Act allows for these consents to remain operative, as these consents will be encompassed in the Rotorua Urban Area Comprehensive Stormwater Discharge consent application currently being processed by Bay of Plenty Regional Council. The comprehensive consent will include all discharge outlets.
Selwyn	80.77%	Consents have been lodged for all stormwater discharges, but only some have been granted.
Tasman	100.00%	All stormwater discharges are now consented under a new global discharge consent.
Timaru	0.37%	Gleniti and Washdyke Industrial Expansion Zone Discharge consent.
Waipā	1.22%	Cambridge, Ohaupo, Kihikihi, Pirongia, Te Awamutu.
Waitaki	10.23%	Has 12 consented outlets in total
Whanganui	100.00%	Permitted activity.
Whangarei	0.00%	Permitted activities under new Proposed Regional Plan.
Dunedin	4.05%	Has 34 stormwater discharges covered by 11 resource consents.
Waimakariri	21.67%	Holds resource consents covering 65 discharge locations. Some consents have been superseded by network discharge consents for the 5 main urban areas.

4.6 Resource consent compliance

Resource consents are held for wastewater treatment plant discharges and, in some cases, wastewater network overflows and stormwater discharges. Of the 37 participants in the Review, 23 reported resource consent non-conformance in wastewater treatment plants, and eight in the piped network.

Table 9: Non-conformance with wastewater resource consents

	Reported non-conformances	Service providers reporting non-conformance
Wastewater treatment plants (WWE4e)	648	23 of 37
Wastewater network discharges (WWE4f)	69	8 of 37

The number of compliance actions taken in relation to breaches of wastewater and stormwater consents is illustrated in Table 10 and Table 11 respectively. Where comments on the nature of abatement notices were provided, these related to discharges outside of compliance limits. The one comment on infringement notices issued related to a wastewater overflow that had occurred over a prolonged period due to faulty monitoring equipment. The one letter of direction commented on related to control of the bird population around the treatment plant. Formal warnings related to dry-weather discharges from wastewater treatment plants directly to receiving environments, non-compliant effluent quality, and odour.

Few comments were provided on stormwater discharges, other than that one infringement notice had been received related to fish obstruction rather than stormwater discharge quality.

Table 10: Wastewater consent non-conformance actions

Wastewater consent non-conformance actions	FY 2021
Wastewater consent abatement notices (WWE4a)	14
Wastewater consent infringement notices (WWE4b)	4
Wastewater consent enforcement orders (WWE4c)	1
Wastewater consent successful prosecutions (WWE4d)	1
Wastewater consent formal warming (WWE4i)	12
Wastewater consent letter of direction (WWE4h)	5

Table 11: Stormwater consent non-conformance actions

Stormwater consent non-conformance actions	FY 2021
Stormwater consent formal warning (SWE2g)	2
Stormwater consent abatement notices (SWE2a)	13
Stormwater consent infringement notices (SWE2b)	0
Stormwater consent enforcement orders (SWE2c)	1
Stormwater successful prosecutions (SWE2d)	0
Stormwater consent letters of direction (SWE2f)	2

Customer focus

www.waternz.org.nz/customerfocus

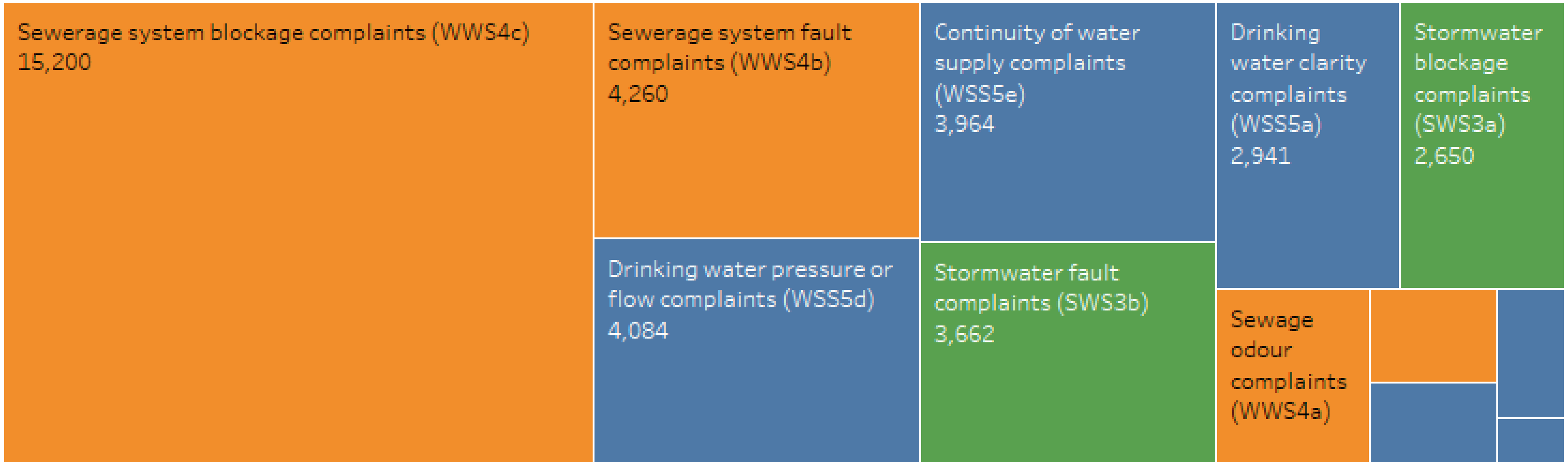
Annaliese helping to water the garden with re-used shower water during a drought
Photo by Kent Langdon of McMillen Jacobs Associates

5. Customer Focus

5.1 Complaints

Customer complaints are recorded using categories shown in the *Non-Financial Performance Measure Rules 2013* (Department of Internal Affairs, 2022). Figure 40 shows all complaints recorded over the reporting year, scaled by their frequency of occurrence. Less frequently occurring complaints related to authorities' responses to issues and drinking water taste are not shown.

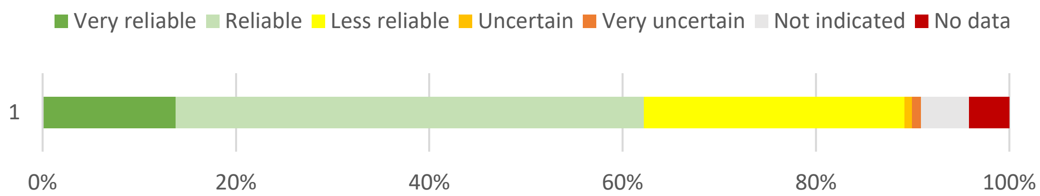
Figure 40: Complaints received by complaint type



5.1.1 Limitations with complaints information

Service providers' complaint management systems are at various levels of maturity, making it difficult to determine whether high complaint levels reflect robust complaint reporting processes or high customer dissatisfaction. Overall, participants considered that less than two thirds of the information was reliable or better.

Figure 41: Confidence ratings assigned to complaints data



5.2 Fault attendance and resolution times

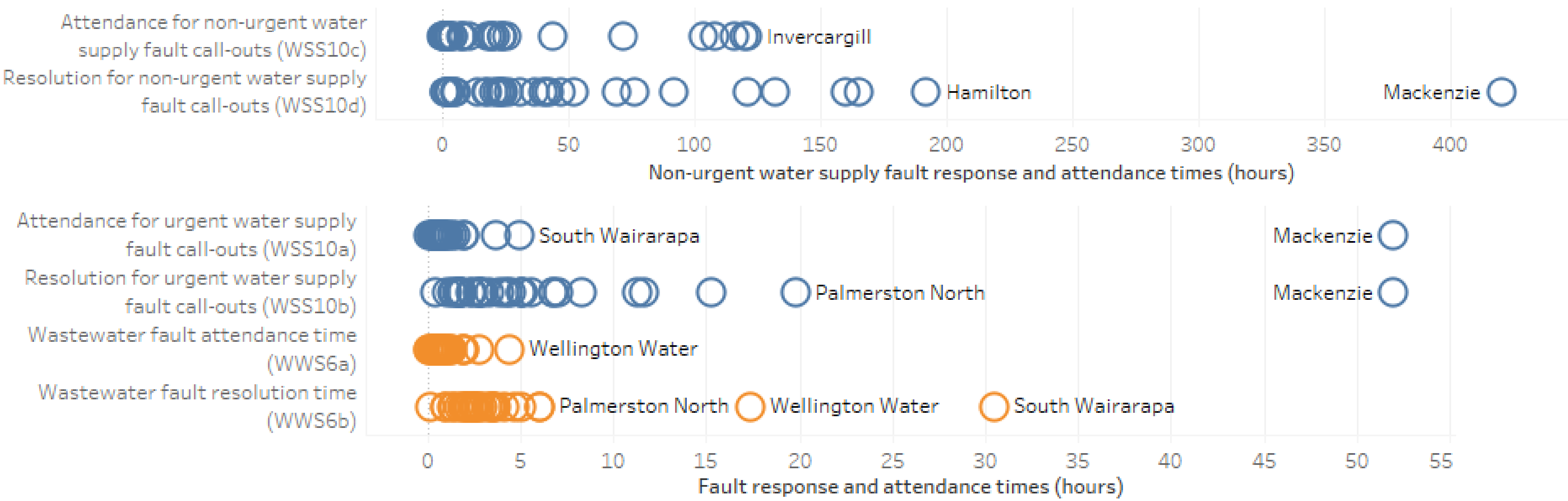
5.2.1 Water and wastewater fault attendance and resolution

Water supply fault attendance and resolution times are reported using *Non-Financial Performance Measure Rules 2013* (Department of Internal Affairs, 2022) categories. Median times across all districts are shown in Table 12. Variation in response times for individual districts are shown in Figure 42.

Table 12: Median fault attendance and resolution times

	Non-urgent water supply faults	Urgent water supply faults	Wastewater faults
Median attendance time (hours)	8.51	0.69	0.67
Median resolution time (hours)	24.26	3.15	2.56

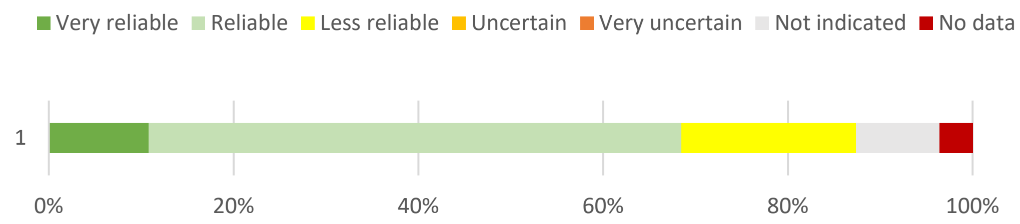
Figure 42: Fault response attendance and resolution times



5.2.1 Information limitations

Two thirds of participants rate their information on fault attendance and resolution times as reliable. In some instances, the target response time from contracts is being reported, rather than basing values on actual fault attendance and resolution times that were delivered in the field.

Figure 43: Confidence gradings assigned to fault attendance and resolution data



5.2.2 Flooding response

Participants are requested to supply information on flood response and attendance times in line with the *Non-Financial Performance Measure Rules 2013* (Department of Internal Affairs, 2022). Only seven participants supplied data on this metric. Five participants took, on average, between one and four hours to respond to flooding. Napier's flood response time averaged 31 hours, and Wellington Water's averaged 58 hours.

A further 23 participants reported a zero response, suggesting there was no flooding in their district to which they were required to respond. The reasons for this are likely to be twofold: in part because not all districts will experience flooding every year, and in part because it is often the responsibility of agencies other than territorial authorities to respond to floods.

5.3 Charges

5.3.1 Charging approaches

Water, wastewater, and stormwater charges are levied using council rates and volumetric charges. The exception is Watercare, which uses solely volumetric charges to collect revenue for water. Auckland uses a unique pricing model for wastewater, being the only provider to have a volumetric charge component for residential wastewater. The volumetric component of residential customer wastewater charges is based on a proportion of water used within the home.

Rates can be one of three types, and are applied in various combinations around New Zealand to fund water and wastewater services:

- **Targeted rates** are paid by a specific group of ratepayers, and generally apply only to users of the service.
- **General rates** are paid by all ratepayers, and vary depending on a property's value and other characteristics.
- **Uniform Annual General Charges** are fixed charges applied to every separately used or inhabited part of a property.

The general approaches used for charging for water services (where information was supplied) are shown in Table 13. More than one type of charge is sometimes used concurrently within a council. For example, a council might charge residential customers both a general and targeted rate for water services. For wastewater services, some non-residential customers are charged a combination of targeted rates, volumetric charges, and contaminant-based charges.

Table 13: Charging approaches for residential water and wastewater

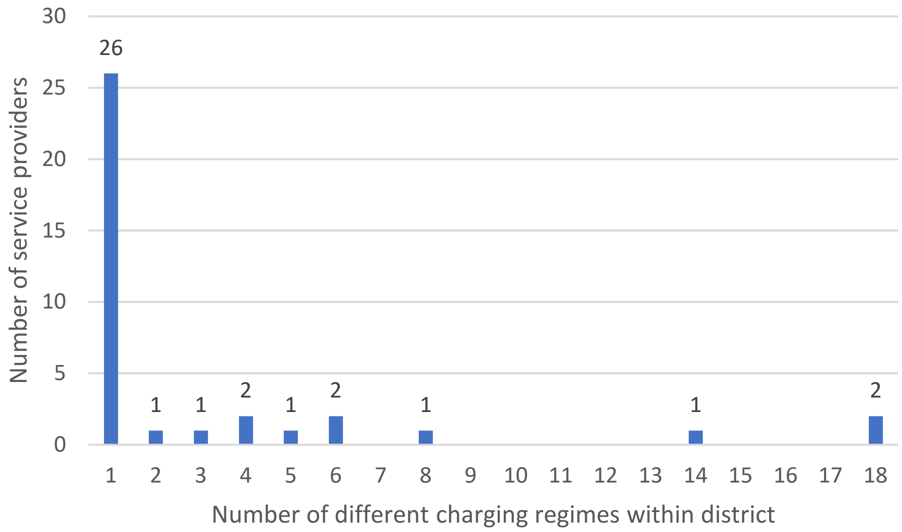
	Targeted rate	Uniform Annual General Charge	General rate	General rate and targeted rate	Based on connection size	Volumetric charge	Contaminant - based charges
Water supply: Residential (WSS8b, WSS8c)	27	3	2	1	1	25	
Water supply: Non-residential (WSS7b, WSS7c)	25	2	0	1	1	34	
Wastewater: Residential (WWS2b, WWS2c)	27	5	3	1		1	
Wastewater: Non-residential (WWS1, WWWS1c, WWS1d)	26	4	1	1		18	20
Stormwater (SWS2)	14	2	11	1			

Charges in Table 13 show the most-often applied approach for charging in the district, however charges can vary within districts.

Most service providers (26 of 37) have a single charge for their entire district, however some service providers associated charges with different networks under their operation. The number of different charging regimes for residential water within a service district is shown in Figure 44. Taupō and Waitaki both have 18 different water prices, corresponding with different service areas, and Waimakariri has 14.

A list of residential water supply charges is included in Appendix II: Residential water charges.

Figure 44: Number of charging regimes for residential water within the service district



5.3.2 Residential charges

The median charge for a residential property using 200m^3 a year of water in the 2021 fiscal year was $470.66, and $522.00 for wastewater. This would take a worker working at the 2021 New Zealand minimum wage 53 hours of work to pay. This is equivalent to 47% of the average residential electricity bill of $2,110 per year (MBIE, 2022).

However, charges around New Zealand vary significantly. The highest wastewater charges in the country ($1,205) are over eight times higher than the lowest ($140). A comparison of average residential charges for each service district is available via the data portal. A list of residential water supply charges is included in Appendix II: Residential water charges.

Figure 46: Average water and wastewater charges (for participants supplying four years data)

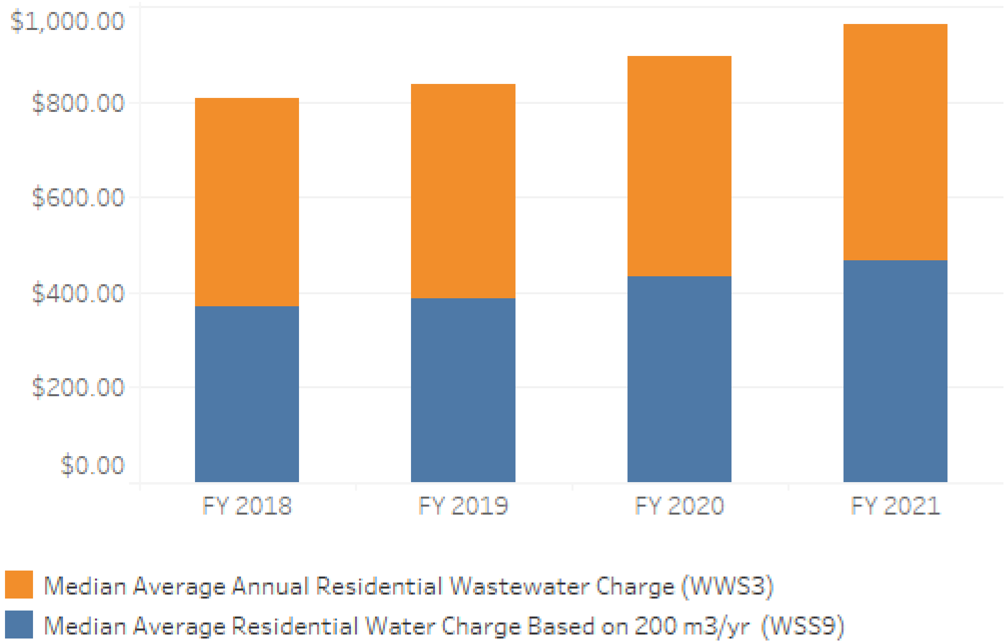
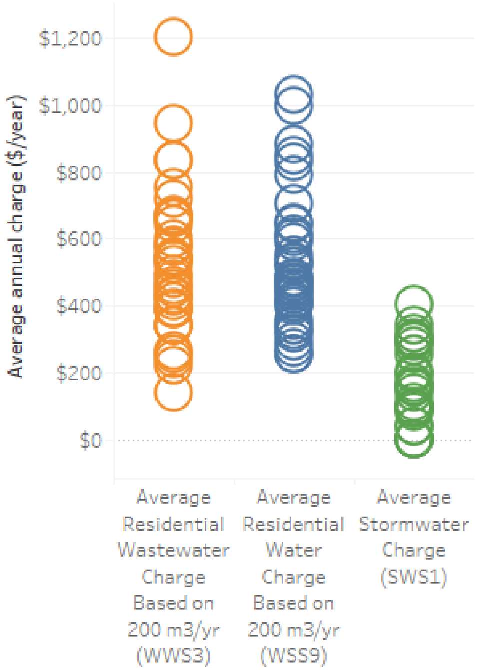


Figure 45: Water, wastewater and stormwater charges in each service distrct



5.3.2 Non-residential charges

Non-residential customers can consume significantly more water than residential customers. In addition, they often also discharge more wastewater, and can have different sewage characteristics, which in turn impact sewers and wastewater treatment plants differently. Some service providers adopt different charging regimes to reflect the different service costs associated with non-residential customers. Volumetric charges are more commonly used for non-residential customers. Twenty of the 37 participating wastewater service providers also have in place contaminant-based charges. Values reported are shown in Appendix III: Contaminant-based charges.

Figure 48: Difference in water charges for non-residential customers

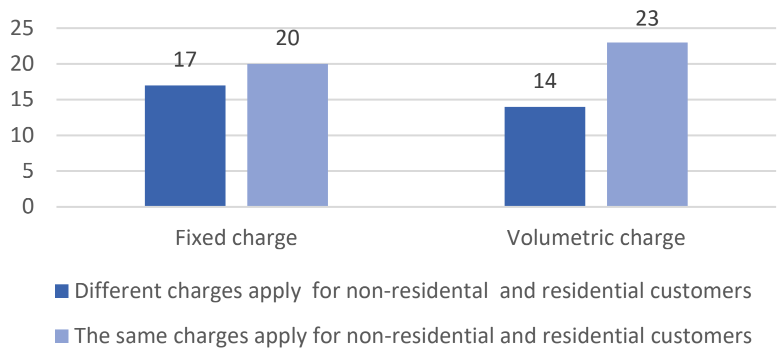


Figure 47: Volumetric charging for non-residential water customers

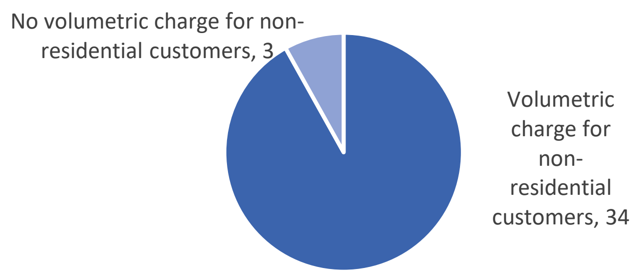


Figure 50: Difference in wastewater charges for non-residential customers

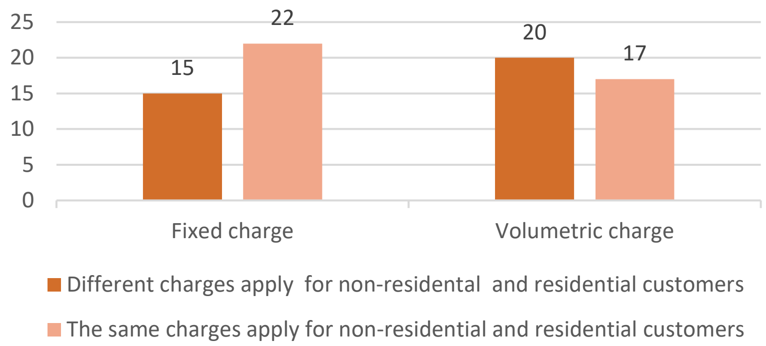
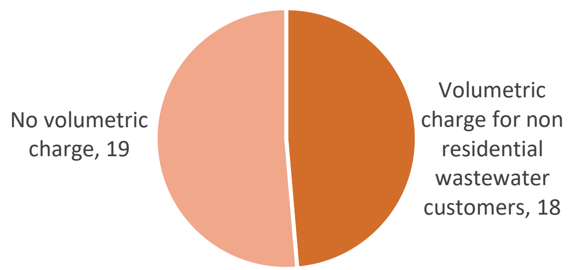


Figure 49: Volumetric charging for non-residential wastewater customers



Economic sustainability

www.waternz.org.nz/economicsustainability

Sewer and stormwater pipe reinstatement at Lake Terrace in Taupō

Photo by Kevin Sears of Taupō District Council

6. Economic sustainability

6.1 Revenue

The predominant source of operating revenue for water, wastewater, and stormwater systems is a combination of rates and volumetric charges. Further detail on charging approaches is outlined in Section 5.3.1 Charging approaches. In the 2021 fiscal year, developer contributions made a larger contribution to the sector's revenue than in previous years. This was driven largely by a rise in wastewater related developer contributions in Auckland.

In the 2021 fiscal year, grants also provided an injection of revenue into the sector. The majority of this funding related to the central government's stimulus and reform funding allocations. Auckland Council also received two other government grants, one from the Ministry for the Environment for its Mahurangi Land Restoration Programme and Hoteo Sediment Reduction Project, and one from the Ministry of Social Development's Skills for Industry initiative.

Table 14: Annual revenue for supply of water services

Funding source	Water Supply	Wastewater	Stormwater	TOTAL
Operating revenue	$677,222,205	$951,656,116	$341,167,655	$1,970,045,976
Revenue from supply of services to other authorities	$7,265,719	$15,564,915		$22,830,634
Development contributions	$102,947,367	$214,238,912	$50,963,169	$368,149,448
External grants	$65,418,815	$58,277,094	$12,219,001	$135,914,910
Total per service	$852,854,106	$1,239,737,038	$404,349,825	$2,496,940,968

Figure 51: Scaled image of total annual revenue received per participant

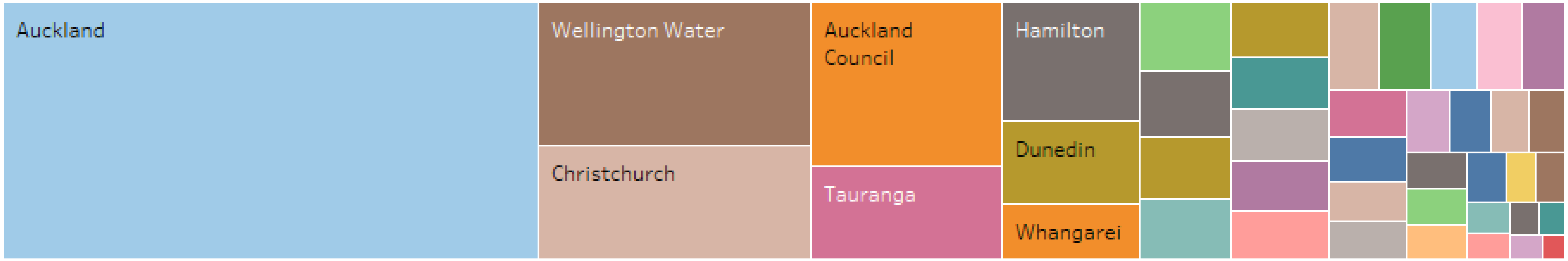
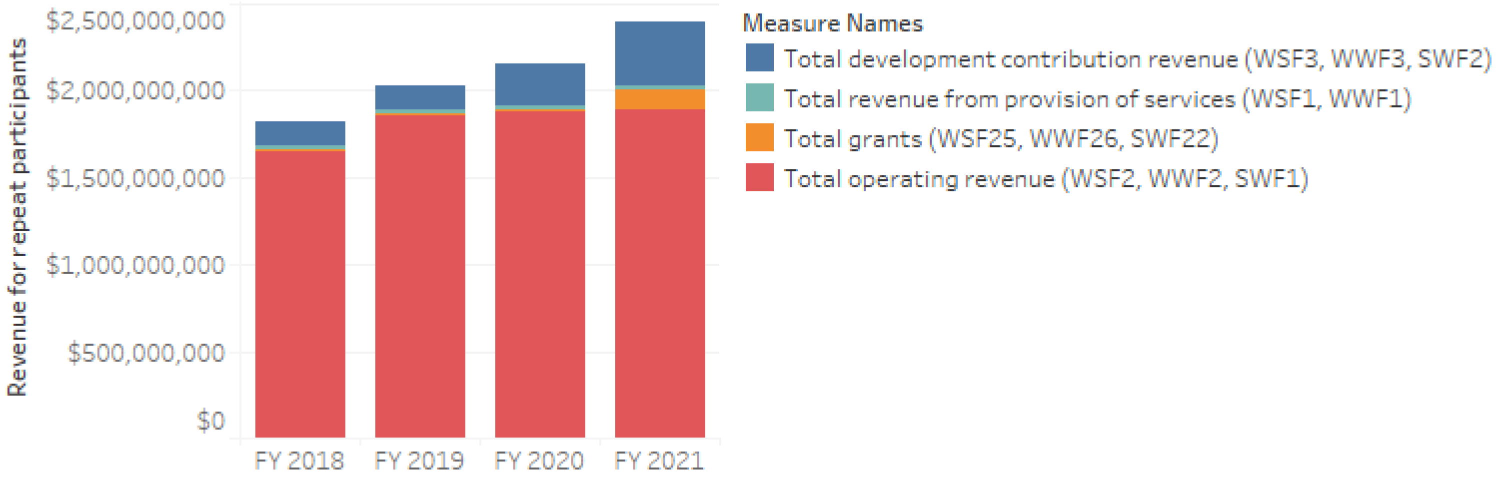


Figure 52: Trend in annual revenue



6.2 Expenditure

Annual expenditure across all service providers was nearly $3 billion. A breakdown of expenditure is provided in Table 15.

Table 15: Annual expenditure on water supply services

	Water supply	Wastewater	Stormwater	TOTAL
Capital expenditure (WSF20, WWF21, SWF17)	$867,561,117	$714,035,383	$237,355,305	$1,818,951,805
Operating expenditure (WSF12, WWF13, SWF9)	$375,763,781	$465,213,390	$117,558,983	$958,536,154
Interest (WSF15a, WWF16a, SWF12a)	$56,018,834	$85,310,012	$30,952,577	$172,281,423
Total cost by service	$1,299,343,732	$1,264,558,785	$385,866,865	$2,949,769,382

6.2.1 Capital expenditure

Capital expenditure totalled over $1.8 billion in the 2021 fiscal year, continuing an upward trend. This was primarily driven by increased spending in Auckland to meet additional demand for water supplies, which increased from $192 million in the 2020 fiscal year, to $406 million. The purpose of expenditure is shown in Figure 54.

Figure 54: Capital expenditure by purpose

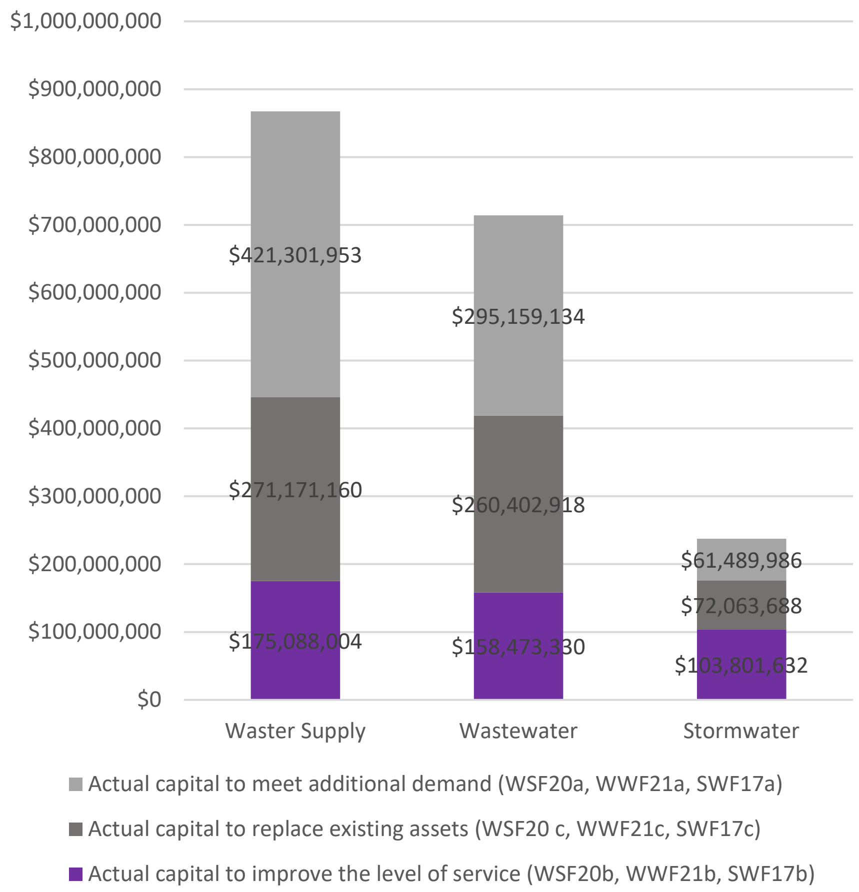


Figure 53: Scaled capital expenditure by service provider

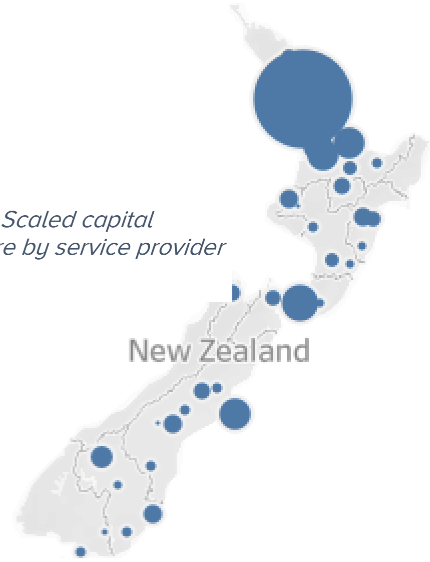
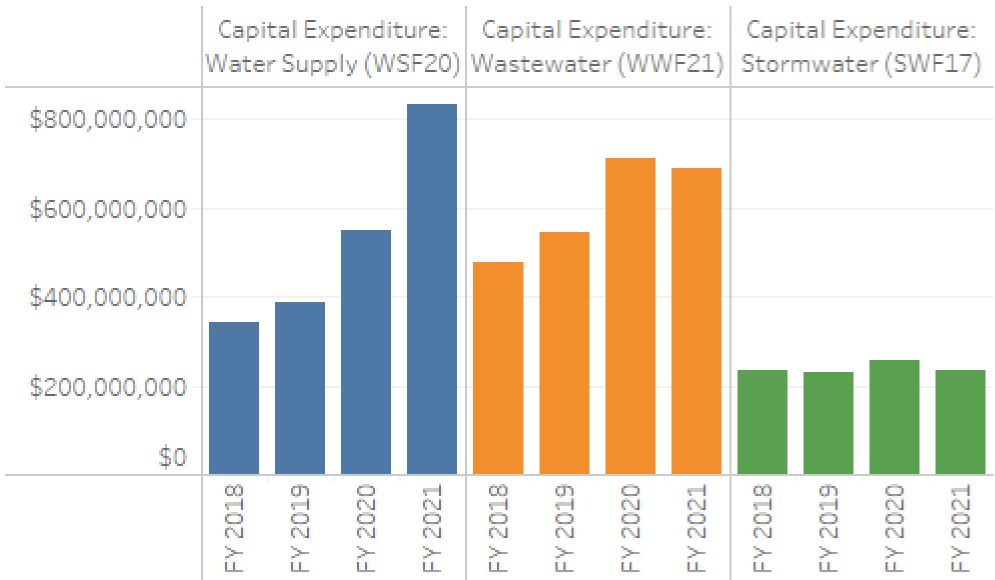


Figure 55: Capital expenditure trend



6.2.2 Operating expenditure

Service providers reported operating expenditure of $958.5 million in the 2021 fiscal year. Average operating expenditure per property has been showing a gradual increase, but while there have been increases by some service providers, there have been decreases by others. Variation in operating expenditure, normalised on a per property basis, is large. Figure 58 illustrates this, showing individual service providers as circles. Variations in individual participants' operating expenditure and year-on-year trends is available via the data portal.

Figure 56: Trends in operational expenditure

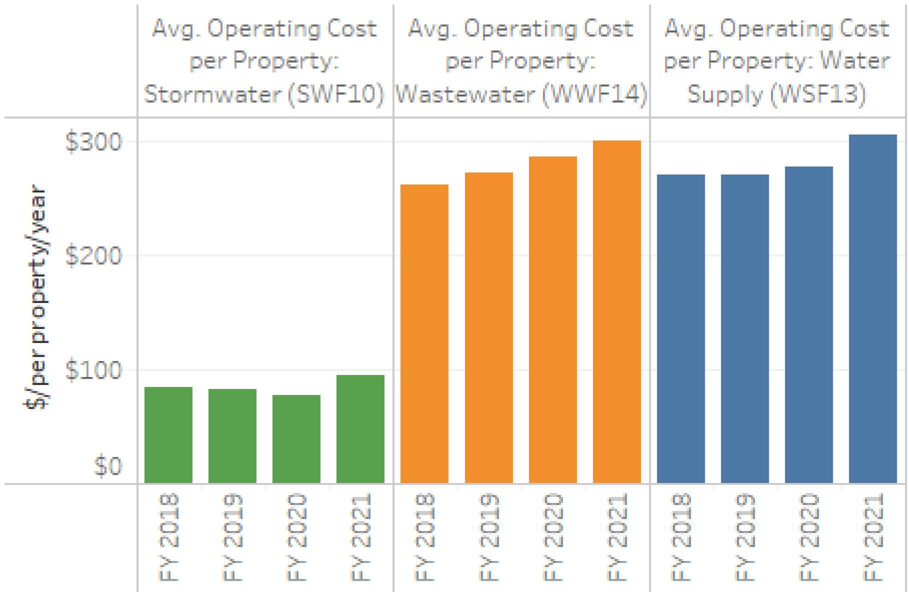


Figure 57: Operating expenditure by purpose

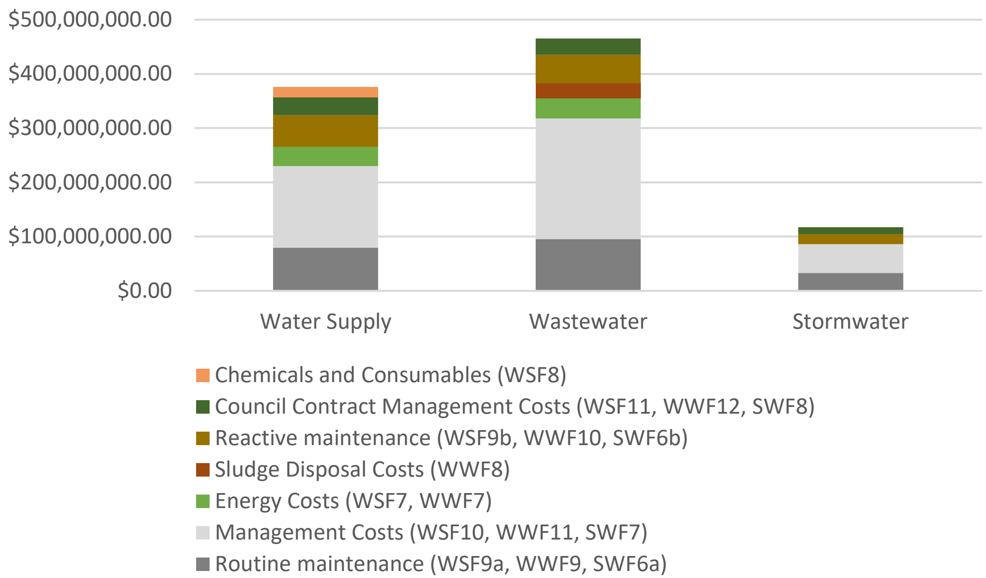
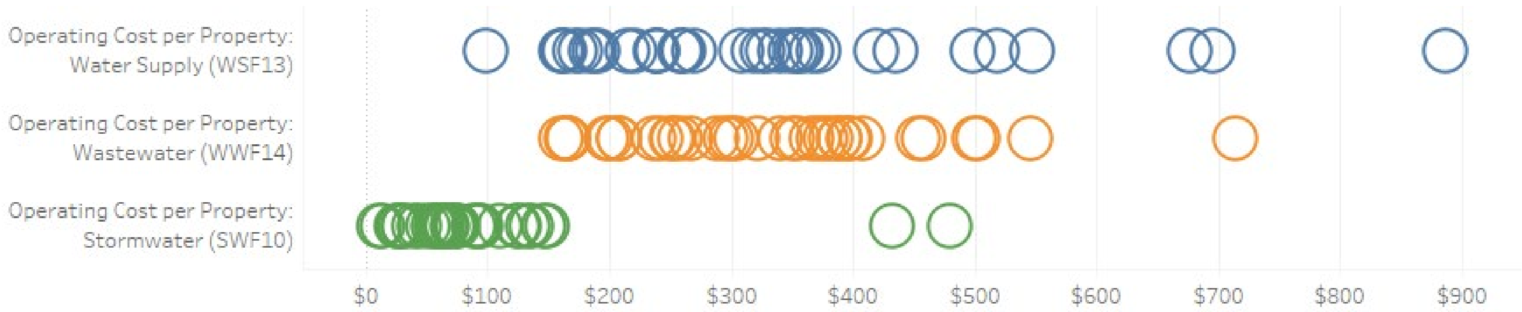


Figure 58: Operating expenditure per property shown per service provider



6.2.3 Limitations with operating expense information

Information was requested on the split between routine and reactive maintenance. This was intended to establish the extent to which performance outcomes (such as water loss and inflow and infiltration) were improved by proactive maintenance. However, over one third of participants (13 for water supply and wastewater, and 14 for stormwater) were unable to provide this breakdown. The large range in results suggests that routine and reactive cost allocations are not being consistently interpreted. For example, the ratio of routine to reactive costs for the stormwater network ranged from 0.24 to 281.

There is variability in the approach service providers used to assign council contract management costs. This was intended to represent the cost of managing contractual relationships, however instances have been identified during audits where the cost for contractors to perform services has been included. These costs were intended to be captured in routine or reactive maintenance fields, which would result in a double count of some costs.

6.3 Financial prudence benchmarks

Water suppliers are required to disclose financial information in line with the *Local Government (Financial Reporting and Prudence) Regulations 2014* (New Zealand Government, 2022). The regulations include a range of benchmarks, which provide useful comparisons of the financial management of water services.

These benchmarks should be interpreted with caution, as a council's overall financial approach will often balance out financial performance across business units when considered as a whole. The Local Government Financial Reporting and Prudence Regulations also include benchmarks on rates affordability, debt affordability, debt control, and operations control not included in this report.

There are also differences between the definition of the essential services benchmark provided in the regulations, and that included in this report, discussed in Section 6.3.4.

6.3.1 Debt servicing

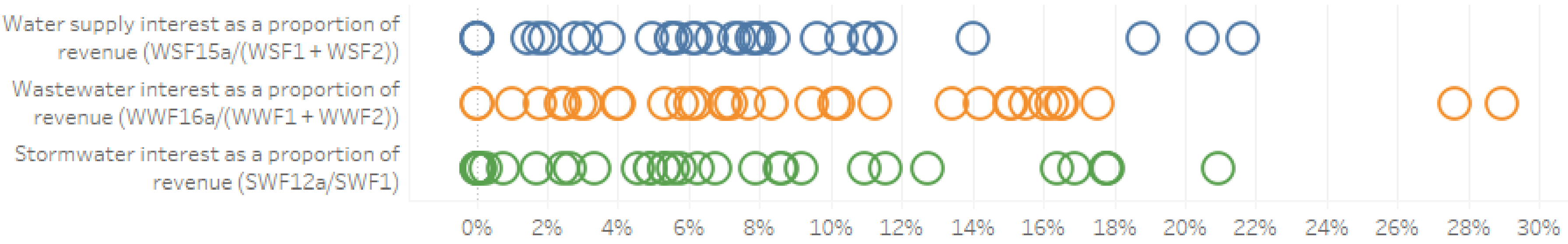
A local authority meets the *Local Government (Financial Reporting and Prudence) Regulations 2014* (New Zealand Government, 2022) debt servicing benchmark if its borrowing costs for the year equal or are less than 10% of its revenue (excluding development contributions, financial contributions, vested assets, gains on derivative financial instruments, and revaluations of property, plant, or equipment) for the year.

However, a high-growth local authority meets the debt servicing benchmark for a year if its borrowing costs (interest) for the year are equal or are less than 15% of its revenue (excluding development contributions, financial contributions, vested assets, gains on derivative financial instruments, and revaluations of property, plant, or equipment) for the year. The figure is calculated using the following formula:

performance = borrowing costs ÷ revenue

Performance in relation to debt servicing for each of the three waters services are illustrated in Figure 59 with each service provider represented as a circle.

Figure 59: Interest as a proportion of revenue for different water service providers



Napier and Central Hawkes Bay's stormwater data were significant outliers, at 90 and 110% respectively, and were excluded from the dataset. This was a result of low values reported for stormwater revenue, likely accounted for elsewhere in the Council's balance sheet.

Figure 59 indicates that some service providers carry higher levels of debt associated with water services than the overall benchmark for council operations. This may be attributable to the long life of water assets, meaning capital used to finance them is commonly funded through debt in adherence with principles of intergenerational equity.

The significant value of water assets may also be a factor in the notable number of service providers carrying more debt than the financial prudence benchmarks. Information on the total levels of debt is available through the Local Authority Financial Impact Tool (Te Tari Taiwhenua | Department of Internal Affairs, 2022) developed as part of the Government's 3 Waters Reform Programme.

6.3.2 Balanced budget benchmark

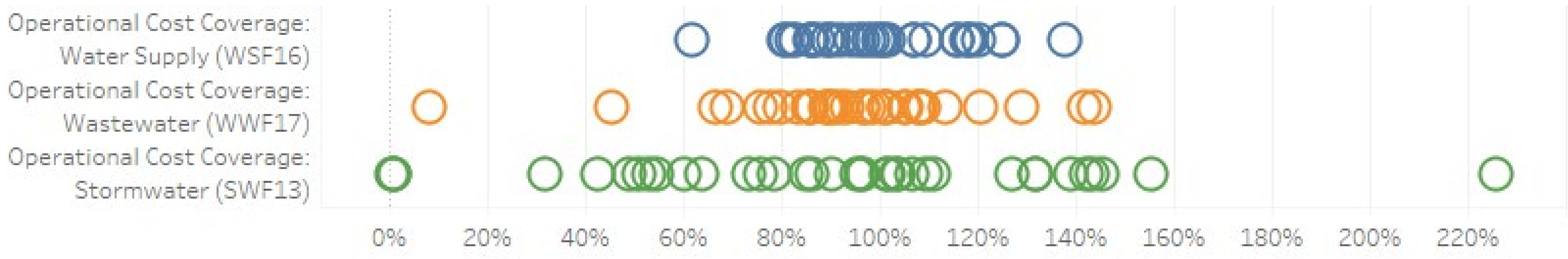
A local authority meets the *Local Government (Financial Reporting and Prudence) Regulations 2014* (New Zealand Government, 2022) balanced budget benchmark if its annual revenue (excluding development contributions, financial contributions, vested assets, gains on derivative financial instruments, and revaluations of property, plant, or equipment) exceeds its annual operating expenses (excluding losses on derivative financial instruments and revaluations of property, plant, or equipment).

Operational cost covered, illustrated in Figure 60, with each service provider represented as a circle, is calculated using the following formula:

performance = revenue ÷ operating expenses (including depreciation and interest payments on debt)

If the operational cost coverage benchmark is met, this ratio will be 100% or above. The figure shows that operational costs were not met for 16 of 34 (47%) water services, 20 of 37 (54%) wastewater services, and 18 of 37 (48%) stormwater services. This suggests that these service providers are electing not to fully fund depreciation and/or do not have charges that cover the full costs of operating the respective networks.

Figure 60: Revenue as a proportion of operational costs for water service providers



This figure shows depreciation instead of capital costs, as this (in theory) provides an average indication of the capital needed to invest in assets to maintain service delivery. There are uncertainties associated with depreciation, discussed further in Section 6.3.5.

6.3.3 Essential services benchmark

A local authority meets the essential services benchmark if its capital expenditure on network services equals or exceeds depreciation on network services for the year. The essential service benchmark is calculated using the following formula:

performance = capital expenditure (on levels of service improvements and renewals) ÷ depreciation

Unlike the financial prudence regulations, capital expenditure related to new growth has been excluded from the figures shown here. This is because growth related spending does not address asset depreciation.

Because capital expenditure is inherently lumpy, with large outlays in some years and low activity in others, Figure 61 and Figure 62 show the previous four years' data, to smooth out variations in expenditure.

Figure 61: Essential services benchmark for different water services

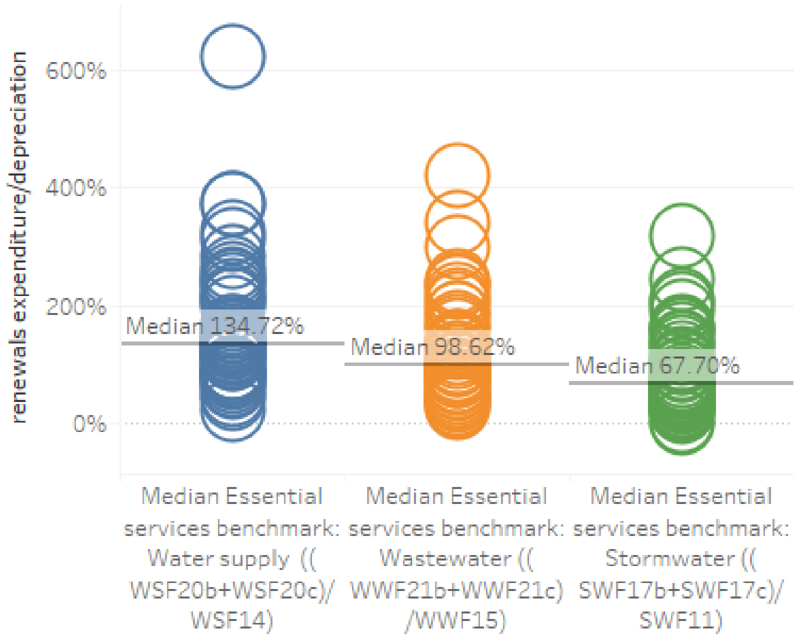


Figure 62: Essential services benchmark for the sector as a whole

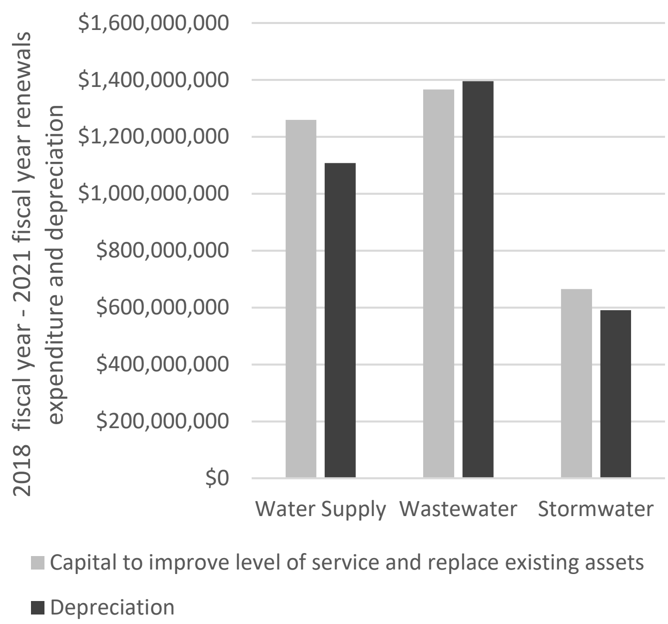


Figure 61 shows capital expenditure on renewals and levels of service upgrades as a proportion of depreciation over the last four years, with each service provider represented as a circle. This shows expenditure on existing assets over the previous four years has not exceeded depreciation for nine water, 14 wastewater, and 15 stormwater service districts, suggesting service levels in these districts would be expected to decline.

Figure 62 illustrates the spending of the sector as a whole, showing that, on average across New Zealand, water supply and stormwater expenditure over the last four years has been sufficient to address asset depreciation. The stormwater spending is significantly skewed by capital expenditure in Auckland, where the combination of capital spent on renewals and levels of service has exceeded depreciation by roughly 50% over the previous three years. This is significant enough to mask what would otherwise be a below average essential service performance benchmark for the sector as a whole.

6.3.5 Limitations with asset depreciation information

There is a range of methods for determining asset depreciation. Depending on which method is used, asset depreciation may be overcompensated for, or its estimate of an asset's useful life may be exaggerated. Uncertainty in how depreciation has been applied, and the accuracy of these values, limits confidence in both balanced budget and essential services benchmarks.

Resource efficiency

www.waternz.org.nz/resourceuseefficiency

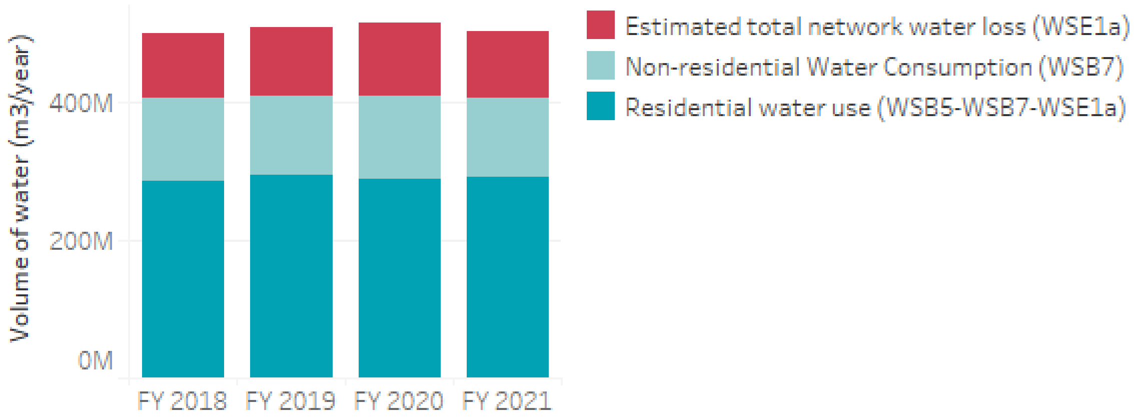
Water droplets at Kina Beach near Nelson
Photo by Charlie Robson-Burrell (chazrbphotography@gmail.com)

7. Resource efficiency

7.1 Water demand management

7.1.1 Water abstractions

Figure 63: Water abstractions trend



7.1.2 Limitations with water loss and non-residential water use information

Participants generally had confidence in the total value of water abstracted from the network (75% rating this as reliable or above), however the proportion allocated to non-residential uses or lost through the network received lower data confidence ratings, illustrated in Figure 65.

Figure 65: Data confidence of water loss and non-residential consumption data

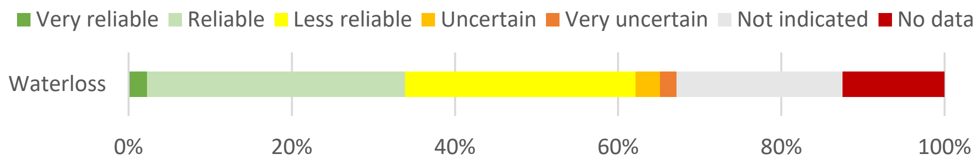
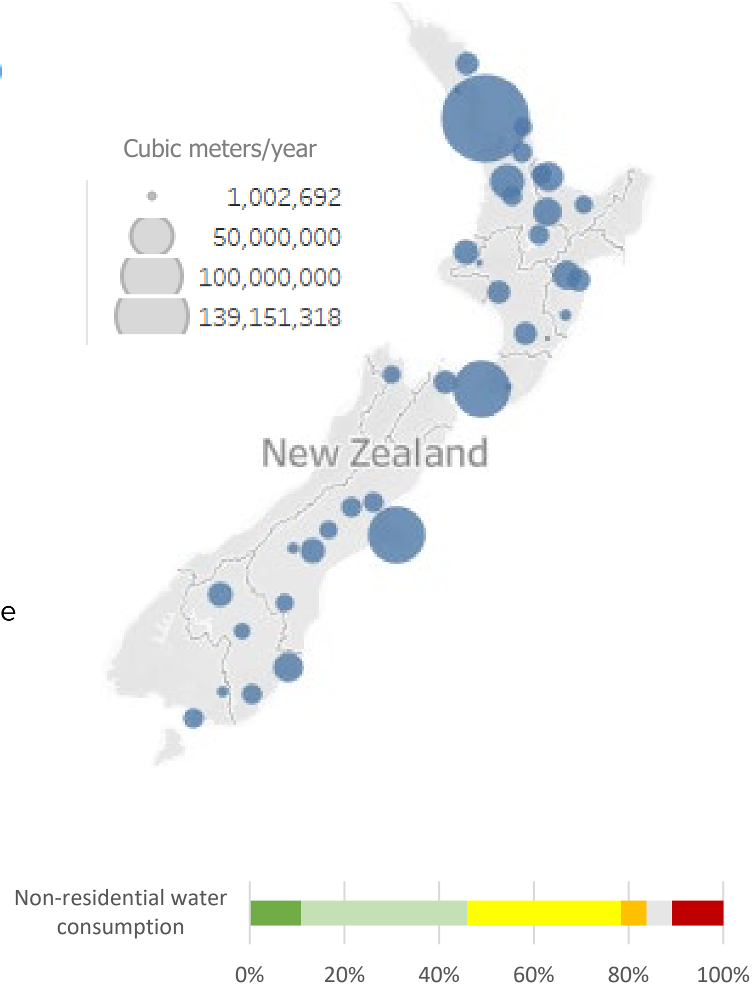


Figure 64: Water supply to participant networks

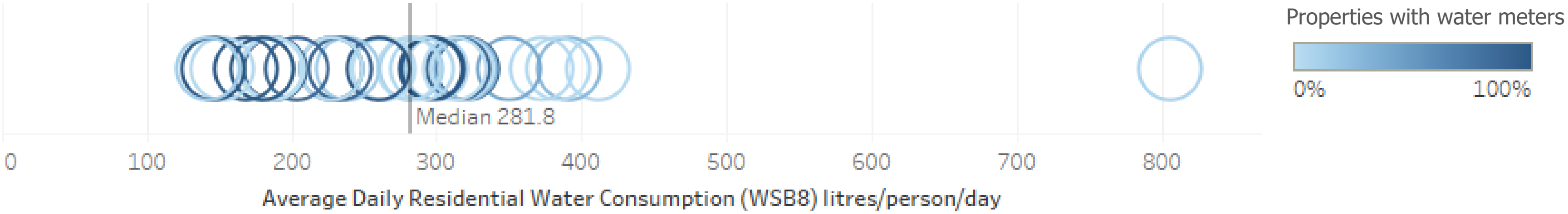


7.1.3 Residential water efficiency

Median residential water consumption across water-serviced districts was 281 litres/person/day.

The relationship between residential water consumption and metering is illustrated in Figure 66. Each circle represents a service district, and is colour coded based on the percentage of residential properties with water meters.

Figure 66: Residential water efficiency for different service districts



7.1.4 Limitations with residential end use information

Residential water efficiency is calculated for a service district using the formula provided below. Accordingly, the accuracy of these figures relies on residential property data, water loss calculations, and a reliable break-down of non-residential use. Non-rsidential and water loss estimates are commonly uncertain. Assigned data confidence ratings for these metrics are shown in Figure 65.

$$Average\ Daily\ Residential\ Water\ Consumption\ [WSB8] = \frac{Water\ Supplied\ to\ Own\ System\ [WSB5] - Total\ nonresidential\ Water\ Consumption\ [WSB7] - Estimated\ total\ network\ water\ loss\ [WSE1]}{365 \times Total\ water\ serviced\ population\ [WSB1]} \times 1000$$

Definition guidelines for this performance measure also included water exported to other authorities [WSB5b] in the calculation. This was included in error in both the 2019/20 and 2020/21 Reviews, and data has been retrospectively amended where relevant.

7.1.5 Water metering

Water meters are one of the tools available to water service providers to assist in demand management. The number of metered properties in service districts covered by the Review is listed in Table 16. Most non-residential properties are metered, and over half the residential population has a water meter.

Overall figures are skewed by full metering coverage in Auckland. There are still 18 water suppliers (half of those in this Review) with less than 10% of the residential population metered. The percentage of metering coverage in different water supplier districts is shown in Figure 68 and Figure 69. A comparison of individual service districts is available via the data portal.

Table 16: Number of metered properties

	Metered (WSA9a, WSA9b)		Not metered (WSB2-WSA9a, WSB3-WSA9b)	
Residential	798,578	59.22%	549,985	40.78%
Non-residential	99,635	79.12%	26,289	20.88%

Figure 67: Residential water metering coverage

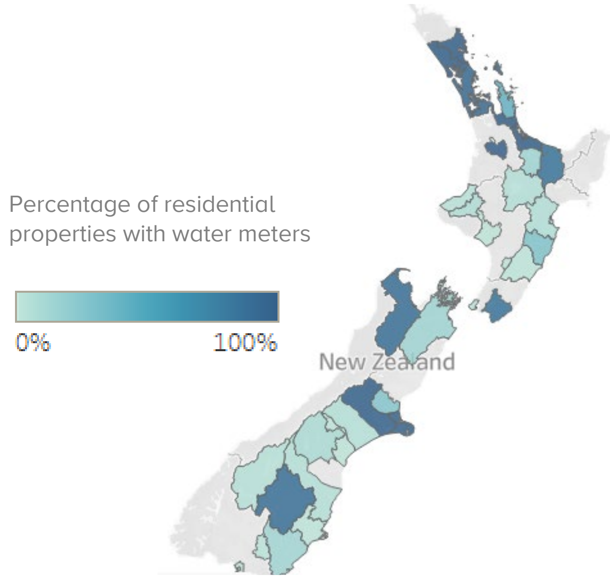


Figure 68: Percentage of non-residential properties with water meters in different service districts

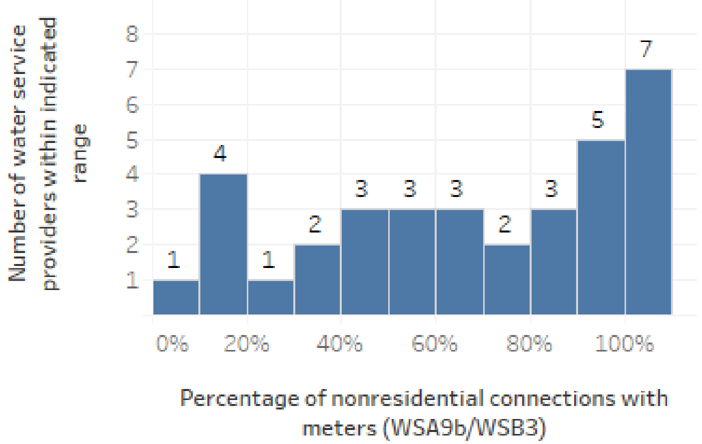
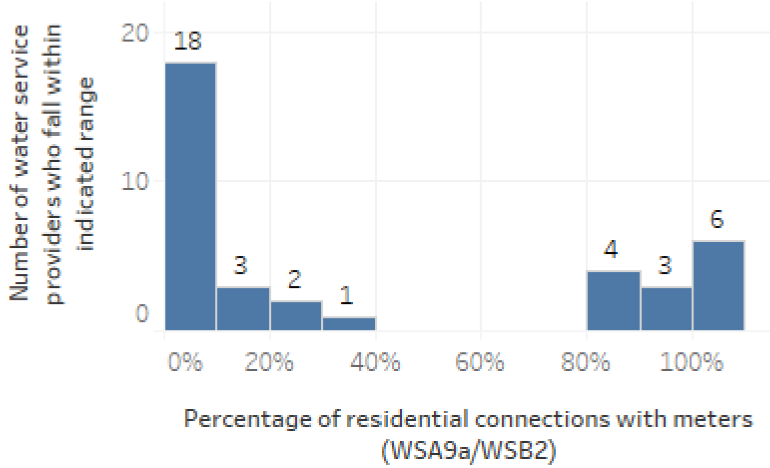


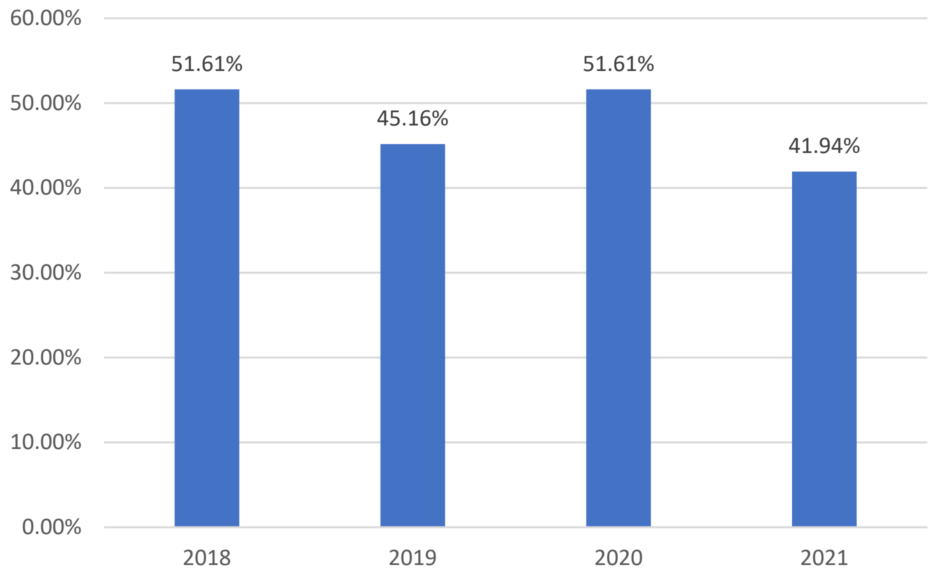
Figure 69: Percentage of residential properties with water meters in different service districts



7.1.6 Water restrictions

Water restrictions are sometimes employed as a demand management tool when water supplies are constrained. Figure 70 shows the percentage of water service providers that have put in place some form of water restrictions over the previous four years.

Figure 70: Percentage of water service providers with water restrictions in place



7.1.7 Information limitations

Water restrictions provide a rough indication of demand pressures on water supplies. The thresholds at which water restrictions are applied differ across regions, as do the restrictions themselves. Preferable performance measures would compare statistical probability of supply shortages and outages. The use of such models is not yet commonplace in New Zealand.

7.2 Energy use

Energy is used in the treatment and conveyance of water and wastewater, as well as in general operations. The definition of energy here covers energy provided by all energy sources, including electricity, diesel, gas, and biogas, consumed by the water system pumps and water treatment plants.

Energy use associated with operations, such as the operation of fleet vehicles and offices, can also be significant, however is not accounted for here. A summary of energy-using components, and an indication of the contributions these make to water services greenhouse gas emissions, is available in *Navigating to Net Zero* (Water New Zealand, 2021).

Some, but not all, stormwater systems are also energy users, primarily where water is pumped away from large bodies of water. Fourteen of the 37 participants in this Review had in place some form of stormwater pumping and associated energy use.

Figure 71: Energy generation and consumption of water services

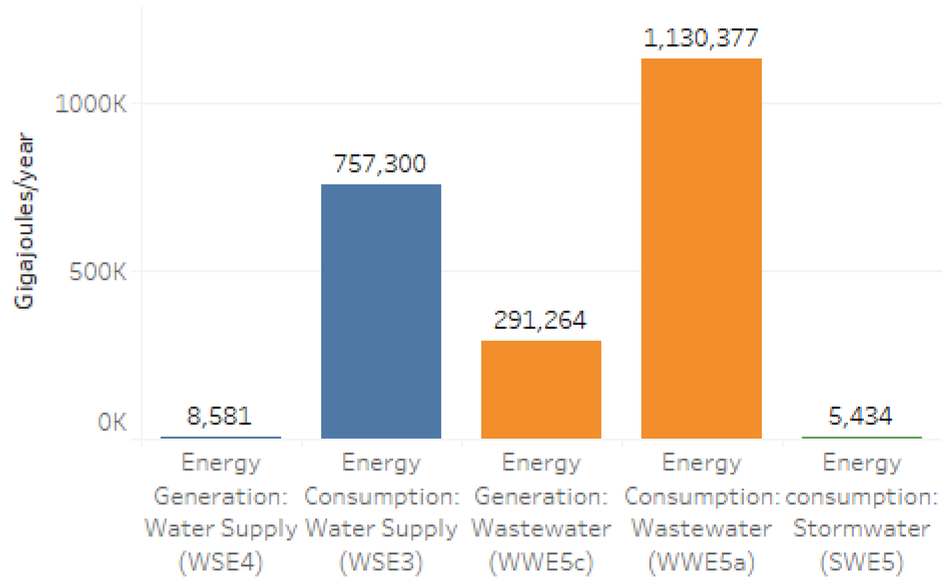
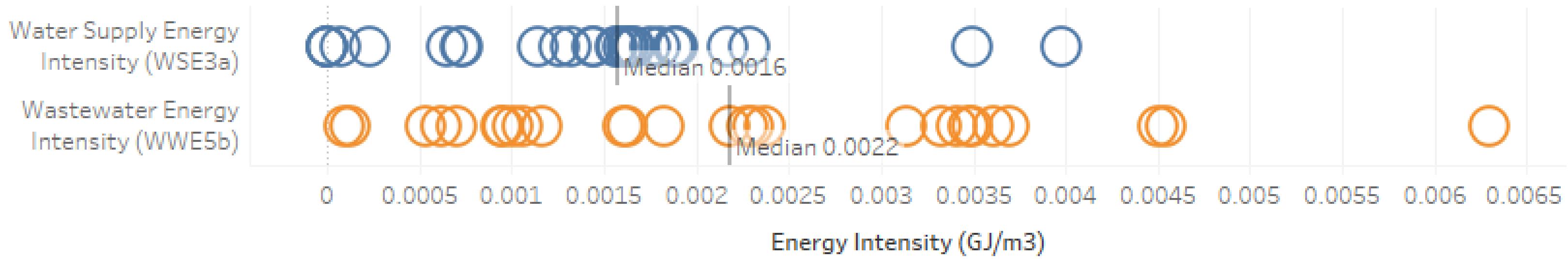


Figure 72: Energy use per cubic meters of water delivered or wastewater treated



Clutha has been excluded from the data set due to anomalies in reported volumes of wastewater produced.

Electricity is the predominant energy source used to operate water and wastewater treatment plants and pump stations. Other fuel sources including natural gas, biogas, biomass, and diesel are also employed, often in backup generation or drying processes. Hence energy consumption in this report has been expressed in joules to provide a metric that encapsulates energy consumption across all fuel sources.

7.2.1 Water supply energy use information limitations

Desktop audits identified several unit conversion errors, suggesting that the use of GJ as a unit of measure is causing confusion, particularly for participants relying solely on electricity bills for reporting their energy use.

Ten participants were unable to supply information on the energy use of their water systems, and a further nine on wastewater. Seven participants likley to have some stormwater energy use (as they operated stormwater pumping stations) did not provide information on stormwater energy use. The proportion of participants supplying data, and their self-assigned confidence gradings, is illustrated in Figure 73

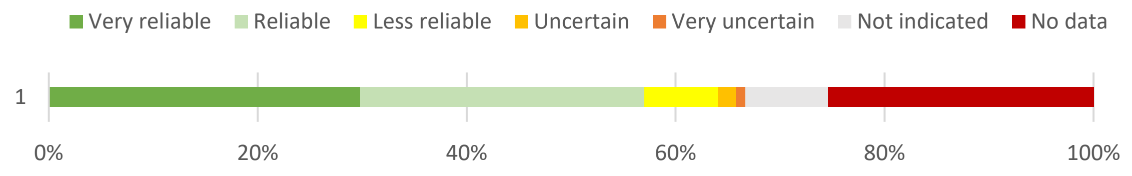
Last years audits of reporting on electricity found:

> The main issue seems to be whether or not organisations have their energy billing and reporting set up so that each of the three waters can be analysed separately, including costs and GJ/year consumption. Half the service providers listing information on their data source (22 of the 37) indicated that information was sourced from energy management software, and the other half from bills.

Where electricity bills are relied upon for energy information, it is likely that some energy use will be excluded, particularly energy use associated with alternative fuel sources (such as diesel, biogas, or biomass) or contractor energy use. In some instances, contractor energy use can be significant, particularly where treatment plants are operated under contract.

For those with bespoke energy or greenhouse gas reporting systems, it is more likely that data reflects an accurate encapsulation of energy use. For example, Christchurch City Council sourced information from a "Resource Efficiency and Green House gas emission dashboard," which included various energy forms used in the wastewater network, including electricity, diesel, and landfill gas and woodchip used in biosolids drying.

Figure 73: Confidence gradings assigned to energy data

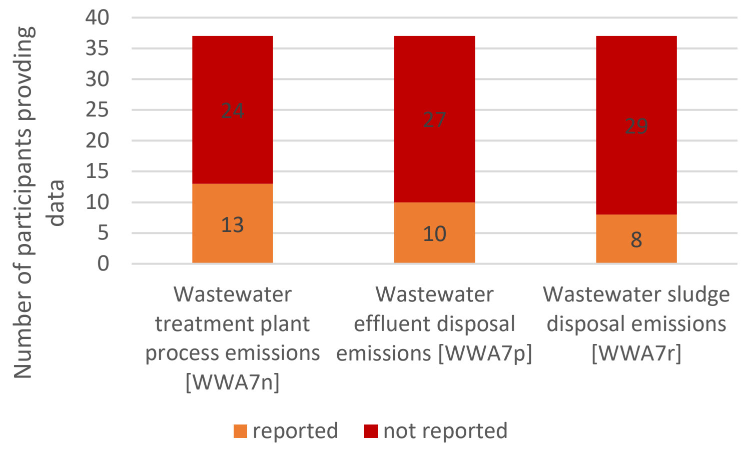


7.3 Direct greenhouse gas emissions from wastewater

The treatment and disposal of wastewater and associated sludges produces methane and nitrous oxide, both potent greenhouse gases. Greenhouse gas emissions are also produced by other water service operations, but are not covered in this Review. Sources of these emissions related to water are included in *Navigating to Net Zero* (Water New Zealand, 2021).

Emissions reporting categories are aligned with the *Carbon Accounting Guidelines for Wastewater Treatment: CH4 And N2O* (Water New Zealand, 2021). They include emissions estimates for municipal and domestic wastewater treatment, effluent discharge, sludge treatment and disposal, and a separate category for treatment wetlands, which are sometimes employed as a polishing stage or standalone method for treating wastewater.

Figure 74: Number of participants providing estimates of greenhouse gas emissions from wastewater



The number of participants providing data for each of the common stages of wastewater processing is shown in Figure 74. Not shown in the figure is that two participants also provided an estimate of wetland emissions, and five that provide an estimate for sludge treatment.

7.3.1 Wastewater greenhouse gas information limitations

Comments and desktop audits indicate that the definition related to wastewater emissions has not been consistently interpreted. Some participants were unable to provide a breakdown of emissions sources. Others included other emissions sources including electricity, gas, and transport emissions. The information is not considered reliable enough to provide an indicative value of greenhouse gases. National emissions estimates of wastewater treatment plant process emissions using alternative methodologies are included in the *New Zealand Wastewater Sector Report* (Beca, GHD, Boffa Miskell, 2020).

Additional uncertainty relates to emissions factor estimates used to derive emissions. Such estimates are used in the absence of direct wastewater emissions monitoring, which has not been undertaken in New Zealand to date. The *Carbon Accounting Guidelines for Wastewater Treatment: CH_4 And N_2O* (Water New Zealand, 2021) comment:

> There is high uncertainty in many of the emission factors described in these guidelines. Emissions of CH_4 and N_2O will vary in wastewater processes temporally and spatially. The choice of treatment process can affect emissions, but equally how a process is operated and the wastewater characteristics will also have a bearing on the GHG flux. To improve estimates of key emissions, a national monitoring plan is needed to look at developing more process specific emission factors.

7.4 Wastewater sludges

7.4.1 Sludge disposal routes

Wastewater sludges are produced as a by-product of wastewater treatment. With appropriate processing, biogas from sludges can be utilised as a source of energy or heat. Sludges are also nutrient and carbon dense making them well suited to reuse as a soil conditioner.

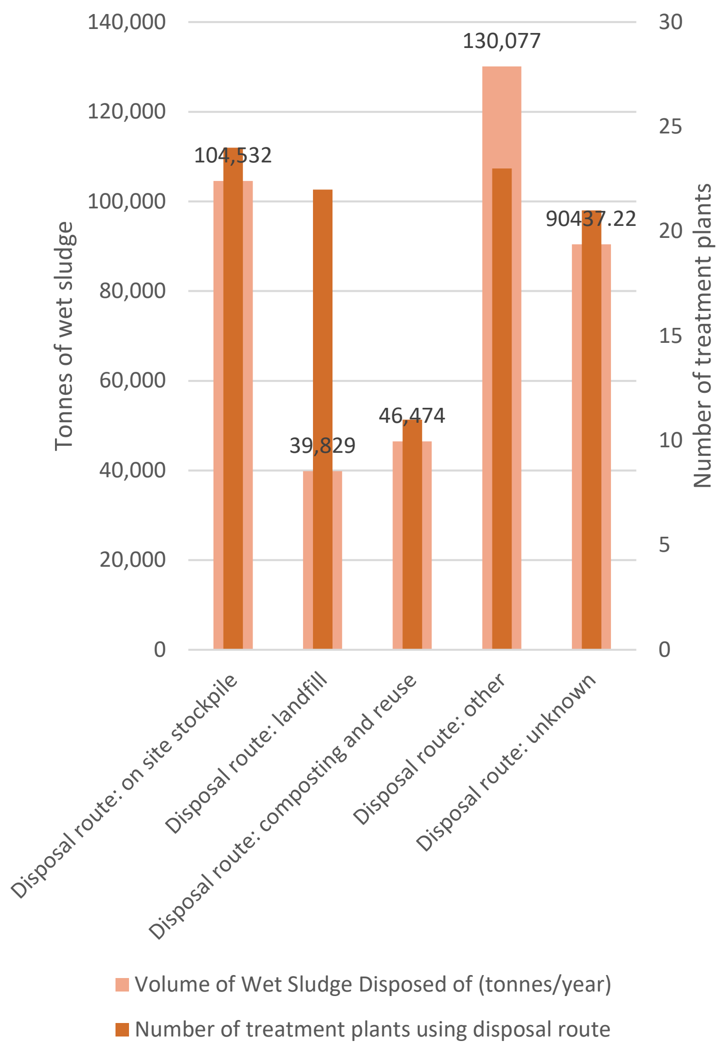
Reuse of wastewater sludges requires appropriate management of contamination and treatment processes. Treatment requirements and limits to the reuse of sludges are outlined in the draft *Guidelines for Beneficial Use of Organic Materials on Productive Land* (Water New Zealand, WasteMINZ, the Center for Integrated Biowaste Research (CIBR) and the New Zealand Land Treatment Collective, 2017).

Figure 75 shows the volume of sludges that have been beneficially reused by participants, for example Hamilton's wastewater treatment plant, where sludges were vermicposted, Christchurch City Council, where sludges were reused for land rehabilitation and soil conditioning, and New Plymouth's wastewater treatment plants, where sludges were converted to the "Bioboost" garden fertiliser.

Data was provided for 80 treatment plants, with a further 92 wastewater ponds having been assumed to not produce sludge. Disposal routes in the "Other" category, included:

- Sludges from Rakaia Wastewater Treatment Plant being applied to pasture.
- Smaller treatments in Christchurch being sent to the city's main wastewater treatment plant for further processing.
- Sludges from Seacliff Wastewater Treatment Plant, and half the sludges from Tahuna Wastewater Treatment, Plant, being incinerated.
- Sludge from smaller treatment plants in Waitaki being temporarily stored in geobags.
- Rehabilitating Puketutu Island by filling the former quarry with biosolids from the Mangere Wastewater Treatment Plant.

Figure 75: Sludge disposal routes

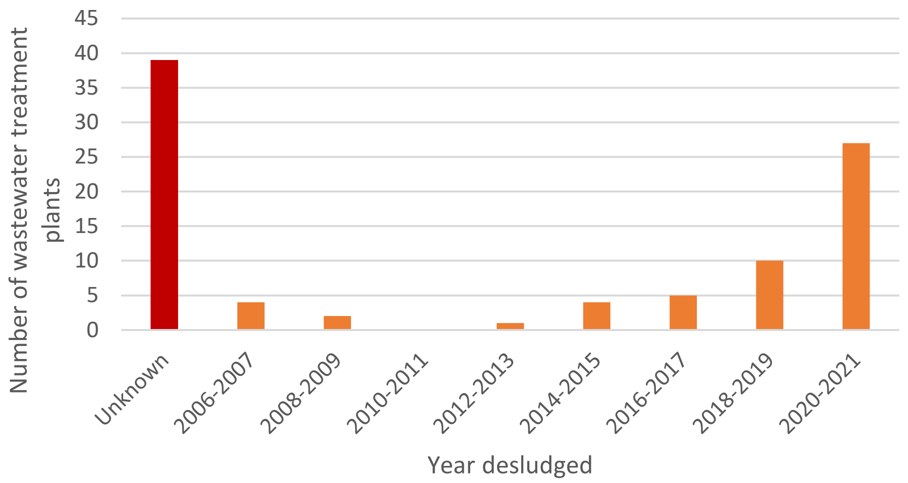


7.4.2 Desludging

Waste stabilisation ponds are among the most commonly used methods for treating domestic sewage in New Zealand. It is estimated (based on information in the *Wastewater Treatment Plant Inventory* (Water New Zealand, 2022) that 92 of the treatment plants in this report employ pond-based treatments.

To ensure their effectiveness, operation ponds require regular desludging. Without this, sludge accumulation can affect pond operation in multiple ways, especially by increasing the emission of odours. Recommendations on desludging methods and frequencies are provided in the *Waste Stabilisation Ponds: Design and Operation Good Practice Guidelines* (Water New Zealand, 2017). In the last year the number of these ponds was desludged is indicated in Figure 76.

Figure 76: Last year of desludging for pond-based wastewater treatment plants



7.4.3 Limitations with information on wastewater sludges

Because desludging is an essential component of pond maintenance, the last year of desluding provides a loose guide to whether treatment ponds are being adequaetly maintained. However, sludge accumulation varies based on a range of factors, so there is no set frequency at which they should be desludged. It is unclear whether the treatment plants that have not provided data were missing information, or the ponds had not been desludged (the later significantly more concerning than the former).

Reliability

www.waternz.org.nz/reliability

Mesophilic gallery pipework at Pukete Wastewater treatment plant in Hamilton
Photo by Martin Scott of Hamilton City Council

8. Reliability

8.1 Interruptions

Most disruptions to water services relate to unplanned interruptions to the water supply. Wastewater interruptions are less common. This is because failures within the wastewater system are generally managed using overland pipe alternatives, meaning customers are less likely to experience a service disruption.

The likelihood of an interruption occurring varies significantly among service providers. Figure 78 illustrates the number of supply interruptions per 1,000 properties for each water service provider.

Outliers excluded from unplanned interruptions to the water supply are Central Otago, Whakatāne, South Wairarapa, and Clutha. Mackenzie was excluded from the figure on planned interruptions to the water supply.

Figure 77: Interruptions to water and wastewater networks

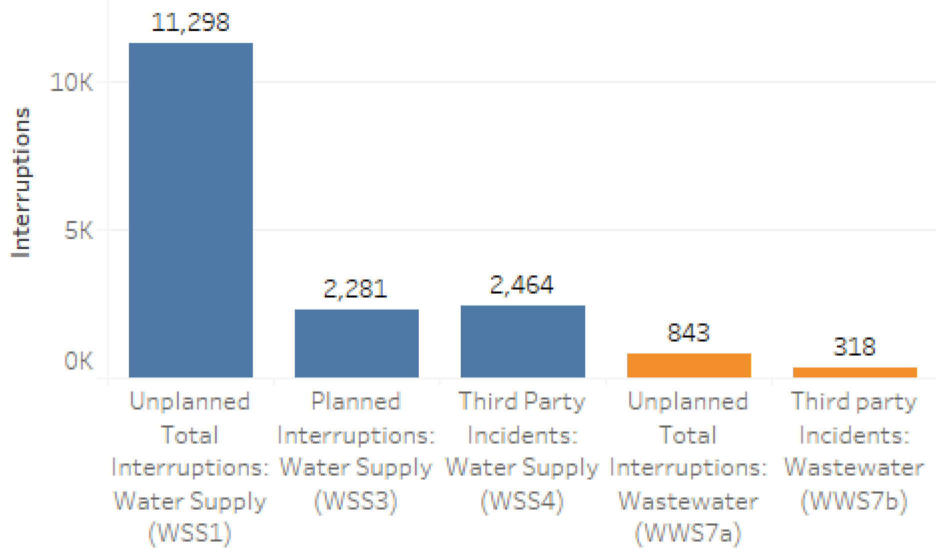
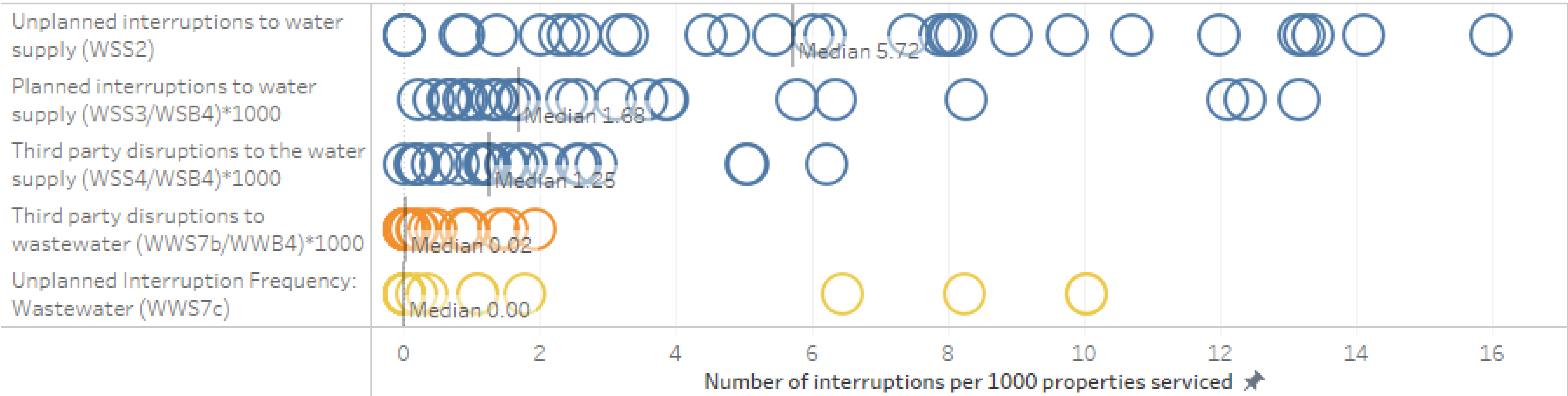


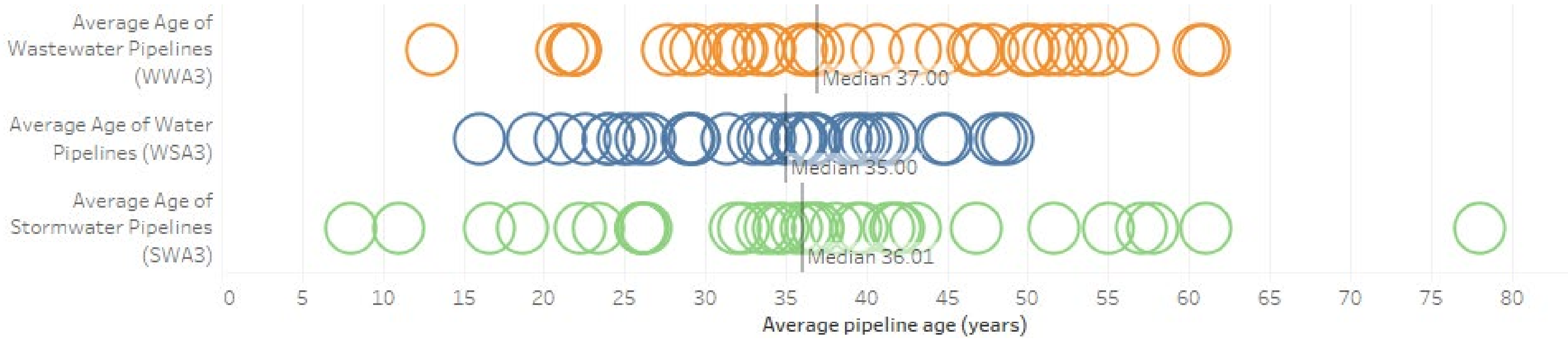
Figure 78: Water and wastewater network interruptions per property[7]



8.2 Pipeline age

Pipeline age provides a rough indication of the condition, and hence reliability, of pipelines.

Figure 79: Average pipeline age per water service provider



8.3 Inflow and infiltration

Inflow and infiltration is the process of stormwater and groundwater entering the wastewater system. Inflow generally relates to incorrectly connected stormwater sources, or damage to entry points to the sewer system. Infiltration generally relates to cracks in pipes, joints, or other wastewater structures.

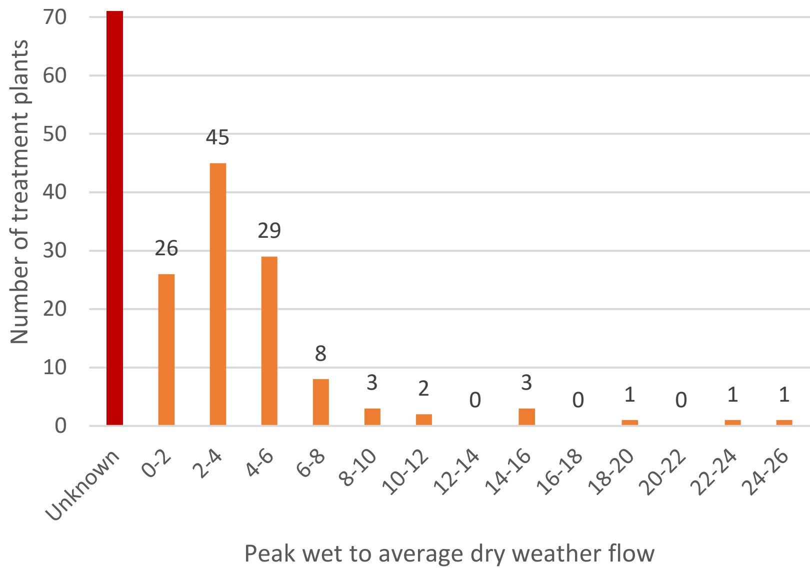
Excessive inflow and infiltration reduces effective wastewater system capacity, and increases the likelihood of wastewater overflows when it rains. *The New Zealand Standard for Land Development and Subdivision Infrastructure, NZS 4404:2010* (Standards New Zealand, 2010) require sewer design to account for an infiltration factor of 2 during wet weather. If peaking flows that occur in practice exceed the design capacity of a sewer, sewage will overflow from the network.

Peak wet- to average dry-weather flow ratios at wastewater treatment plants provide a rough indication of levels of inflow and infiltration, and are summarised in Figure 80. More detailed information is available via the data portal.

8.3.1. Limitations with information on inflow and infiltration

Peak wet- to average dry-weather flow ratios at wastewater treatment plants are an inexact representation of infiltration occurring within a network. The *Inflow and Infiltration Control Manual* (Water New Zealand, 2015) suggests a range of Key Performance Indicators for determining inflow and infiltration, and suggests these be calculated on an individual flow monitor or pump station catchment basis.

Figure 80: Peak wet to average dry weather flow ratio entering wastewater treatment plants



8.4 Water loss

Water loss comprised a total of 107,530,248 cubic meters in the 2021 fiscal year, slightly over 20% of all water supplied to networks, and roughly equivalent to the combined volume of water supplied to Hamilton, Rotorua, Dunedin, and Christchurch networks.

Water loss for some providers was significantly higher than this, as illustrated in Figure 82 which represents each water service provider as a circle. Water losses have been disaggregated based on district size, with small networks classified as having less than 20,000 water and wastewater connections, and large networks having greater than 90,000, illustrating that average losses are generally lower in more populated service districts.

Considering water loss in percentage terms can be misleading, as system input volumes vary year on year, and input and outputs included in a water balance can vary. For this reason, the Infrastructure Leakage Index, which shows the ratio of current annual real loss to unavoidable annual real losses, is recommended for making water loss comparisons between networks.

Infrastructure Leakage Index values (for participants that had calculated them) are shown in Figure 81. The number of service providers achieving each of the ILI performance bands contained in Water New Zealand's *Water Loss Guidelines* is shown in Figure 82.

Figure 81: Number of participants in each category of the Infrastructure Leakage Index

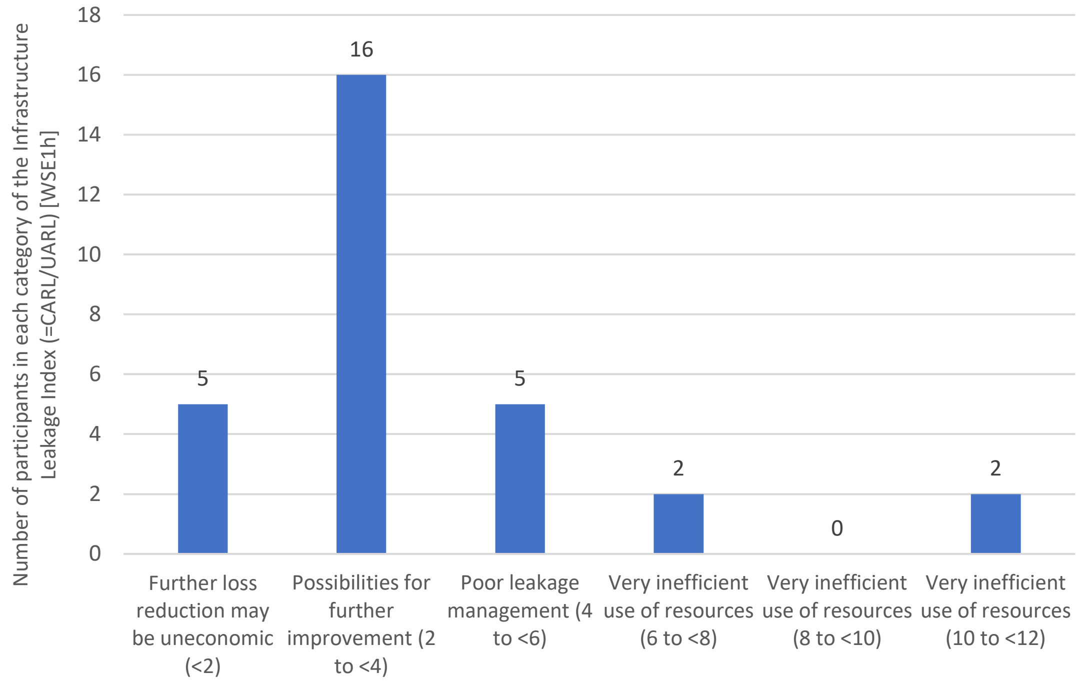
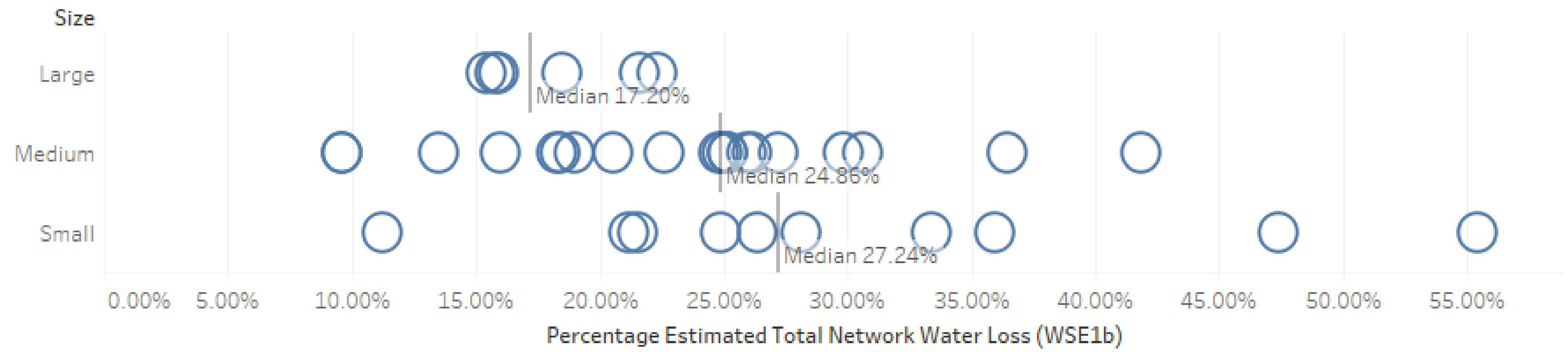


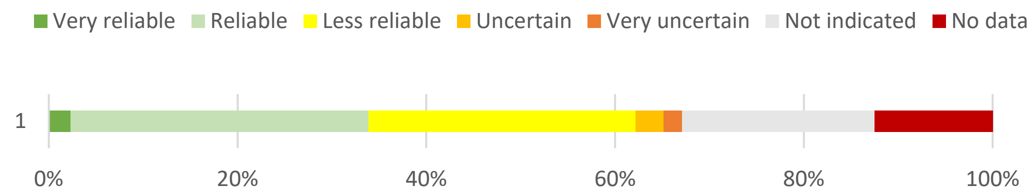
Figure 82: Percentage of estimated total network water loss



8.4.1 Limitations with information on water loss

Large annual variation, audit responses, and self-assigned data confidence ratings suggest low confidence in estimates of the volume of water lost from the network. Data confidence issues are exasperated in non-metered supplies, which generally rely on default values provided in the *Water Loss Guidelines* (Allan Lambert and Richard Taylor, 2010), last revised in 2010.

Figure 83: Water loss data confidence



Resilience

www.waternz.org.nz/resilience

Water storage lakes at Te Marua - Stuart Macaskill Lakes
Photo by Karan Narayan of Victoria University

9. Resilience

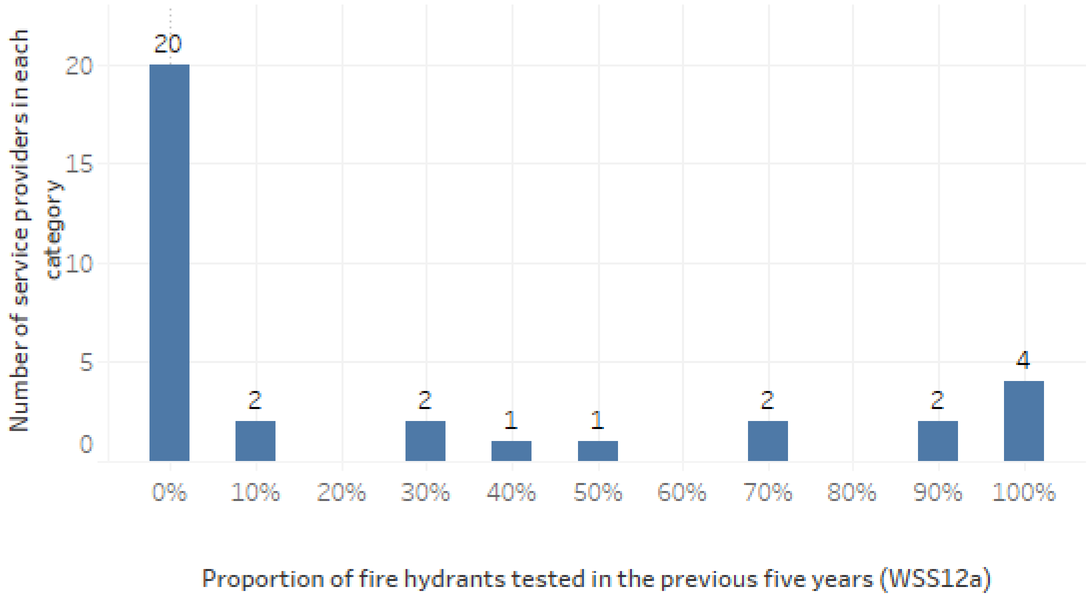
9.1 Firefighting water

The provision of water is crucial for firefighting. Water requirement flows and volumes are outlined in the *Firefighting Water Supplies Code of Practice* (Standards New Zealand, 2008). The Code is not mandatory, but has been adopted in some regional plans. The Code requires that:

> All fire hydrants must be inspected and flushed every five years by an approved tester. To achieve this, a progressive inspection programme must be agreed between the Fire Service and the Water Supply Authority.

Figure 84 shows the percentage of hydrants that have been assessed in different service districts. Only four water service districts have met the testing frequency requirements of the Code.

Figure 84: Proportion of fire hydrants tested against code in different service districts



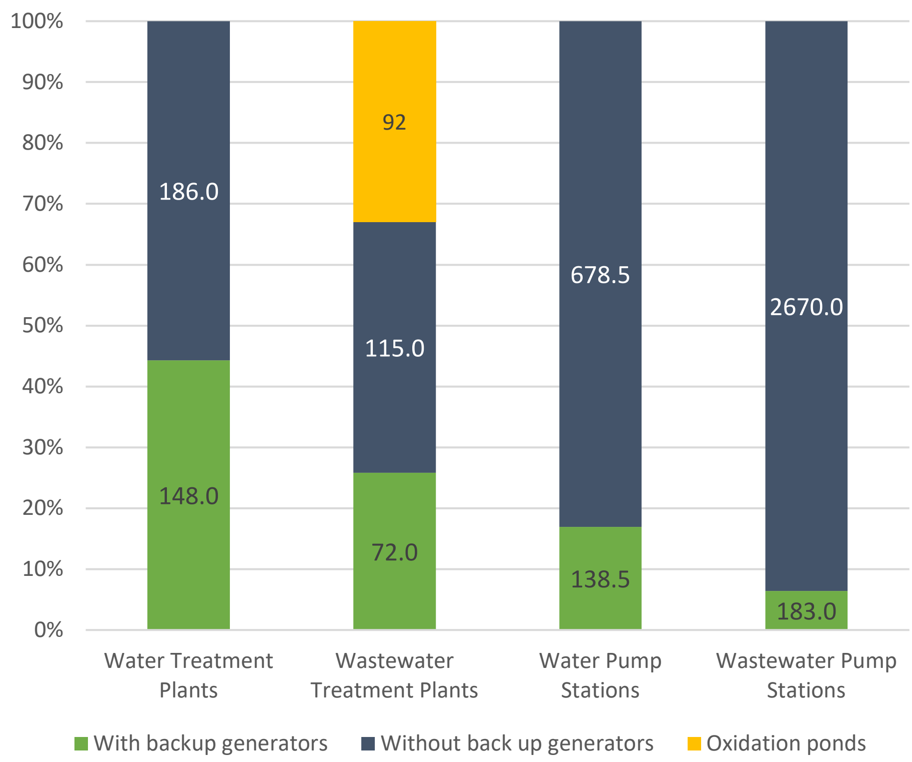
Of those that had undertaken testing of more than 50% of their network, only one water service provider reported that all hydrants were compliant with the Code.

The number of non-compliant hydrants ranged from 25 to 381. Where comments were provided in relation to the nature of the non-compliance, insufficient flow was commonly cited.

9.2 Backup power supplies

Most water pump stations and wastewater treatment plants require backup generation to operate during electricity outages. A notable exception is wastewater treatment plants with pond-based processes. Figure 85 shows the percentage of treatment plants and pump stations with and without backup generators.

Figure 85: Backup generation at treatment plants and pump stations



9.21 Limitations with information on backup power generation

The presence of backup generators provides a crude measure of whether networks would continue to be able to function in the event of a power outage. Comments suggest that many of the pump stations included in the above figures are mobile, meaning that, unless power supplies were knocked out to the entire district, many of them would still receive generation. In addition, capacity exists within networks for some network elements to experience downtime during a power outage without affecting service delivery, for example, several days' worth of treated water stored in reservoirs, as shown in Figure 86 below.

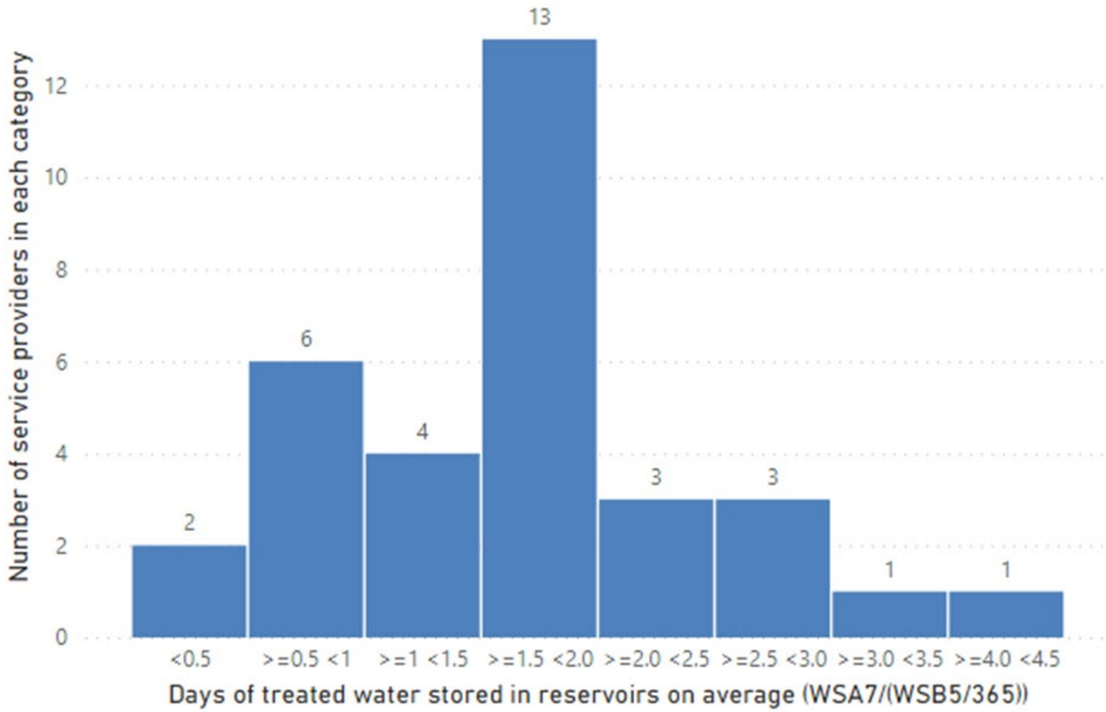
Furthermore, there are several other interconnections between water and other critical infrastructure, notably telecommunications and roads. Broader measures of resilience are needed than those provided in this report to understand a network's infrastructure interdependencies and associated resilience.

Treatment plants and pump stations have only been included in figures if information on backup power supplies was provided. If plants have two forms of backup generation (for example an onsite generator and a backup generator) available, this has only been accounted for once.

9.3 Drinking water storage

On average 1.47 days of treated water is kept in water storage reservoirs. Figure 86 illustrates the average number of days' storage in different service districts.

Figure 86: Average number of days of drinking water stored in reservoirs



9.3.1 Limitations with information on water storage

This performance metric provides an indication of how many days' worth of treated water is available for use if treatment plants go offline. It does not include raw water storage volumes, which in some instances would be significantly larger. For example, a large proportion of Auckland's water comes from 10 dams in the Hūnua and Waitākere ranges. In Wellington, the Stuart Macaskill Lakes in Te Marua provide raw water storage capacity for the Wellington region. Such water storages provide a water supply buffer during times of drought. Additional performance metrics are needed to determine how resilient water supplies are to drought, both in supplies with raw water storage and those without.

9.4 Flooding

9.4.1 Flooding events

Floods are caused either by heavy rainfall that inundates the stormwater network, or rivers overtopping their banks, and storm surges. Only the first category of flooding is within the power of stormwater service providers to control.

For this reason, reporting in the National Performance Review distinguishes between the main causes of flood events. The number of habitable floors impacted by floods is also recorded, in line with the Stormwater Drainage System Adequacy Performance Measure in the *Non-Financial Performance Measure Rules* (Department of Internal Affairs, 2022).

Table 17: Reported flooding events and habitable floors impacted

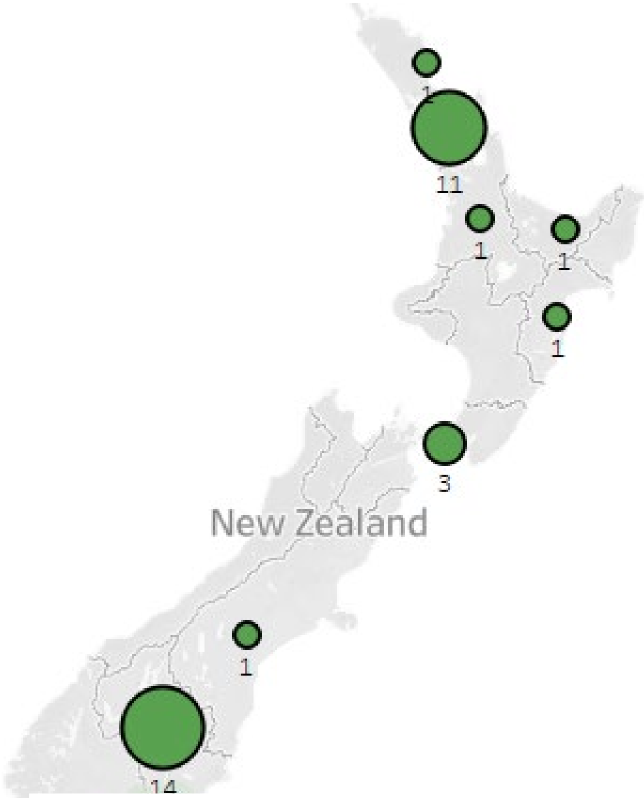
	FY 2019	FY 2020	FY 2021
Flooding events resulting from storms exceeding stormwater capacity (SWS5)	99.0	25.0	41.0
Flooding events resulting from other causes (SWS5c)	105.0	45.0	69.0
Number of habitable floors affected by flooding from other causes (SWS5d)	104.0	46.0	96.0
Number of habitable floors affected by storms exceeding stormwater capacity (SWS5a)	97.0	35.1	85.0

9.4.2 Limitations with information on flooding

Flooding events shown here reflect only those that have led to the flooding of habitable floors, and occur within stormwater-serviced districts.

These results are largely driven by rainfall, and tell us little about the adequacy of the stormwater service to prevent flooding. Improved metrics are required to provide an indication of the level of protection the existing stormwater network is providing against flooding. Flood design standards provide an indication of this for new stormwater network design, however this does not account for historic design standards or measured performance.

Figure 87: Number of flooding events resulting from storms exceeding network capacity



9.4.3 Flood design standards

The annual exceedance probability targeted during the design of primary and secondary stormwater networks is shown in Figure 88 and Figure 89. Design standards for individual service districts is available via the supporting data portal.

Figure 88: The annual exceedance probability targeted during the design of the primary stormwater network

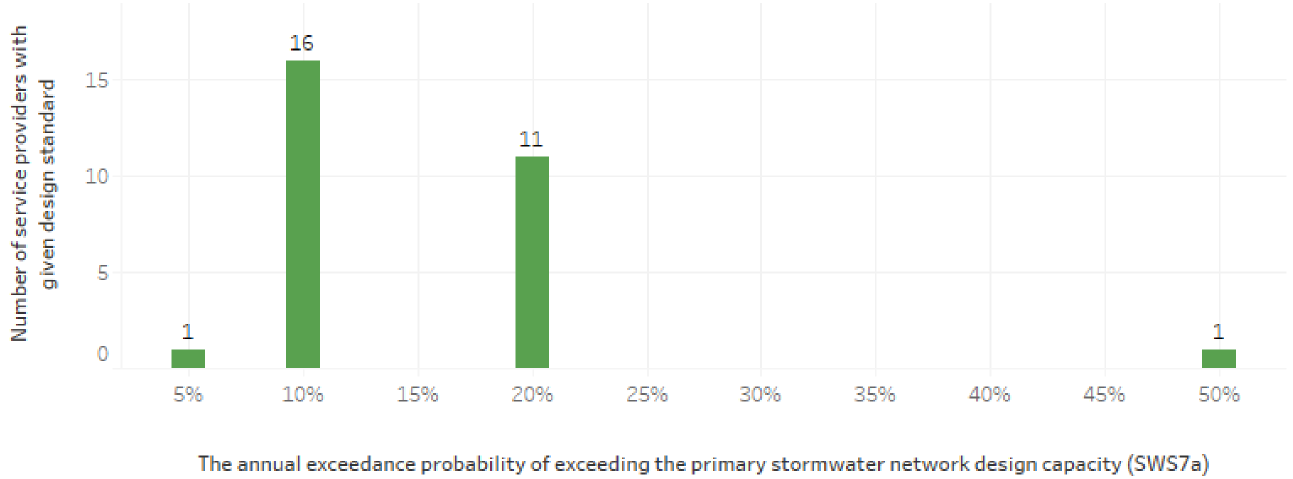
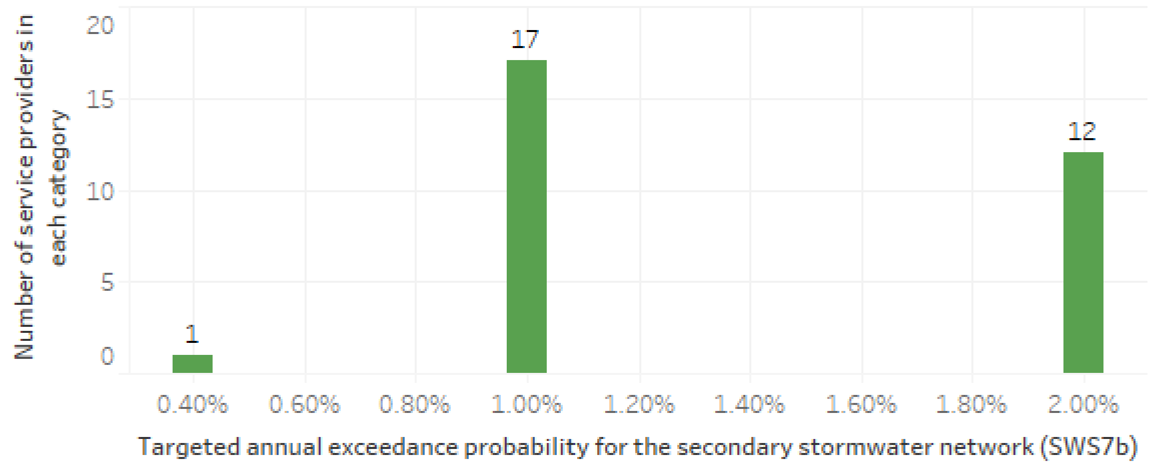


Figure 89: The annual exceedance probability targeted during the design of the secondary stormwater network



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Appendix I: Review participants and data quality

Participant	Percentage complete	Average data confidence	Audit status	Water service properties	Included in trends (have participated in the previous four consecutive NPR's)
Ashburton	88.89%	2.128	Audit complete	10,778	Yes
Auckland	67.27%	2.603	Audit complete	489,612	Yes
Auckland Council	46.99%	1.851	Audit queries not returned	0	Yes
Central Hawkes Bay	93.55%	2.152	Audit queries not returned	5,608	No
Central Otago	88.53%	1.929	Audit complete	10,445	Yes
Christchurch	81.36%	1.650	Audit complete	160,740	Yes
Clutha	91.76%	1.584	Audit queries not returned	6,920	Yes
Dunedin	84.59%	2.855	Audit complete	48,416	Yes
Gore	92.83%	1.672	Audit complete	4,857	Yes
Hamilton	84.23%	1.663	Audit queries not returned	60,937	Yes
Hastings	79.21%	2.137	Audit complete	26,217	Yes
Hauraki	82.44%	1.825	Audit complete	7,517	Yes
Invercargill	87.10%	1.524	Audit complete	21,568	Yes
Kaipara	87.81%	2.040	Audit complete	3,665	No
Mackenzie	88.17%	2.050	Audit queries not returned	3,752	Yes
Marlborough	83.87%	1.794	Audit complete	20,216	No
Napier	92.47%	1.798	Audit complete	23,935	Yes
New Plymouth	79.93%	2.427	Audit complete	31,407	Yes
Palmerston North	91.40%	2.013	Audit complete	31,843	Yes
Queenstown Lakes	74.91%	2.048	Audit queries not returned	27,833	Yes
Rotorua	92.11%	1.640	Audit complete	25,728	Yes
Selwyn	87.46%	1.624	Audit complete	20,135	Yes
South Wairarapa	93.19%	2.290	Audit queries not returned	4,596	No
Stratford	87.81%	2.481	Audit queries not returned	3,017	Yes
Tararua	88.89%	2.000	Audit queries not returned	5,653	Yes

Participant	Percentage complete	Average data confidence	Audit status	Water service properties	Included in trends (have participated in the previous four consecutive NPR's)
Tasman	85.30%	1.514	Audit complete	13,917	Yes
Taupō	88.17%	2.057	Audit complete	19,287	Yes
Tauranga	94.27%	1.587	Audit complete	63,191	Yes
Thames-Coromandel	72.76%	2.133	Audit complete	19,709	No
Timaru	92.83%	1.633	Audit complete	21,426	Yes
Waimakariri	93.19%	2.089	Audit queries not returned	20,452	Yes
Waipā	90.68%	2.473	Audit complete	17,641	Yes
Waitaki	82.08%	1.980	Audit complete	11,103	No
Wellington Water	44.09%	2.164	External audit partially complete	152,607	Yes
Western Bay of Plenty	93.55%	2.139	Audit complete	17,436	Yes
Whakatāne	83.15%	1.890	Audit complete	14,748	Yes
Whanganui	53.05%	2.000	Audit complete	19,843	Yes
Whangārei	76.70%	1.808	Audit complete	27,732	Yes

Appendix II: Residential water charges

Charging area	Fixed charge (WSS8a)	Fixed Charge Type: Residential water [WSS8b]	Volumetric charge (WSS8c)	Volumes it applies to (WSS8c comments)
Ashburton: Group	$415.30	Targeted rate	$0.96	Low Density Residential Zone for water use exceeding 1,200L/day
Ashburton: Methven Springfield	$2,199.90	Targeted rate	$0.96	
Ashburton: Montalto	$1,069.70	Targeted rate	$0.96	
Auckland	$0	Volumetric charge only	$1.594	
Central Hawkes Bay	$847.95	Uniform Annual general charge	$2.65	Where 300m³ limit is exceeded
Central Otago	$358.84	Uniform Annual general charge	$0.60	
Christchurch: Regime 1	$329.02	Targeted Rate		No volumetric charge for residentail (yet) - an excess charge of $1.05/m³ will apply from 1 July 2022 for water taken above 700 litres/day.
Christchurch: Regime 2	$215.25	Targeted Rate		
Clutha	$646.40	Targeted Rate	$1.94	<366m³ / year = $0.00 (incorporated in annual water rate). >366m³/year = $1.90/m³
Dunedin	$419.50	Targeted Rate	$0	
Gore: Urban	$394.84	Targeted Rate	$0.97	Urban supplies, i.e Gore and Mataura, are charged via Regime 1. Otama Rural water scheme gets charges based on the following: $215 per connection, $200 per unit (1 unit = an allocation of 1.8 m³/day), $0.75 per m³ consumed.
Hamilton	$444.00	General rate	$0	
Hastings	$515.3735619	Targeted Rate	$0.81	Per m³ . Figures include GST. Volumetric charges only apply to those properties that have a water meter, and where they have exceeded any allowance provided. An allowance of 365m³ per SUIP charged is provided.
Hauraki	$124.22	Targeted Rate	$2.01	
Invercargill	$409.18	Targeted Rate	$0	
Kaipara: Dargaville	$124.23		$2.96	Volumetric charge per m³ beyond the first m³.
Kaipara: Glinks Gully	$364.97		$1.55	

Charging area	Fixed charge (WSS8a)	Fixed Charge Type: Residential water [WSS8b]	Volumetric charge (WSS8c)	Volumes it applies to (WSS8c comments)
Kaipara: Mangawhai	$124.23		$3.67	
Kaipara: Maungatūroto Station Village	$297.97		$4.08	
Kaipara: Maungatūroto Township	$285.28		$4.24	
Kaipara: Ruawai	$227.85		$5.45	
Mackenzie	$409.28		$0	
Blenheim	$346.00	General rate	$1.30	Based on quantity of water supplied to residential metered rating units.
Havelock	$232.00	General rate	$1.86	
Picton	$588.00	General rate	$3.56	
Renwick	$232.00	General rate	$1.04	
Seddon	$540.00	General rate	$1.86	
Wairau Valley	$240.00	General rate	$2.48	
Riverlands	$41.00	General rate	$1.02	
Rural Awatere	$900.00	General rate	$2.21	
Napier	$244.00	Targeted Rate	$1.11769	
New Plymouth	$303.00	Targeted Rate	$1.2	
Palmerston North	$255.00	Targeted Rate		
Queenstown Lakes	$481.7855173	Targeted Rate		
Rotorua	$342.56	Uniform Annual general charge	$1.43	Volumetric charge ($1.43 /m^3) for residential properties over 2,000m^2 area or other extraordinary supply only.
Selwyn	$254.00	Targeted Rate	$0.50	
South Wairarapa	$631.00	Targeted Rate	$1.84	Fixed Targeted + Metered over 350m^3/yr
Stratford	$552.00	Targeted Rate	$0	
Tararua	$477.88	Targeted Rate	$1.75	
Tasman: Urban Supply	$349.20	Targeted Rate	$2.22	
Tasman: Motueka	$174.43	Targeted Rate	$2.06	
Tasman: Rural Extensions	$649.41 per unit	Targeted Rate		
Tasman: Dovedale	$745.45 per unit for the first 2	Targeted Rate		

Charging area	Fixed charge (WSS8a)	Fixed Charge Type: Residential water [WSS8b]	Volumetric charge (WSS8c)	Volumes it applies to (WSS8c comments)
	units, $574.00 per subsequent unit			
Tasman: Redwood	$493.68 per unit	Targeted Rate		
Tasman: 88 Valley	$336.19 fixed charge plus $314.35 per unit	Targeted Rate		
Taupō	$493.10	Targeted Rate	$0	
Taupō: Kinloch	$602.46	Targeted Rate	$0	
Taupō: River Road	$853.12	Targeted Rate	$0	
Taupō: Mangakino	$515.30	Targeted Rate	$0	
Taupō: Ātiamuri	$1,107.04	Targeted Rate	$0	
Taupō: Whakamaru	$1,271.80	Targeted Rate	$0	
Taupō: Motuoapa	$627.28	Targeted Rate	$0	
Taupō: Tūrangi	$376.86	Targeted Rate	$0	
Taupō: Omori	$346.94	Targeted Rate	$0	
Taupō: Whareroa	$500.08	Targeted Rate	$0	
Taupō: Hātepe	$977.76	Targeted Rate	$0	
Taupō: Whakaroa	0.0023603/$ Land Value	Land value based rating	$2.29	
Taupō: Rākaunui Road	0.0028720/$ Land Value	Land value based rating	$0.63	
Taupō: Centennial Drive (Untreated)	0.0062715/$ Land Value	Land value based rating	$0.51	
Taupō: Bonshaw Park	0.0049784/$ Land Value	Land value based rating	$2.91	
Taupō: Whakamoenga Point	0.0015136/$ Land Value	Land value based rating	$1.61	
Taupō: Waihāhā	0.0032760/$ Land Value	Land value based rating	$0	
Taupō: Tirohanga	0.0012054/$ Land Value	Land value based rating	$0.93	
Tauranga	$33.00	Increase with size of the connection	$2.9	
Thames-Coromandel	$640.78	Targeted Rate	$1.37	

Charging area	Fixed charge (WSS8a)	Fixed Charge Type: Residential water [WSS8b]	Volumetric charge (WSS8c)	Volumes it applies to (WSS8c comments)
Timaru: Urban	$399.00	Targeted Rate	$0.66	Volumetric charges are applied once the property uses more than the equivalent amount of theTargeted rate (approx 600m³), and volumetric charges are applied to excessive residential water users only.
Timaru: Te Moana	$889.00	Targeted Rate		
Timaru: Seadown	$494.00	Targeted Rate		
Timaru: Ōrarī	$297.40	Targeted Rate		
Timaru: Downlands	$769.00	Targeted Rate		
Waimakariri: Rangiora	$327.00	Targeted Rate		
Waimakariri: Woodend	$386.20	Targeted Rate		
Waimakariri: Waikuku Beach	4409.00	Targeted Rate		
Waimakariri: Mandeville	$480.20	Targeted Rate		
Waimakariri: Ōhoka	$1,358.00	Targeted Rate		
Waimakariri: Kaiapoi	$223.10	Targeted Rate		
Waimakariri: Oxford Rural No. 1	$2,061.07	Targeted Rate		
Waimakariri: Oxford Rural No.2	$1,252.068	Targeted Rate		
Waimakariri: Oxford Urban	$477.20	Targeted Rate		
Waimakariri: Summerhill	$1,368.30	Targeted Rate		
Waimakariri: Cust	$1,004.80	Targeted Rate		
Waimakariri: Poyntzs Road	$757.20	Targeted Rate		
Waimakariri: West Eyreton	$1,013.00	Targeted Rate		
Waimakariri: Garrymere	$1,707.66	Targeted Rate		
Waipā	$114.00	Targeted Rate	$1.59	
Waitaki: Regime 1	$497.00	Targeted Rate	$0.52	Amended to zero despite there being volumetric charging, as the volumetric charging only applies for residential properties when a credit (calculated using the targeted rate - typically greater than 200m³) is exceeded.
Waitaki: Regime 2	$568.00	Targeted Rate	$1.19	
Waitaki: Regime 3	$673.00	Targeted Rate		
Waitaki: Regime 4	$673.00	Targeted Rate	$1.19	
Waitaki: Regime 5	$520.00	Targeted Rate		
Waitaki: Regime 6	$641.00	Targeted Rate	$0.96	
Waitaki: Regime 7	$584.00	Targeted Rate	$0.52	
Waitaki: Regime 8	$905.00	Targeted Rate	$1.19	

Charging area	Fixed charge (WSS8a)	Fixed Charge Type: Residential water [WSS8b]	Volumetric charge (WSS8c)	Volumes it applies to (WSS8c comments)
Waitaki: Regime 9	$452.50	Targeted Rate		
Waitaki: Regime 10	$866.00	Targeted Rate		
Waitaki: Regime 11	$364.00	Targeted Rate		
Waitaki: Regime 12	$655.00	Targeted Rate		
Waitaki: Regime 13	$402.00	Targeted Rate		
Waitaki: Regime 14	$176.00	Targeted Rate		
Waitaki: Regime 15	$542.00	Targeted Rate		
Waitaki: Regime 16	$454.00	Targeted Rate		
Waitaki: Regime 17	$434.00	Targeted Rate		
Waitaki: Regime 18	$439.00	Targeted Rate		
Wellington Water: Wellington City	$410.28	General rate and targeted rate	$2.43	
Wellington Water: Lower Hutt				
Wellington Water: Porirua City	$401.56	Targeted Rate	$2.20	
Wellington Water: Upper Hutt City	$539.77	General rate and targeted rate		
Western Bay of Plenty	$422.70	Targeted Rate	$1.42	
Whakatāne: Regime 1	$248.55	Targeted Rate	$0.27	Regime 1 = $0.27, or $0.90 for excess water by meter consumed over and above the purchased entitlement.
Whakatāne: Regime 2	$156.78	Targeted Rate	$1.03	
Whakatāne: Regime 3	$384.09	Targeted Rate		
Whakatāne: Regime 4	$206.68	Targeted Rate	$1.56	
Whakatāne: Regime 5	$549.51	Targeted Rate		
Whanganui	$253.68	Targeted Rate	$0	
Whangārei	$34.50	Targeted Rate	$2.26	

Appendix III: Contaminant-based charges

	BOD5 $/kg	BOD $/kg	Peak flow $/m³	off peak $/m³	SS $/kg	Ni $/kg	Cd $/kg	Cu $/kg	Zn $/kg	Hg $/kg	COD $/pa	TSS $/kg	TKN $/kg	TP $/kg	Volume $/m³
Ashburton	$2.00														
Christchurch		$0.60	$0.90	$0.45	$0.43		$16,147	$92.42	$64.56	$26,016.87					
Invercargill		$0.44													
Tasman	$2.16										$0.15	$1.27	$1.92	$1.07	
Waipā					$1.12								$1.31	$5.32	
Waitaki		$211.00													
Whanganui											$16.87	$60.07			$34.85
Whangārei											$0.37	$0.54	$0.70		
Waimakariri		$0.50										$0.40			$0.75
New Plymouth		$2.34			$0.98	$376.40		$225.94	$75.15						