Watercare Services Limited

Asset Management Plan 2018 to 2038

(Forecasts from 1 July 2018 to 30 June 2038)

Watercare
An Auckland Council Organisation

Foreword by the chief executive

Our work is vital for life, keeps people safe, and helps communities to flourish.

Delivering 100% Aa-grade water

Watercare delivers 100% Aa-grade water, day in, day out, to Auckland. Drinking water appears. Wastewater disappears.

We are leading the water utility of a major city – Auckland – at a time when, globally, the use of the planet's water resource is in question.

While water is not as scarce for us here as it is in other countries, across New Zealand there is now a growing discussion about the use of water for industry and the quality of water in our rural and urban waterways. Water treatment in towns and cities is under scrutiny also, following a serious drinking water supply incident in Havelock North. This event was linked to four deaths and thousands of sick people and prompted an in-depth government inquiry into the delivery of water services nationally.

So, questions are being asked about water use and the steps that need to be taken to make improvements for the sake of the environment, our economy and our community.

Public consciousness of the value of water seems to be growing – and with it the material importance to our stakeholders of all that is within Watercare's remit.

Enabling growth

Here in Auckland, where the population is well served with high-quality water services, the discussion about water is focused on the city's rapidly-growing population.

Water demand is forecast to outstrip current supply within 10 years, prompting planned additions to our existing water supplies.

In parts of the city, at times of rainfall, the wastewater system is sometimes swamped by stormwater resulting in overflows. This creates a risk of significant impact on homes and businesses, and polluting waterways. Watercare is undertaking our own large-scale works to increase the system's capacity and effectiveness, as well as working with Auckland Council to support the council's plans and projects to address its stormwater infrastructure.

As the city grows, we are upgrading and extending our core water and wastewater infrastructure – all while maintaining the thousands of kilometres of pipes, pump stations and plants.

The planning process for these system upgrades is carried out in conjunction with Auckland Council, together with the developers who are building new houses and suburbs.

But, as we work through the challenges of growth, we are mindful that Watercare's business, our services and our decision-making increasingly matter to Aucklanders. It also matters to the public that we run an operation that is environmentally and socially sustainable over the long term.

Minimum cost

Our infrastructure and funding plans stretch into the future. Indeed, our planning horizon extends out 50 years and beyond. This is due to the long life and strategic nature of our infrastructure assets.

We are legally required to operate at minimum cost and we know that affordability is important for the users of our services. We are able to keep the cost of our services down by operating efficiently. We benchmark our performance against other utilities, both national and international. The most recent

results placed Watercare in the top four for customer service in New Zealand (Water New Zealand) and fourth amongst 38 water companies surveyed across Australasia for value for money (Water Services Association of Australia). Our focus will continue to be on innovations that will enhance operational efficiency.

This Asset Management Plan demonstrates our commitment to providing Auckland with exceptional services at an affordable cost.

Sustainable approach
A sustainable approach underpins our role as a lifeline services provider, here for the long term. Our commitment to sustainability means listening and responding to our stakeholders. We need to be mindful of the resources we use and recover resources where possible, and protect and enhance the environment affected by our operations, while ensuring we maintain the 100% Aa-grade standard of water delivery.

Service promise
When it comes to day-to-day transactions, we know our customers want responsive service. During 2017/18, we have made enormous strides in modernising our systems and building our people capability so that we can deliver on our responsive service promise.

We all have a part to play
In conclusion, the water and wastewater system operated by Watercare belongs to all Aucklanders. A sustainable water system – one that supports our community and ecological systems long into the future – is one to which we all contribute.

Like all modern sustainability efforts, we know that each individual's contribution, however small, makes a difference.

All of us can be mindful of our water use – switch to low-flow shower heads or take shorter showers, fix dripping taps and leaks, irrigate the garden in the early morning or at dusk, and choose drought-resistant garden plants.

We can ensure the stormwater from our roof is not plumbed into the wastewater system. We can stop flushing items that don't disperse (plastic toys, cloth wipes) or substances that clog the pipes (fats, oil and grease).

These significant actions protect the network and ensure that, for all our benefit, it continues to work effectively. They are an important dimension of the partnership between Watercare and the community we serve.

We have the great privilege of leading the water utility that you and your community rely on.

Raveen Jaduram
CHIEF EXECUTIVE

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Glossary

ADWF	Average dry-weather flow
AELG	Auckland Engineering Lifelines Group
AMP	Asset Management Plan
AUP	Auckland Unitary Plan
BNR	Biological nutrient removal
BOD	Biochemical Oxygen Demand
BPO	Best practicable option
CCO	Council-controlled organisation
CSO	Combined sewer overflow
DMA	District metering area
DWSNZ	Drinking Water Standards for New Zealand
EOP	Engineered overflow point
FULSS	Future Urban Land Supply Strategy
FFO ratio	Funds from operations to interest cover ratio
HIF	Housing Infrastructure Fund
IGC	Infrastructure Growth Charge
km	Kilometres
kWh	Kilowatt hours
LoSI	Level of service improvement
L/c/d	Litres per connection per day
L/p/d	Litres per person per day
L/s	Litres per second
LTP	Long Term Plan
m^2	Square metres
m^3	Cubic metres
m^3/d	Cubic metres per day
m^3/s	Cubic metres per second
ML	Mega-litres or million litres
MLD	Mega-litres per day or million litres per day
mm	Millimetres
NDC	Network Discharge Consent
NIWA	National Institute of Water and Atmospheric Research
NZTA	New Zealand Transport Agency
PDWF	Peak dry-weather flow
PWWF	Peak wet-weather flow
RCM	Reliability-centred maintenance
RUB	Rural Urban Boundary
SHA	Special Housing Area

SOI	Statement of intent
TRC	Tamaki Regeneration Company
WTP	Water Treatment Plant
WWTP	Wastewater Treatment Plant

1. Introduction

Watercare Services Limited (Watercare) prepares an Asset Management Plan (AMP) to show how we will operate, maintain and renew existing water and wastewater assets and provide new assets to meet demand as Auckland grows. While the AMP has a 20-year horizon, Watercare's planning horizon extends out for 50 years and beyond due to the long life and strategic nature of the water and wastewater infrastructure assets.

The AMP complements our 2018 Annual Report and utilises the integrated reporting framework.

The financial information contained in the AMP forms the basis of Watercare's input to Auckland Council's consultation document for the 2018 Long Term Plan (LTP) process.

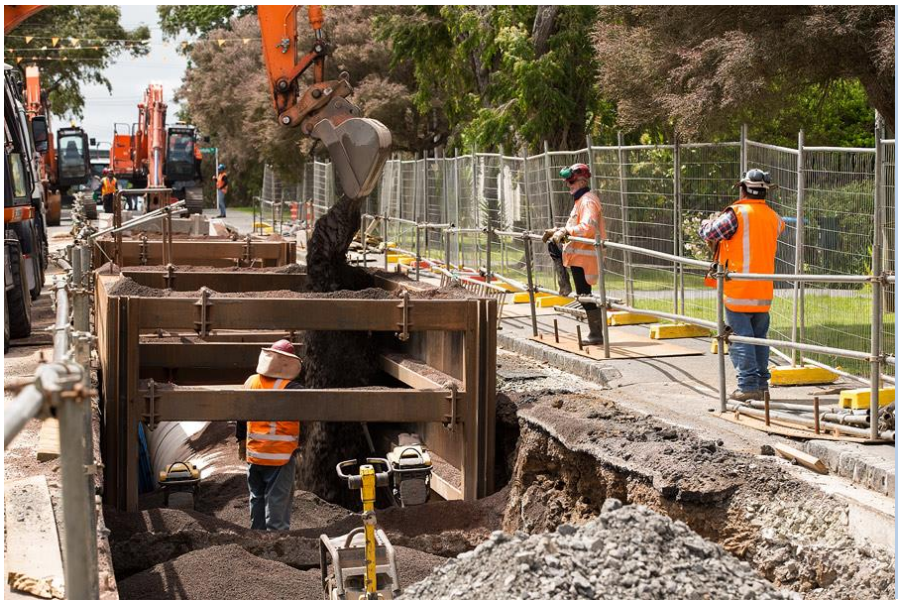
The AMP covers the period 1 July 2018 to 30 June 2038.

2. Why we do what we do

We are a lifeline utility that provides vital water and wastewater services protecting the public health and well-being and providing quality of life to around 1.5 million people in the Auckland region. Our services make it possible to safely live in a compact, growing urban environment.

Our customers expect that our services are safe and reliable '24/7' and they expect the same or improved levels of service to continue into the future. We want our customers to receive a safe and reliable service which meets all of their expectations at a price that is affordable and is considered value for money.

These services make our company a major contributor to the health, prosperity, well-being and quality of life for the Auckland region, and the northern Waikato communities of Tūākau and Pōkeno.



Hūnua 4 Watermain
The construction of the 32km Hūnua 4 Watermain, from the Manukau Heights to Grafton, is essential to cater for Auckland's population growth and ensure security of water supply. 28 km of watermain has been laid over four years. Parts of East Tamaki, Manukau and Māngere are already being supplied by the watermain. The final stretch will include 3km of tunnelling to minimise traffic disruption.

Our value creation model (see **Figure 1** below) shows the resources (capital) we use and the activities we undertake to provide value to our stakeholders and community.

Manufactured capital, which comprises our assets and infrastructure, is critical to the delivery of our services.

The AMP sets out how, when and where we plan for these assets and infrastructure.

Figure 1: Our value creation model

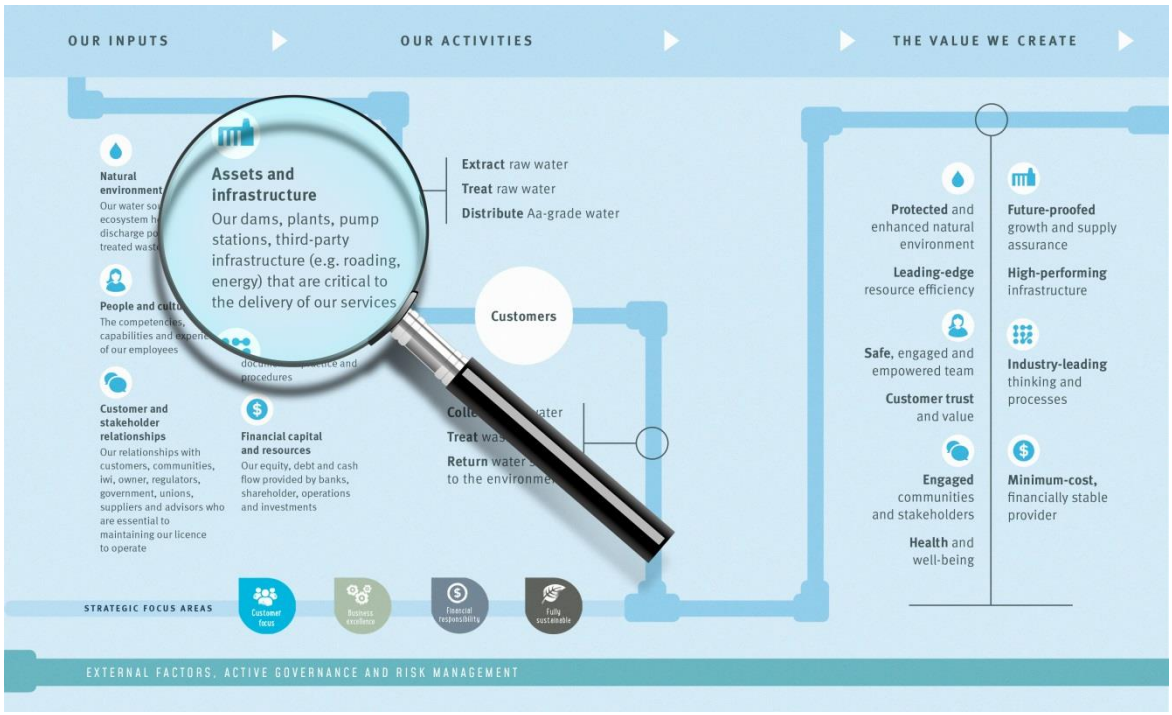
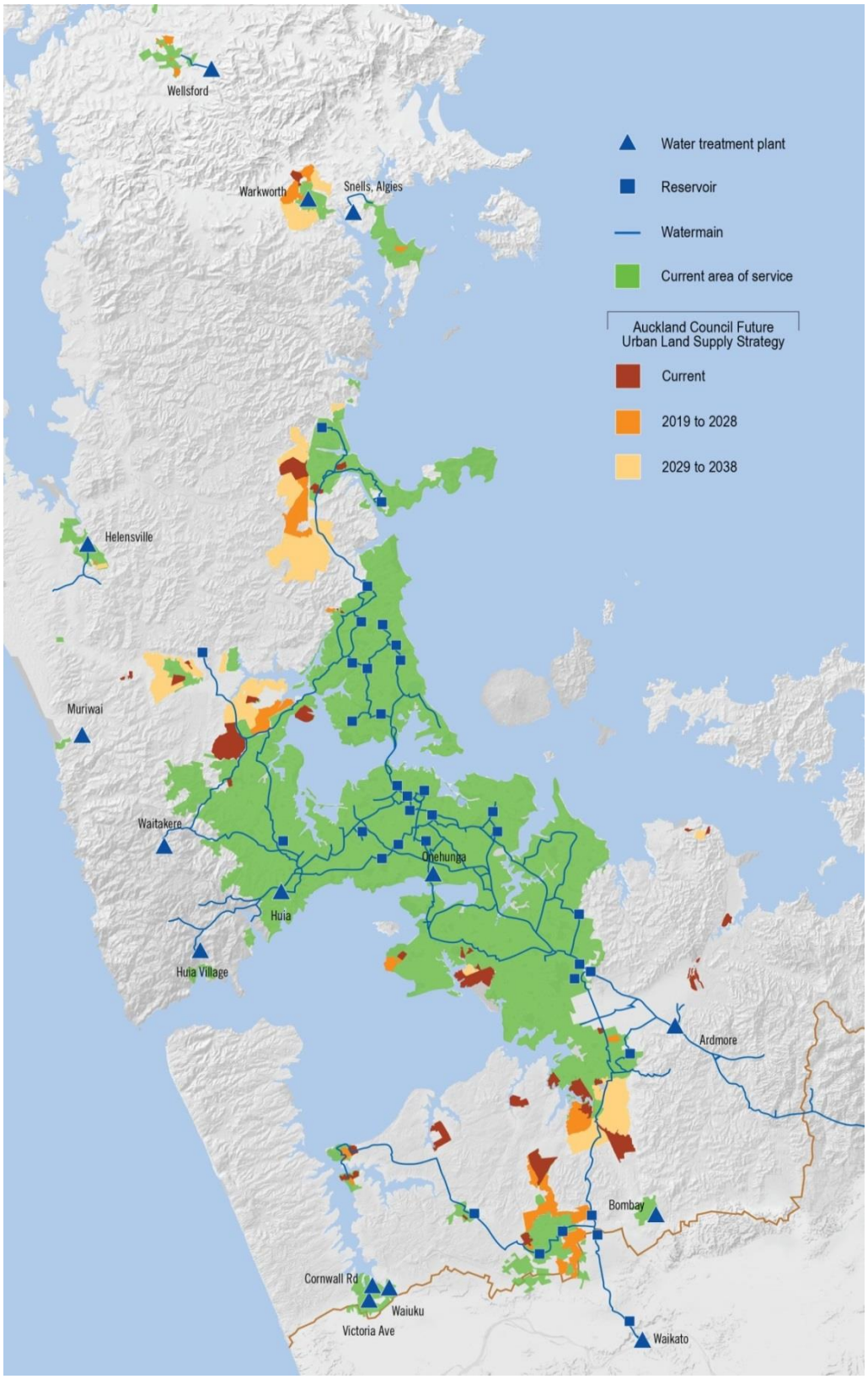
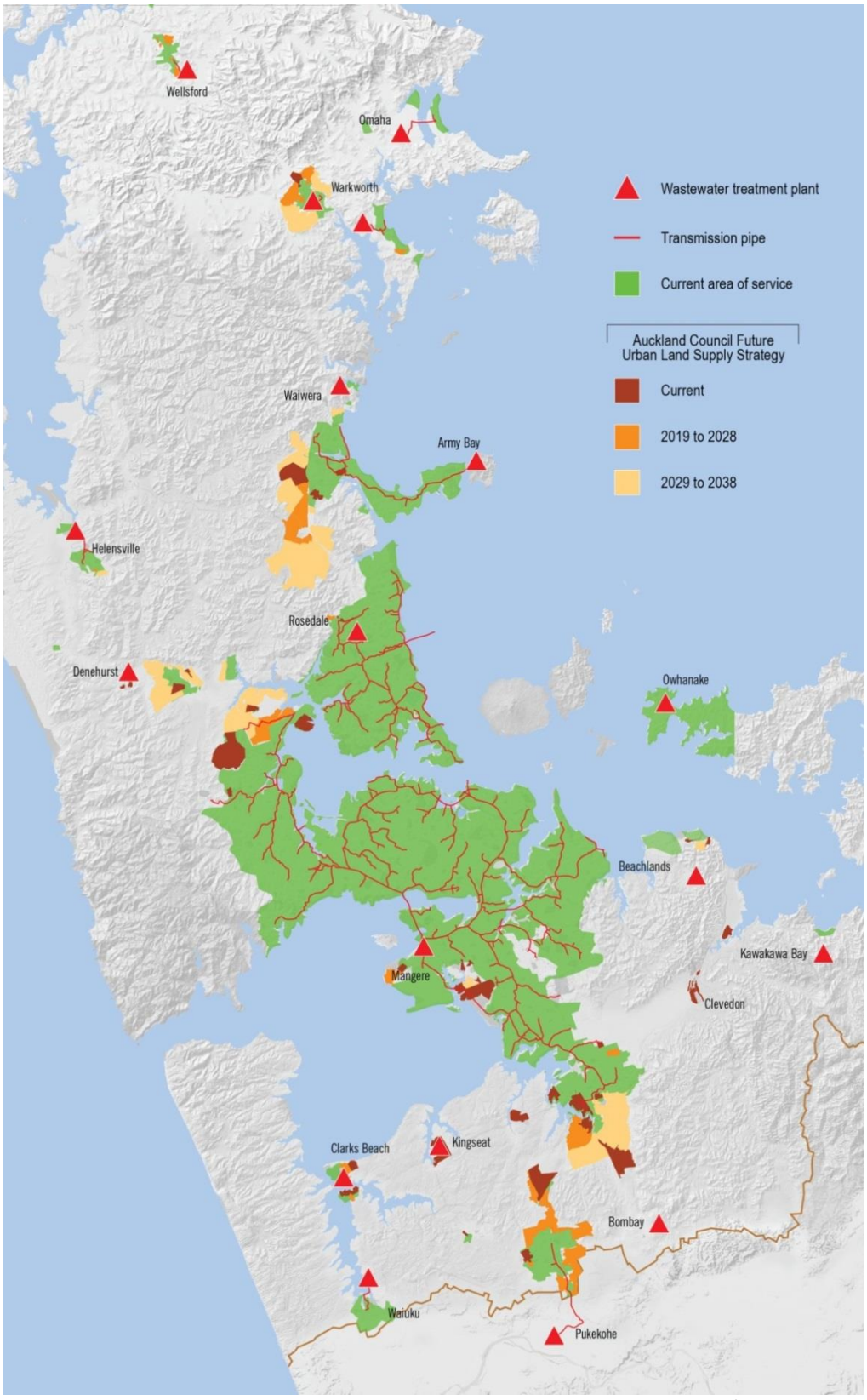


Figure 2: Watercare water network area of service



Note: The term "current" in this figure relates to the financial year 2017/2018.

Figure 3: Watercare wastewater network area of service



Note: The term "current" in this figure relates to the financial year 2017/2018.

3. How we do it

Our mission is to deliver safe, reliable and efficient water and wastewater services.

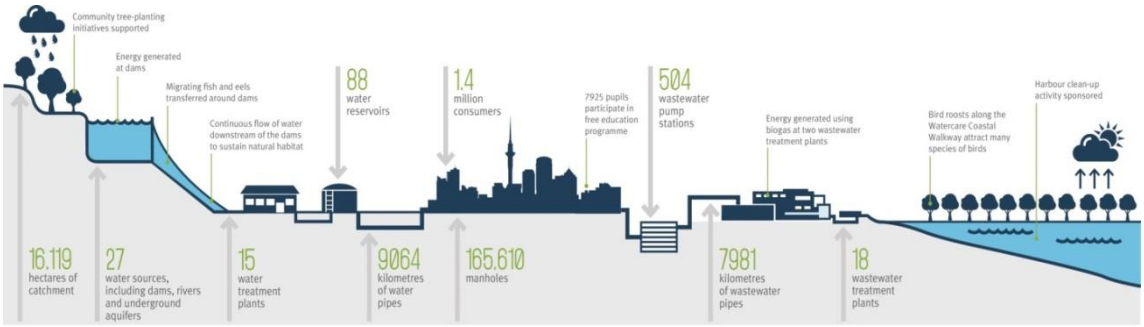
Water supply:

Raw water is taken from river, dam and aquifer sources and treated at our water treatment plants to remove bacteria and contaminants. Each day, around 365 million litres (ML) of Aa-grade drinking water is distributed around the region through 9300 kilometres (km) of pipes.

Wastewater collection and treatment:

Similarly, each day we collect around 460ML of wastewater through 8100km of pipes, treat it to the highest standard and return it to the environment.

Figure 4: Delivering water and wastewater services



All of the projects and programmes Watercare undertakes are to maintain our lifeline services, both now and into the future.

Our philosophy is to make sure that we maximise the use of existing assets and only build new assets at the right time, in the right place and for the right reasons to continue to deliver on our mission. In doing so, we can be responsive to changing customer expectations as well as population growth, providing safe and reliable services to customers 24/7.

4. Understanding our customers

Our customers expect us to deliver reliable water supply and wastewater services seamlessly. When something does go wrong, they expect us to be responsive and accountable. For us, reliability of service comes from our operational and maintenance practices and policies, as well as from the resilience of our sources and receiving environments.

Globally and locally the public consciousness of the value of water is growing. Going beyond our service commitment, our customers expect us to think and plan for the future – that we are building a water system which will enable our city to flourish for many years to come.

Our customers also expect us to provide leadership on matters relating to the water cycle and water use, that we operate sustainably and mitigate any impacts our activities might have on the environment. We recognise that we must be stewards and guardians of the environment. We cannot provide our services without a healthy environment.

As our population grows and changes, the need to interact with water in an urban environment will increase. To allow for a flourishing city into the future, we must be aware of the effects of our growth on the water system and our natural environment. More and more we will need to address issues outside of our core functions and responsibilities to make this happen.

For us to continue to provide services into the future, in the face of significant change, we must remain a viable business. Viability of operation covers both environmental and financial sustainability. We must ensure that we make the most of what we have, are efficient in our spending and make sure that our costs are always covered by our revenue.

Our services must provide value for money, while maintaining a financially stable business. Our prices must be affordable. We undertake a large capital programme of works each year, to maintain our services and meet customer expectations. Our assets provide benefits over long periods of time, and we arrange our funding and financing so that these costs are shared equitably during that time. We are always looking for ways to become more efficient or to make improvements to minimise the costs associated with our work.

We must also be aware of the effects of climate change. Our climate is changing. The dry periods are predicted to become drier, and the storms more intense. This will impact how we interact with the environment and how we set up and run our water and wastewater systems.

4.1. Water and wastewater resilience

With the expectation of 24/7 services, we must be resilient to changing conditions. In practical terms, this means analysing critical facilities and assets and minimising both the number of service interruptions and the effects on our customers during those interruptions. This starts right from the raw water sources, and progresses through the raw and treated water networks, into the wastewater network and treatment facilities and on to the receiving environments.

Overall, our water network has a high degree of resilience, allowing customers largely unrestricted access to safe drinking water throughout the year. There are multiple sources of raw water, connected to multiple treatment facilities located across Auckland. The water network is largely integrated, with a number of ways to move large volumes of water around the region to several treated water storage reservoirs serving local demand. Local water pipes serving individual customers are highly interconnected also, ensuring fewer service interruptions.

However, there is a significant reliance on the Ardmore Water Treatment Plant, which typically treats between 60% and 70% of all of Auckland's water. In March 2017, the extreme-weather event, Tasman Tempest, resulted in an unprecedented volume of rainfall and increased

sedimentation in our Hūnua water storage lakes. As a result, the quality of water coming in to Ardmore was highly turbid (or cloudy due to sediment particles). The treatment processes could not cope and production was limited. Using our integrated supply network, we were able to maximise production from our other treatment plants and launched a campaign to encourage Aucklanders to save water.

Following the tempest, we have implemented process improvements to future-proof our sources and ensure greater resilience to our supply. Other projects that are timed to improve the resilience of the water network include:

- Completion of the 32km, 1900mm-diameter Hūnua 4 Watermain to Khyber Reservoirs
- Replacement of the 12.5ML Khyber 2 treated water reservoir
- Expansion of the Waikato Water Treatment Plant
- Replacement of the Huia Water Treatment Plant
- Construction of the 33km, 900- to 1200mm-diameter North Harbour 2 Watermain to service customers between Titirangi and Ōrewa
- Increasing boost-pumping capability across the region to increase the volume of water able to be transported through the existing pipes when needed.

Watercare's wastewater network is resilient too, largely due to the type of network that it is. Wastewater flows are collected from houses and commercial premises, and transferred through a pipe network to single points of treatment. Wastewater pipes become progressively larger in size as they approach the treatment facility.

The capacity of our wastewater networks is generally driven by instantaneous peak flows, measured in litres per second (L/s). We build resilience into the wastewater network through understanding the instantaneous peak flows and the situations under which overflows occur, thereby limiting the occurrence of these events and minimising adverse effects, when they do occur.

Resilience at each plant is achieved through process duplication and/or additional capacity provision to allow flows through the plant to be diverted to an alternative process stream, or to bypass parts of a process while continuing to use other parts in case of capacity constraints or extreme weather.

Projects timed to improve wastewater resilience include:

- Construction of the first-stage 9km, 600mm-diameter rising main of the Northern Interceptor, ultimately connecting west Auckland communities around Te Atatū to the Rosedale Wastewater Treatment Plant so that Rosedale's capacity can be used optimally
- Construction of the 13km Central Interceptor will primarily provide for growth but will also contribute to the overall resilience of the wastewater network within the Māngere WWTP catchment
- Construction of thermal hydrolysis facilities and other process upgrades at both the Rosedale and Māngere wastewater treatment plants, to reduce biosolids production and improve treatment processing

- Ongoing process upgrades at our smaller plants, like better screening, membrane technology and disposal methods, to improve the quality of treated discharge and meet community expectations.

Our asset management systems are aligned with the international standard, BS ISO 55000 Series – Asset Management, and we continue to identify and implement improvements to our asset management system to achieve best practice.

4.2. Protecting the environment

Our business is intrinsically linked to, and directly dependent upon the health of, the natural environment. Water sources must have sufficient volume and reliability to provide water for Auckland, and they must be protected from overuse. For the wastewater system, receiving environments must have the capacity to accept treated wastewater discharges without adverse effects, and overflows from the network must be minimised. Where possible, we work to improve the quality of the receiving environment. Integrating environmental considerations into everything we do is key to our role as a trusted iwi partner and community organisation. We need to keep our harbours, estuaries and freshwater ecosystems healthy so Aucklanders can continue to enjoy a safe, clean environment.

We fulfil our environmental responsibilities through a regulatory framework. Meeting our legal and regulatory obligations are baseline requirements for our organisation. Our assets are subject to a large number of consent conditions, and we work to comply with regulatory conditions at all times.

As Auckland's lifeline service, we have resource consents associated with:

- Water abstraction from various sources for the purposes of potable water supply
- Discharges from our water and wastewater treatment plants
- Discharges from our water and wastewater networks
- Our infrastructure construction activities.

Legislation governs where and how water and wastewater services are delivered, and how the water and wastewater networks are managed, to ensure that public health and the environment are both protected.

Tightening of legislative conditions in relation to our consents can lead to greater protection of our natural resources, but can also require significant technological improvements. These improvements tend to come with cost implications, both to construct and maintain over the long term.

4.3. Growth

Regional growth in population, industry and commerce has a direct impact on our ability to provide reliable services and protect public health and the environment.

Around 1.5 million people currently live in Auckland. Over the next 35 years this number could grow by another 800,000 people to reach 2.3 million; this means another 320,000 dwellings and another 270,000 jobs. Around 1.41 million people are connected to our metropolitan water and/or wastewater services, increasing to 2.2 million over a 35-year period.

Growth on this scale is significant, and requires us to ensure we have a clear understanding of where and when investment in planning and infrastructure will be made. We are expected to provide services in the long term, while complying with environmental and legislative requirements, including giving effect to Auckland Council's plans and strategies.

Albany Reservoir
To increase security of supply in the North Shore and Rodney, a second water reservoir at Albany was built and commissioned in July 2015. Construction on the $5.9 million project began in April 2014. It duplicates the existing Albany reservoir on the same site in Corinthian Drive, providing another 10,000 cubic metres of storage in the 40-metre-diameter concrete tank. This picture shows Water Planning Manager, Tuan Hawke, on the roof of the completed reservoir. The inset on the left shows the inside of the reservoir while the inset on the right shows the construction of the Albany-Pinehill watermain.

Optimal planning for growth requires certainty around how much expansion there will be and where it will take place so that infrastructure can be built on time, and in the right location to meet desired service levels.

Central government has prepared a National Policy Statement (NPS) for Urban Development Capacity which sets clear expectations around council planning for growth and the provision of capacity to allow it. The NPS Urban Development Capacity:

- Identifies Auckland as a high-growth urban area, with an expectation to meet all of the requirements of policies

- Requires council to use the most recent Statistics New Zealand population projections, where the medium projection is considered the most suitable for assessing future population changes
- Stipulates that at any one time there is sufficient development capacity available in the short, medium and long term, and defines the capacity requirements for each timeframe
- Assumes that other infrastructure needed to support urban development is likely to be available
- Requires local authorities to provide an additional margin of feasible development capacity over and above projected demand of at least: 20% in the short and medium term, and 15% in the long term
- Requires provision of further development capacity and enabling of development if any assessments indicate capacity is not sufficient over the short, medium or longer term.

There are a number of documents prepared by Auckland Council to meet the requirements of the NPS Urban Development Capacity, including the Auckland Plan, the Auckland Unitary Plan (AUP) and the Future Urban Land Supply Strategy (FULSS). These frameworks, and the associated predicted growth, influence the timing of the provision of water and wastewater services, within the overall need to protect public health and comply with our statutory requirements.

Population projections are used to size, stage and plan the timing of infrastructure requirements for the region. If, over time, population projections are higher than estimated, timing of projects will need to be brought forward. If population projections are lower than estimated, projects would be deferred until the need arises.

Changes in the timing of projects may impact on cost estimates and the Funding Plan.

Projects timed to realise growth include:

- Boost pumping of the Waikato Watermain to increase transfer capacity of the pipeline
- New treated water storage in Pukekohe East and additional storage at Redoubt Road
- Additional water storage at the replacement Huia Water Treatment Plant
- Boost pumping of the existing North Shore watermains and to Pinehill
- Boost pumping of the Ōrewa 1 and 2 watermains to increase transfer capacity to the Whangaparaoa Peninsula
- Upgrades to non-metropolitan water supplies, including Wellsford, Warkworth, Snells/Algies, Helensville and Waiuku
- Construction of a North-East Sub-Regional Wastewater Treatment Plant and associated conveyance between Warkworth and Snells Beach
- Construction of the Northern Interceptor
- Construction of the Central Interceptor, to provide for growth and reduce existing overflows
- Construction of the Howick Diversion, to reduce existing overflows while providing for growth
- Augmentation of the Southern Interceptor between Hingaia and Manurewa, to meet southern growth expectations

- Expansion of the Pukekohe Wastewater Treatment Plant
- Construction of the South-West Sub-Regional Wastewater Treatment Plant to provide for growth and improve environmental outcomes for the Manukau Harbour.

These are significant projects, timed and staged to accommodate the forecast rate of population growth in specific locations. We give a lot of thought to where and when growth will most likely occur in order to minimise the risk of investing in the wrong places and/or at the wrong time.

4.4. Sustainable operations

Sustainability lies at the heart of everything we do. Our customers want our service levels to be maintained into the future, which requires us to be a viable business in the long term. We are committed to making the best use of our assets and resources.

As Auckland's population grows, reducing wastage of water becomes more and more important. We are committed to helping residents and businesses to reduce their water use. This helps us defer the need to build new water infrastructure, which in turn keeps our costs down. The "Auckland Water Efficiency Strategy 2017 to 2020" provides a framework and documents initiatives for Auckland to become more water efficient. Auckland already outperforms other New Zealand cities in conserving water, and compares favourably with similar cities internationally. We are working with households and businesses to manage water, and we offer free water audit and efficiency services through our "Be Waterwise" programme.

Through these initiatives and our non-revenue water reduction programme, we aim to reduce our total water demand by 15%, saving around 21 million litres per day (MLD), by 2025.

Non-revenue water is water that is supplied from our network but cannot be billed for various reasons. There are different types of non-revenue water such as water used for fire-fighting, which is considered an allowable use. However, one of the components is leakage from water pipes. The majority of the proposed savings are expected from reducing losses in the network, they include:

- Creation of district metered areas (DMA's) – Dividing the water network into smaller areas that meter the water in and out to enable non-revenue water to be calculated at a DMA level rather than a city wide level. This will enable us to prioritise areas that have higher leakage.
- Pressure management – Lower pressure in the network means less water lost through cracks and holes. As the network ages, lower pressure can also reduce the likelihood of faults. There are a number of areas within Auckland that have higher than necessary pressures. Identifying these areas and putting in place a programme to lower the pressures will reduce non-revenue water.
- Active leak detection – A methodical planned leak sweep (currently by using acoustic techniques), zone by zone to find unreported leaks. Zones are prioritised based on consultation with operations and planning staff.

- Smart meter trial – Smart meters have been installed in Waiuku. One of the main purposes of the trial is to compare non-revenue water calculations undertaken using daily data from the smart meter on a weekly basis. Smart meters can also provide immediate feedback to us and our customers on their water usage. Coupled with targeted communications from us, a change in attitude toward wasting water will reduce water consumption. Smart meters will allow us to identify abnormal water use sooner and notify customers of any potential leaks.

Our current target, as defined in the Auckland Water Efficiency Strategy, for real losses is that these should be less than or equal to 13% of the water supplied, reducing to less than 12% by 2040. In addition, we will also report real losses in terms of litres per connection per day (L/c/d). Our current performance is just over 126L/c/d. Our target is to reduce this to 101L/c/d by 2025, with real losses limited to a total of 50MLD (the figure is 60MLD currently). This would lead to an overall reduction in non-revenue water of 10MLD by 2025.

The wastewater equivalent of non-revenue water is inflow and infiltration of stormwater and groundwater into the wastewater network, which erodes the capacity for growth. Inflow and infiltration (I&I) can lead to uncontrolled overflows from manholes and pump stations during and after periods of heavy rain. We are developing a region-wide I&I reduction programme as part of our wet-weather overflow reduction strategy.

Better energy management is one of our strategic initiatives. We have ambitious targets to reduce our carbon footprint as part of our energy-efficiency and neutrality programme. Biogas produced at the Māngere and Rosedale wastewater treatment plants currently generates around 52% and 64% of their energy needs respectively. This reduces our costs and improves our resilience. Hydroelectric power is generated at our Hūnua dams as well as at our three Huia dams. Annually we produce around 44,000,000 kilowatt hours (kWh) of electricity, or the amount used by around 7,000 New Zealand households.

We aim to make the Māngere and Rosedale wastewater treatment plants' energy neutral by 2025, which would be a world-first for a plant the size of Māngere.

We work to minimise the impact of our activities and contribute to the restoration of Auckland's environment. From recycling and composting our office waste, reusing biosolids and treated wastewater for operational uses, to restoring habitats, we work hard to enhance our environment and protect biodiversity. We view our treatment plants, particularly wastewater, as resource recovery centres. For example, biosolids are nutrient-rich, organic sludge produced when we treat wastewater. We are exploring opportunities to extract valuable end products from the biosolids, creating bio-polymers, safe-to-use compost and phosphorus-rich fertilisers.

Also, we are looking at ways to recycle wastewater at our sites for drinking and non-drinking water reuse. Currently at our two largest wastewater treatment plants, Māngere and Rosedale, we reuse about 34ML of treated wastewater each day in on-site processes such as utility water and clarifier water. This is equivalent to the daily water consumption of more than 130,000 Aucklanders.

In addition, we partner with local organisations to:

- Promote awareness about water and wastewater
- Sponsor Waikato RiverCare, which undertakes riparian restoration on the lower Waikato River preparing, planting and maintaining areas of native flora
- Sponsor the Harbour Clean-up trust, which removes litter from Auckland's harbours and inner-gulf islands
- Sponsor the Trees for Survival programme, which involves schools in the Hūnua region growing and planting native trees to restore natural habitats by helping landowners revegetate erosion-prone land, improve stream flow and water quality, and increase biodiversity
- Help customers who are struggling to manage their water costs, through the Water Utility Consumer Assistance Trust
- Offer a free water education programme on water and the environment to schools across Auckland
- Restore commercial forestry planting with native trees to protect our water source catchments.

Our Funding Plan details our funding and financing policies and our price path for the next decade.

While our costs are projected to increase, we are committed to ensuring that our services are affordable, and considered excellent value for money. Our costs are recovered from those who use our services or increase demand on our system. All properties that are connected to our water network are metered, so that our customers are charged for water used, as well as the associated wastewater services, and benefit through lower bills for less consumption. Our infrastructure assets have a long life, so our costs must also be spread over time, ensuring that today's generation is not unduly burdened to cater for growth in the future.

We are forecasting a capital expenditure of around $11 billion over the 20-year Asset Management Plan period, and around $6 billion in operational costs. Our forecast revenue for the first 10 years of the AMP is around $8 billion. Our expenditure is assessed on the basis of the level of service required and the strategic legislative framework, and influenced by external factors such as growth and customer expectations. Our funding requirements are included in council's long-term planning processes, and are consulted on through those processes.

4.5. Climate change

The climate is changing and the frequency of extreme-weather events is increasing. We have been involved in a joint study with Auckland Council and National Institute of Water and Atmospheric Research (NIWA), looking at the projected effects of climate change on the Auckland region. The project has identified that generally:

- Average temperatures and the number of hot days will increase.

- Average rainfall will decrease but extreme rainfall intensity will increase.
- Soil moisture will decrease with increased days of soil moisture deficit.
- Sea levels will rise.

This will likely lead to water demand increases from our customers, particularly those in the irrigation and horticultural industries. Summers will see longer dry periods and winters less frequent but more intense rainfall, increasing the need to collect and store raw water and the development of more resilient water sources.

We have initiated an enterprise-wide climate change adaptation and mitigation strategy which brings together current best practice and a plan for the future.

We already manage our water sources to minimise the effects we have on the environment. Our water storage dams are kept full during winter, and we abstract from the Waikato River when it is in full winter-flow conditions. In summer, when the river levels fall, we use more water from our dam sources.

Further, we manage our dams based on their characteristics. The Hūnua dams are large-capacity dams, with relatively small catchments. They fill slowly, but can be used for long periods. The Waitākere dams are the opposite, with small capacities and relatively large catchments, filling quickly, but unable to sustain prolonged use.

Climate change presents many challenges including rises in sea levels. This has the potential, especially when coupled with storm surges, to impact low-lying communities and our water and wastewater facilities and networks in those areas. Our approach to replacing those assets which could potentially be impacted by sea level rise is:

- Services to existing communities will be maintained unless a decision is made to do otherwise
- Existing or new technologies will be implemented as required, to prevent impacts on wider metropolitan systems.
- Assets requiring replacement or major refurbishment will be relocated outside areas that are forecast to be impacted.

Watercare will continually assess the impacts of the latest climate projections on our networks, and will consider these factors in setting the timing of new projects and programmes. Issues already identified for our water services include an increase in land stability concerns in water supply catchments, competition for additional water sources, magnitude of impacts (for example degradation) on raw water quality, and variability in water demands during sustained dry and wet periods.

Issues to be taken into account for our wastewater services include impacts on wastewater treatment processes due to increased variability in quality and quantity of influent; sea level rise; the implications of increased flooding events on low-lying, conveyance systems, pump stations, and treatment plants; negative impacts on the assimilation capacity of receiving environments; and the increasing frequency/severity of wastewater overflows.

As with all projections, there is some uncertainty around the details, but the trends are consistent. We are working with Auckland Council and NIWA to understand the impacts of this uncertainty and how it affects critical infrastructure.

5. Our business

Watercare is a council-controlled organisation, wholly owned by Auckland Council. The council appoints our board of directors, who in turn appoint our chief executive. Operational responsibility is delegated to the chief executive by way of a formal delegated authority framework.

Our board of directors and executives are committed to ensuring the company applies best-practice policies and procedures.

The board is ultimately responsible for making governance decisions.

Our legislative framework

Watercare is a limited liability company registered under the Companies Act 1993, and a local government organisation under the Local Government Act 2002 and the Local Government (Auckland Council) Act 2009. We cover the cost of all our activities and receive no funding from Auckland Council or central government. We are prohibited by statute from paying a dividend to Auckland Council.

We are subject to regulation governing planning, health and environmental matters. The principal regulators under the Resource Management Act 1991 include Auckland Council, Waikato Regional Council and Waikato District Council. Other organisations that undertake regulatory oversight of our business include the Ministry of Health, Ministry of Commerce and WorkSafe.

Further details of the legislative framework can be found on our website and in **Table 5: Legislative requirements**.

Our strategic framework

Our strategic framework is presented in **Figure 5** below and influences our business decision-making, focusing on the following four strategic priorities:

- Customer focus
  - We understand our customers' needs and deliver value
  - We consistently provide exceptional products and service
  - We are trusted by our customers who understand our purpose and value our service
- Business excellence
  - We have a safe and engaged team
  - We are a commercially savvy business
  - We are responsible stewards of our assets
  - We continually strive for process excellence

- Financial responsibility
  - We are a minimum-cost service provider
  - We are financially stable over the long term
- Fully sustainable
  - We are a socially responsible business
  - We protect and enhance our natural environment
  - We meet all our legal and regulatory obligations

Figure 5: Watercare strategic framework

Stakeholder inclusiveness

Watercare is accountable to a wide range of stakeholders, which comprise entities or individuals that can affect or be affected by our activities.

We have a structured process of engagement with many of our stakeholders. Media enquiries, complaints and other public interaction have also helped us to understand stakeholders' expectations. Our stakeholders considered the issues below as material in 2017/18, **Table 1**.

Table 1: Stakeholders' issues

RESIDENTIAL, COMMERCIAL CUSTOMERS AND DEVELOPERS	AUCKLAND COUNCIL	ENVIRONMENTAL GROUPS	TANGATA WHENUA (MĀORI)	STAFF
• Safe and reliable water and wastewater services • Responsiveness to issues (leaks, blockages, bursts) • Affordability of services • Timing, sequencing and location of Watercare-funded infrastructure	• Support and give effect to long-term plans and other initiatives • Funding and sequencing for long-term infrastructure • Adhere to a two-way 'no surprises' policy • Support group efforts such as co-sourcing and procurement to reduce servicing costs	• Climate change adaptation and mitigation • Planned upgrades and consenting for infrastructure • Water quality in receiving environments	• Understanding values and cultural impact of operations and initiatives • Consulting on and supporting matters of mutual interest • Local residents and community groups that neighbour our worksites • Opportunities for consultation on projects before work begins • Accurate and timely information on projects' progress • Consideration for social and environmental impacts of projects	• Supportive work culture • Competitive pay • Digital and organisational transformation
WIDER PUBLIC	**REGULATORS**	**INFRASTRUCTURE PROVIDERS**	**LOCAL BOARDS**	**SUPPLIERS AND CONTRACTORS**
• Security of supply, now and in the future • Access to water sources • Wastewater overflows caused by network blockages and stormwater ingress • Infrastructure to cater for growth	• Involvement in the development of statutory and regulatory changes affecting the water industry	• Co-ordinated approach to infrastructure projects to minimise disruption to community • Opportunities to collaborate and deliver infrastructure effectively	• Information on infrastructure projects ahead of works • Timely information on local network issues so there are 'no surprises'	• Access to information on planned and upcoming projects • Opportunities for innovation and collaboration

5.1. Our statement of intent (SOI)

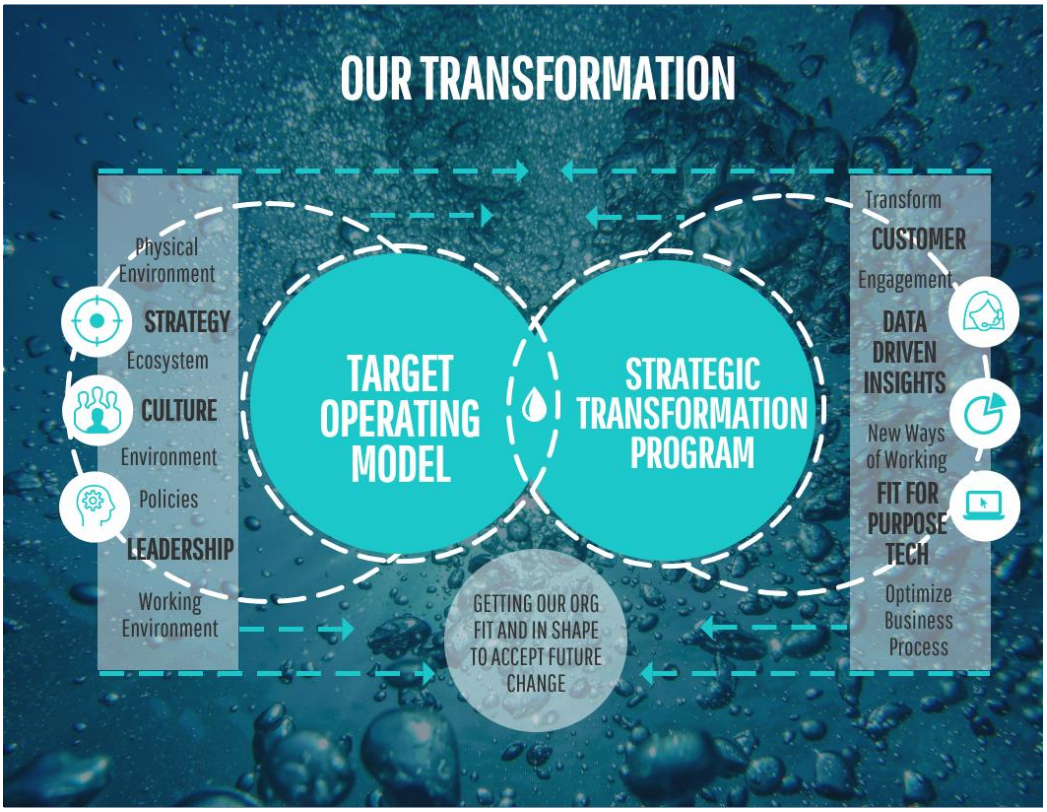
Every year, we consult with our shareholder, Auckland Council, to develop a SOI covering the next three years. The SOI sets out Watercare's response to the Mayor of Auckland's letter of expectation, our obligations and how we intend to fulfil our mission to provide safe, reliable and efficient water and wastewater services to all of Auckland. The SOI highlights the various initiatives that we are collaborating on with the Council group and reaffirms our continued commitment to working with Council and other infrastructure providers to enable the region's sustainable growth and development. The 2018-2021 SOI is available on our website.

5.2. Our transformation

Watercare is implementing a business-wide transformation. We are creating a new target operating model that will ensure our leadership, strategy, culture and structure enable us to be agile and deliver value to our customers.

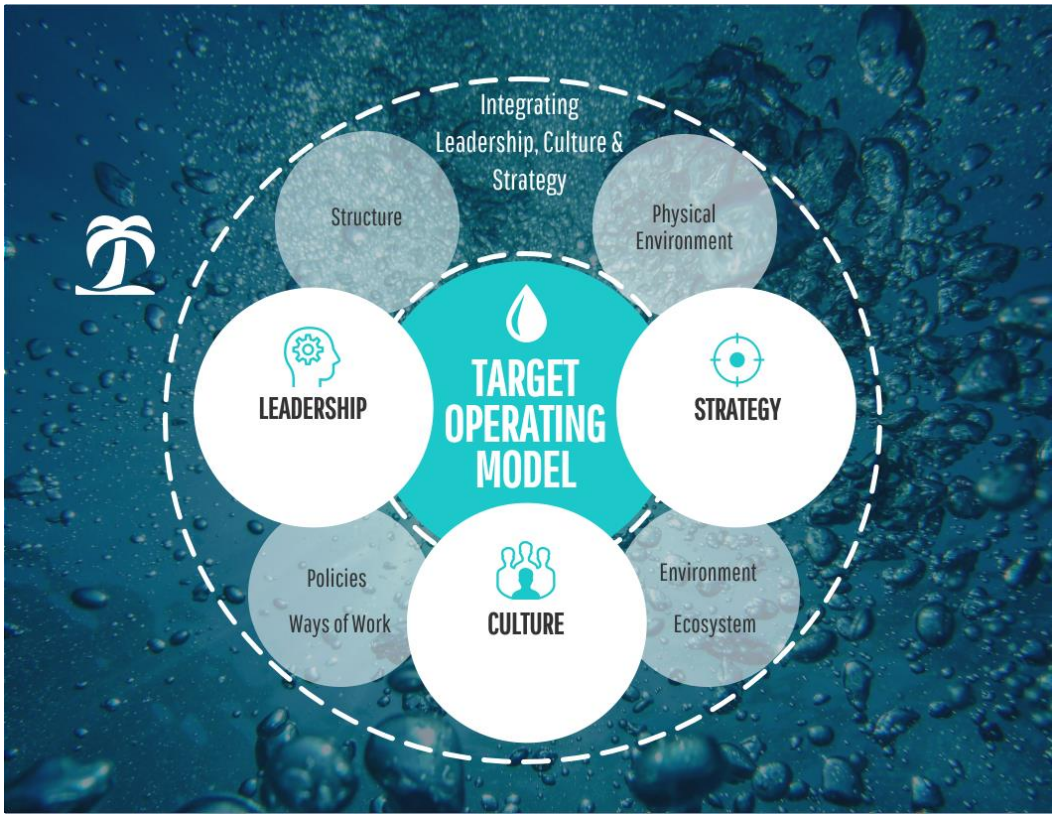
At the same time, we are implementing a strategic transformation programme that will ultimately enable customers to serve themselves in a single interaction. It will also provide our employees with the right tools and best processes so that they can make informed decisions with confidence.

Figure 6: Strategic transformation



The target operating model addresses the environment that we operate in.

Figure 7: Target operating model



5.2.1. Our structure

Following a review of our company structure in 2017, four substantial business units have been established:

- Infrastructure
- Operations
- Customer
- Finance and business support.

These units receive support from:

- People and capability
- Digital, transformation and innovation
- Communications and stakeholder engagement.

The two business units directly involved in our asset management approach are Infrastructure, and Operations.

Our Infrastructure unit sets strategy and plans, and designs and builds the assets to provide and maintain expected levels of service, now and into the future.

Once the assets are built and commissioned, our operations unit is responsible for their ongoing operation and maintenance. How we manage our assets, and identify which ones are critical, is considered according to the risks they pose to the achievement of our goals and objectives.

5.3. Our asset management approach

We are committed to best-practice asset management across our business. Our asset management systems are generally aligned with the international standard ISO 55000, and follow the guidelines of the International Infrastructure Management Manual. These guidelines suggest that after the organisational vision, goals and objectives have been defined, they must be supported by an asset management policy framework, principles and operating model.

5.3.1. Our asset management policy

Combining the issues that are material to our stakeholders, the SOI, the Mayor of Auckland's letter of expectation, legislative requirements and our strategic priorities, we have developed a policy around how we plan, design, construct, acquire, maintain, operate, rehabilitate and dispose of our assets. We keep in mind both present and future customers, considering the assets in a manner that:

- Protects the public health of the community and provides a defined level of service to our customers
- Takes an asset life-cycle approach
- Develops cost-effective management strategies for the long term, including optimising the cost of maintaining and operating our networks
- Manages risks associated with asset failure
- Uses physical resources sustainably and cares for the natural environment
- Continuously monitors and improves our asset performance and management practices.

The executive sponsor of the Asset Management Policy is our chief infrastructure officer, with the policy approved by our chief executive. Our head of planning and design is responsible for monitoring and reviewing the policy.

The general policy leads on to a number of high-level objectives and principles around the management of our assets.

5.3.2. Asset management objectives

We are committed to achieving the following high-level asset management objectives (see **Table 2**) that, in turn, will achieve our strategic priorities stated above:

Table 2: Asset management objectives

Asset management objective	Strategic priority being addressed
To operate and maintain the water and wastewater systems in an efficient manner	Customer focus, business excellence, financial responsibility, fully sustainable
To ensure there is sufficient infrastructural capacity to meet growth in demand	Customer focus, business excellence, financial responsibility, fully sustainable
To meet regulatory requirements and levels of service	Customer focus, fully sustainable
To replace assets when they reach the end of their economic lives	Customer focus, business excellence, financial responsibility, fully sustainable

5.3.3. Asset principles

The principles applied to the management of the water and wastewater systems and their associated strategies are as follows:

- We are required by legislation to give effect to Auckland Council's plans and strategies as set out in the Auckland Plan and associated documents.
- We will plan and seek resource consents for plant and transmission assets, and stage construction to match demand.
- A risk-based philosophy will be applied for the replacement or rehabilitation of critical water assets.
- Non-critical assets will be utilised until they no longer provide the expected levels of service to the customer, at which time they will be replaced.

In addition, there are a number of water-specific principles that apply, as follows:

- The metropolitan water supply dams will be operated to a 1:100-year event (with a 15% residual storage at the end of the drought event) with additional water sources planned to meet the medium growth demand.
- Water treatment plant expansions will be implemented to meet a three-day peak demand in conjunction with regional treated water storage.
- Metropolitan water treatment plant resilience will be managed to enable an outage of a single water treatment plant, excluding the Ardmore Water Treatment Plant, without a reduction in water demand.
- Water demand management will be implemented to achieve the average day consumption should the Ardmore plant be limited to the minimum production of 140MLD. Further restrictions will be implemented if the Ardmore plant is out of service and contingency reservoir storage cannot be maintained.
- The 24-hour treated water reservoir storage will be increased to improve system resilience as demand increases.
- In conjunction with water treatment and treated water reservoir storage capacity, the overall water transmission system will provide, wherever possible, redundancy against a transmission asset failure.

- Boost pumping will be implemented to maximise the use of existing assets and, where possible, provide redundancy to treatment and transmission outages.

A number of wastewater-specific principles apply as follows:

- Wastewater treatment plant capacity will be augmented to match growth in demand and to maintain compliance with the plants' discharge consents.
- Non-metropolitan wastewater treatment plants will be optimised as their discharge consents are renewed.
- Augmentation of the wastewater transmission and local networks will be carried out prior to the peak dry-weather flow exceeding the capacity of the network and in accordance with discharge consent conditions.
- Wet-weather performance will set the conveyance standard for the wastewater network.
- We will not permit cross connections from the stormwater system to the wastewater network.
- The wastewater system is for the conveyance of wastewater only; therefore, as much as practical, stormwater and groundwater will be removed from the system.
- An I&I programme will be developed to maximise the use of existing assets.
- As the transmission system reaches capacity, we will augment the interceptors[1] by truncating the catchment or diverting flow to an adjacent interceptor.
- High-risk rising mains[2] and inverted siphons[3] will be duplicated to provide redundancy.
- Wastewater treatment plants will be regarded as 'resource recovery plants'.

5.3.4. Our risk management process

Risk management is an integral part of the life cycle of major infrastructure assets.

Watercare takes an enterprise-wide approach to managing risks and opportunities through a formal enterprise risk management framework and by supporting processes which align with AS/NZS ISO 31000:2018 (Risk Management – Principles and Guidelines).

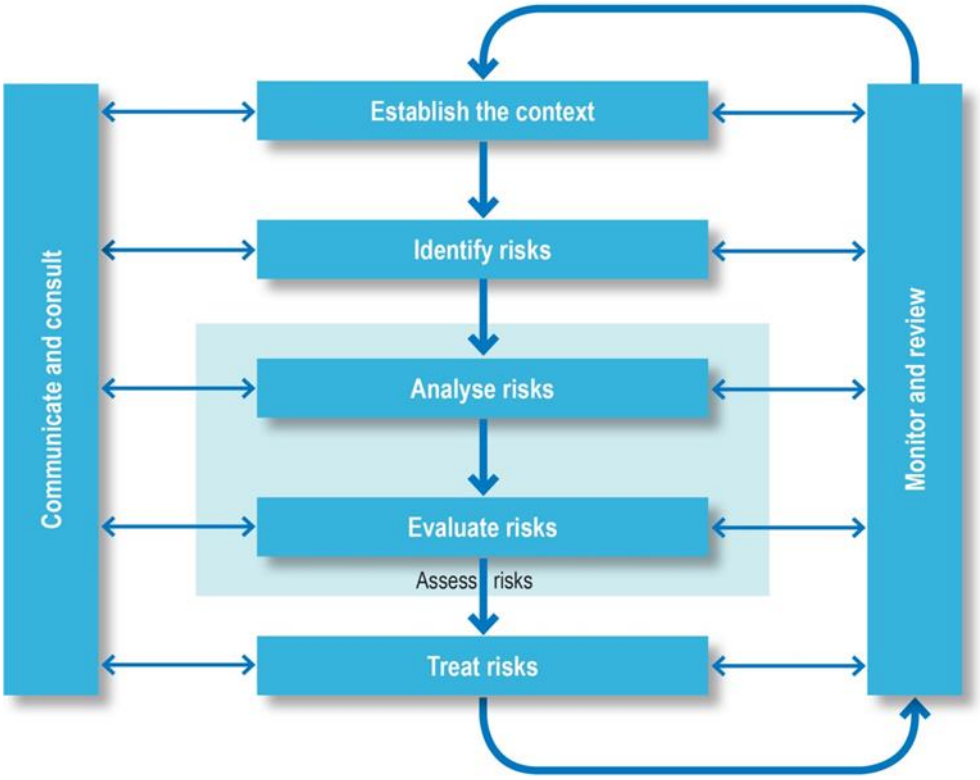
The continued application of risk management processes ensures that we identify the risks to achieving our business objectives. Risks are analysed, prioritised for treatment, and then appropriate risk mitigation measures are applied. The process is illustrated in **Figure 8.**

[1] An **interceptor** is a component of a wastewater network. It is a pipe network that receives flow from trunk wastewater pipes and sometimes stormwater run-off and directs it to the wastewater treatment plant. It is among the larger pipes of a wastewater network and is categorised as a transmission asset.

[2] A **rising main** is a type of wastewater pipe through which wastewater is pumped from a pump station, typically from a lower ground level to a higher ground level to join with the main wastewater network.

[3] **Inverted siphons** allow wastewater pipes to pass under obstructions such as rivers. Unlike the main wastewater pipe, the **siphon** pipes flow under pressure and must have flow velocities greater than 0.9 m/s to keep any solid material suspended so it can continue to be conveyed to a wastewater treatment plant for collection and disposal.

Figure 8: Risk management process



Enterprise Risk Management

Watercare maintains a board-approved Risk Management Policy, the intent of which is to direct the risk management function. The policy focuses risk management onto those risks that are material to the achievement of our organisation's principal objectives.

We apply a risk management framework, consistent with ISO 31000:2018 Risk Management – Guidelines, in order to ensure that risks are managed consistently throughout the company.

This framework defines the management policies, procedures and practices to be applied to the risk management tasks of identifying, analysing, evaluating, treating and continuing to monitor risk to provide enterprise-level information.

As part of the risk management framework, we have established a Risk Management Steering Committee, which meets quarterly to monitor emerging risk and risk mitigation actions and strategies. The committee comprise the chief executive, senior management team and the head of risk and resilience.

Regular monitoring, review and reporting of risks is an important component of the Watercare Risk Management Framework, as it ensures new risks and changes to existing risks are identified and managed, and that risk mitigation plans are developed and implemented.

A number of significant risks are monitored by the board at least quarterly, or as required. In addition, external reviews are carried out to ensure we meet and exceed good-practice measures in risk management.

Our enterprise risks, **Table 3,** reflect the interdependencies that we are faced with in delivering our services.

Emergency management and contingency planning

In providing our water and wastewater services, we use an incident escalation system to manage emergency incidents. This system defines roles, responsibilities and processes for response. It is documented in our incident management plan, which aligns with a number of other plans including:

- Our pandemic response plan
- Our operations incident management plans
- Auckland Council's crisis management plan.

For the management of wider-scale incidents, we are also a participant in the Auckland Engineering Lifelines Group (AELG). The AELG is made up of all the essential utilities in the Auckland region which work together to improve the resilience of Auckland's infrastructure to major hazards such as volcanic eruptions or earthquakes. Working with the AELG improves our understanding of the risks to the water and wastewater assets and services during major natural incidents. The AELG also works alongside Civil Defence during emergencies to restore essential services. Lifeline procedures are included in our incident management plan.

At an operational level, we also have a number of contingency plans to manage planned or emergency events as well as specific critical assets. These include:

- A drought response plan. Shutdown procedures for bulk water mains
- Business continuity plans for sites that set out procedures we must follow in order to maintain services levels and minimise disruption to our customers
- Water safety plans for treatment plants to ensure the water entering supply is safe to drink.

Risk evaluation

Within our risk management framework, risks are evaluated using a semi-quantitative method that explicitly considers the likelihood of various adverse consequences occurring.

Consequences are scored according to the impact that the risk may have on the achievement of the following objectives:

- Providing for the health and safety of staff, customers and the public
- Achieving environmental compliance and minimising third-party damage
- Effective management of systems, assets, project performance and service delivery
- Minimising financial losses
- Maintaining a professional reputation.

The likelihood of adverse consequences is also scored based on a number of contributory factors. These include the asset's location, the operating environment, assessment of the asset's condition and the forecast remaining life of the asset.

Our risk management framework assesses each risk across five classifications. Each risk is categorised according to the magnitude of the risk score and the magnitude of the potential consequences.

All high and very high risks are defined as enterprise risks. Very low, low and medium asset risks may be considered tolerable if risk reduction is impractical or if the cost of treatment exceeds the improvement gained. Very low risks are considered to be of minor significance with the asset generally being run to failure before being replaced.

The process of evaluating risks involves considering the scope and effectiveness of existing risk control measures in terms of prevention, protection and recovery. Where further risk reduction is warranted, new business projects are identified, investigated and defined for inclusion in the AMP.

Kohimarama wastewater storage tank and pipeline upgrades
This is a view of the inside of the Kohimarama wastewater storage tank. The Kohimarama wastewater upgrades will reduce the frequency and volume of overflows into the local stream and improve the condition of local waterways; they will also provide extra capacity for future population growth. The improvements at Kohimarama include upgraded wastewater pipelines and the construction of a new underground storage tank at Madills Farm Reserve. Construction began in April 2014 and was completed in early 2016.The project has been recognised with a 'Highly Commended' award for Best Public Works Project over $5 Million by the Institute of Public Works Engineering Australasia.

Table 3: Enterprise risks

Enterprise Risk description	Potential consequence	Integrated reporting capitals showing dominant capital	Key controls and mitigation strategies
Health and Safety (H&S) – Operational Hazards Watercare's work involves significant operational hazards, which include: Confined Spaces, Working at Height, Trenching and Excavations, Working Alone, Working near/on Bodies of Water	Workers may be exposed to serious harm	○ Financial ○ Natural ○ **Human** ○ Social and Relationships	○ Clear standards for work involving significant operational hazards ○ Training of staff to industry standards ○ Using qualified, well-trained contractors ○ Ongoing monitoring of relevant lead and lag H&S indicators
Health and Safety – Process Safety A catastrophic failure of a major Watercare plant such as an explosion, fire or chemical leak which carries significant H&S risk	Workers, the public or the environment may be exposed to serious harm	○ Manufactured ○ Financial ○ Natural ○ Human ○ **Social and Relationships**	○ Plant design, operation and containment systems to address this risk ○ Regular plant condition assessments and specific regulation-driven compliance reviews undertaken
Insufficient Treated Water Supply to Meet Demand The risk could arise from: Protracted drought conditions, the loss of a major storage dam or the loss of water treatment capacity which could arise from climate change (including extreme-weather events)	Inability to supply sufficient treated water to meet Auckland's demand	○ Manufactured ○ Financial ○ Natural ○ Human ○ **Social and Relationships**	○ Risk mitigation is inherent in the design of the water systems, from source to treatment ○ Integrated source management model for water abstraction ○ Geographically separated dams ○ Drought Management Plan
Failure to Treat Wastewater to the Required Standard and Convey Wastewater Flows This includes the impact of stormwater overflows in wet-weather events and longer-term climate change	Environmental impacts or failure to meet consent conditions that impact stakeholders	○ Financial ○ **Natural** ○ Human ○ Social and Relationships	○ Wastewater treatment plant upgrades ○ Asset management renewal and upgrade programmes ○ Transmission and network upgrades to convey required stormwater and wastewater flows ○ Network upgrades to address capacity constraints

Enterprise Risk description	Potential consequence	Integrated reporting capitals showing dominant capital	Key controls and mitigation strategies
Major Water Quality Event The quality of treated water supplied is compromised	Compliance with DWSNZ and/or public health is adversely impacted	○ Manufactured ○ Financial ○ Natural ○ **Human** ○ Social and Relationships	○ Operation within well-established water treatment protocols reflecting Ministry of Health/DWSNZ requirements ○ Disinfection and testing of all water prior to entering supply ○ Chlorine levels are maintained in the distribution system ○ Water safety and contamination notification in place ○ Regular accreditation reviews with the Drinking Water Assessors
Cybersecurity for Business and Control Systems Malicious acts compromising SCADA control systems, noting the cyber-threat environment continues to grow globally and in New Zealand	Corporate network and/or operating control systems are compromised, impacting operations	○ Manufactured ○ Financial ○ Natural ○ Human ○ Social and Relationships ○ **Intellectual**	○ Comprehensive cybersecurity policies in place ○ Regular staff training and awareness ○ Deployment of specialist cybersecurity to reduce overall risk ○ Independent experts used to advise on an enhanced cybersecurity roadmap and tools
Failure to Meet Developer Service Commitments Poor processes, engagement and slow delivery of Watercare's AMP	Failure to meet developer service commitments	○ Manufactured ○ **Financial** ○ Natural ○ Human ○ Social and Relationships	○ Proactive developer relationship engagement ○ Digital Strategy - enable online connection service ○ Consenting Service Level Agreement with council ○ Improving transparency and working closely with developers on delivery of growth-related capital projects
Availability of Trained Staff, Contractors and Suppliers Failure to attract and retain sufficient direct or supporting skilled and qualified resources	Watercare employees, contractors, suppliers and consultants not resourced to deliver Watercare's objectives	○ Manufactured ○ **Financial** ○ Natural ○ Human ○ Social and Relationships ○ Intellectual	○ Operational succession planning ○ Ensure sufficient numbers of skilled and qualified resources are available ○ Market resources are identified and retained to support business deliverables
Major Project Cost Overrun Actual cost of delivery is higher than anticipated	The funding requirement is outside the AMP envelope	○ Manufactured ○ **Financial** ○ Human ○ Social and Relationships ○ Intellectual	○ Procurement strategies to minimise capital and whole-of-life costs on new assets ○ Monitoring of projects costs and delivery time

Asset risk management

Table 4 outlines the risks evaluated for each asset group.

Table 4: Risks evaluated for each asset group

Asset group	Risks evaluated
Water system	
Water sources	• Structural failure of embankment, valve tower and cut-off wall • Failure of control valves, pipework and power supply • Contamination to groundwater source • Land instability
Raw water transmission	• Structural failure of aqueducts, tunnels, portals and raw water mains • Land instability
Water treatment plants	• Structural failure and land instability • Failure of dosing systems, clarification, filtration, disinfection or power supply
Treated watermains	• Failure of rising mains, exposed pipes (including pipe bridges), gravity pipes, chambers, valves and bulk supply points
Water pump stations	• Structural failure and land instability • Failure of pumps, valves, pipework, power supply, motors, drives and controls
Water reservoirs	• Structural failure and land instability • Failure of control valves, pipework and power supply
Wastewater system	
Wastewater treatment plants	• Structural failure and land instability • Failure of screens, primary tanks, reactor-clarifiers, filters, ultraviolet plant, discharge pumps, digesters and centrifuge dewatering • Failure of outfall
Wastewater pump stations	• Structural failure and land instability • Failure of overflow, odour control, pumps, valves, pipework, ventilation, power supply, motors/drives and controls
Wastewater pipes	• Failure of rising mains, exposed pipes (including pipe bridges), grit chambers, gravity pipes, overflows, manholes, chambers, valves/penstocks, ventilation/odour, and mechanical issues

Risk mitigation

Efficient and effective risk mitigation does not necessarily eliminate the potential for adverse consequences. Risk mitigation is delivered through the combined application of a number of different forms of risk control, including risk avoidance, risk transfer, operational initiatives and engineered solutions.

Wherever possible, and economically feasible, engineered solutions are put in place to avoid risks. This is particularly important in areas of Auckland with ageing infrastructure and growing demand.

In situations where the risk cannot be avoided, we carry out operational initiatives including:

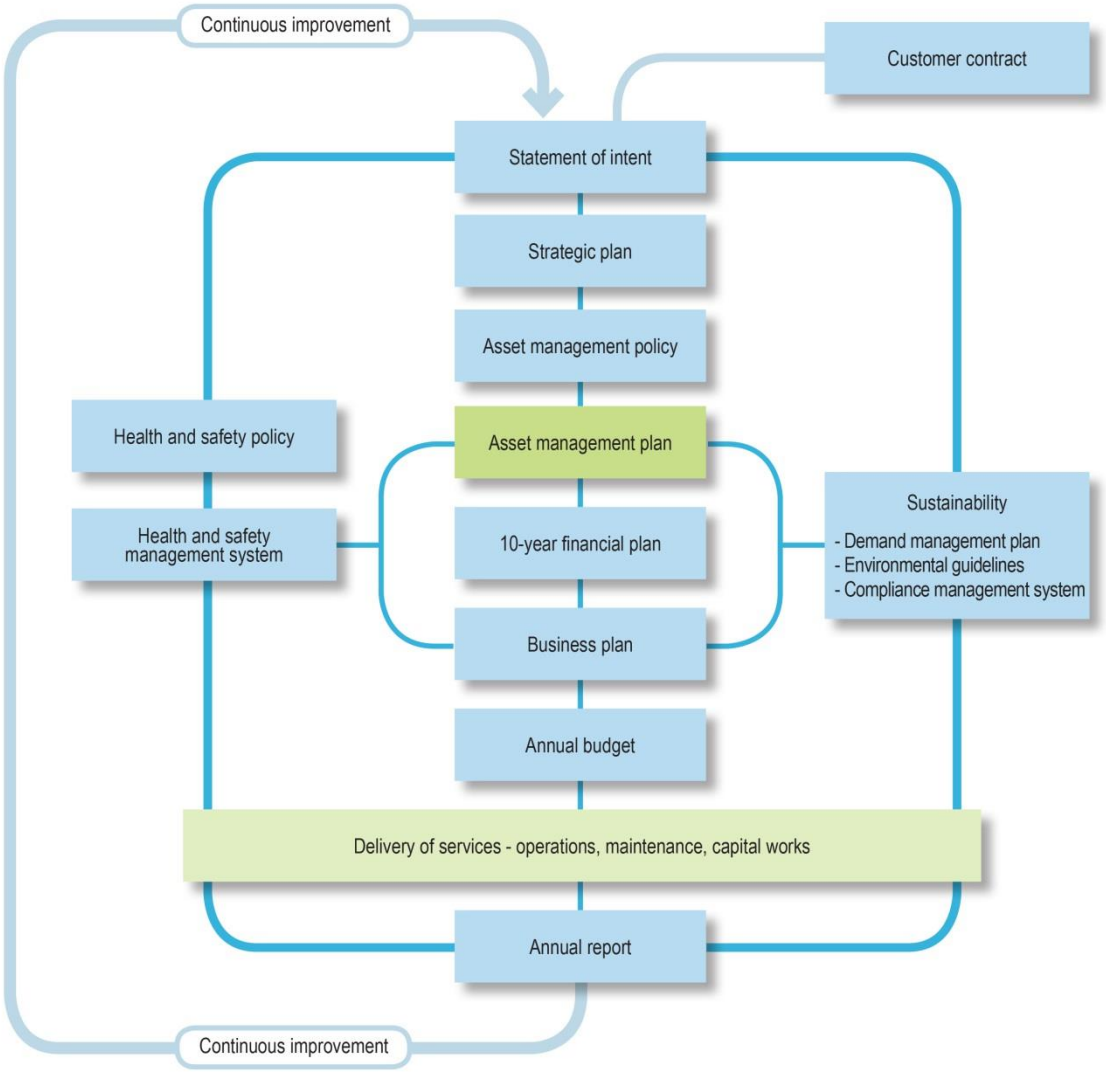
- Asset condition assessment programmes
- Reliability-centred maintenance (RCM) planning
- Authorisation and monitoring of third-party works
- Inspection regimes
- Computational modelling of emergency network management and failure scenarios
- Capture, retention and distribution of incident and engineering knowledge
- Development and exercising of emergency management and contingency response plans.

Contractual agreements and insurance cover are used as well, where it is appropriate and cost effective to transfer responsibilities for the control of risks and some liabilities.

5.3.5. Asset management planning

The AMP is our tactical plan for managing our infrastructure cost-effectively to achieve our long-term strategic goals. The relationship between our AMP and other company documents is shown below in **Figure 9.**

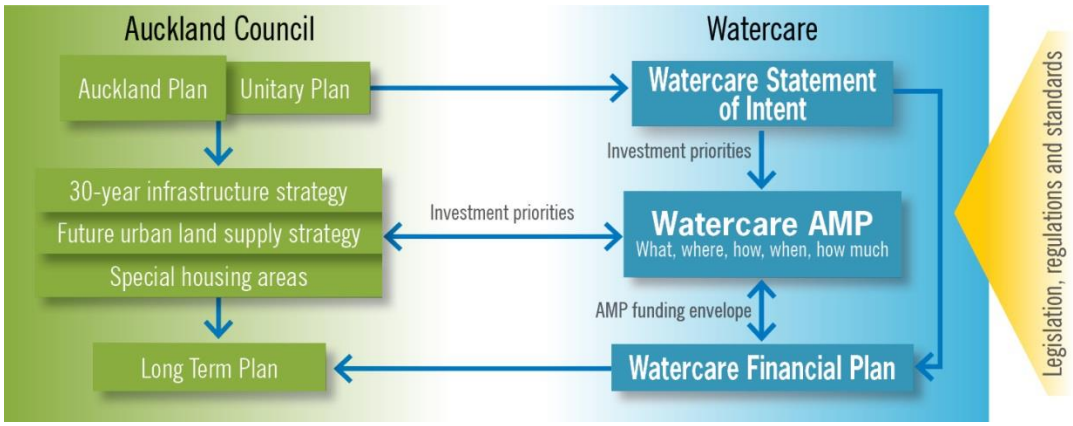
Figure 9: Watercare's management system



The AMP sets out the levels of service we provide and the life-cycle asset management strategies, programmes and costs to continue to deliver those services into the future.

The AMP is aligned with Auckland Council's strategic plans and is an important part of the Auckland Council's planning framework, as illustrated in **Figure 10**.

Figure 10: Alignment of the Watercare AMP with the Auckland Plan



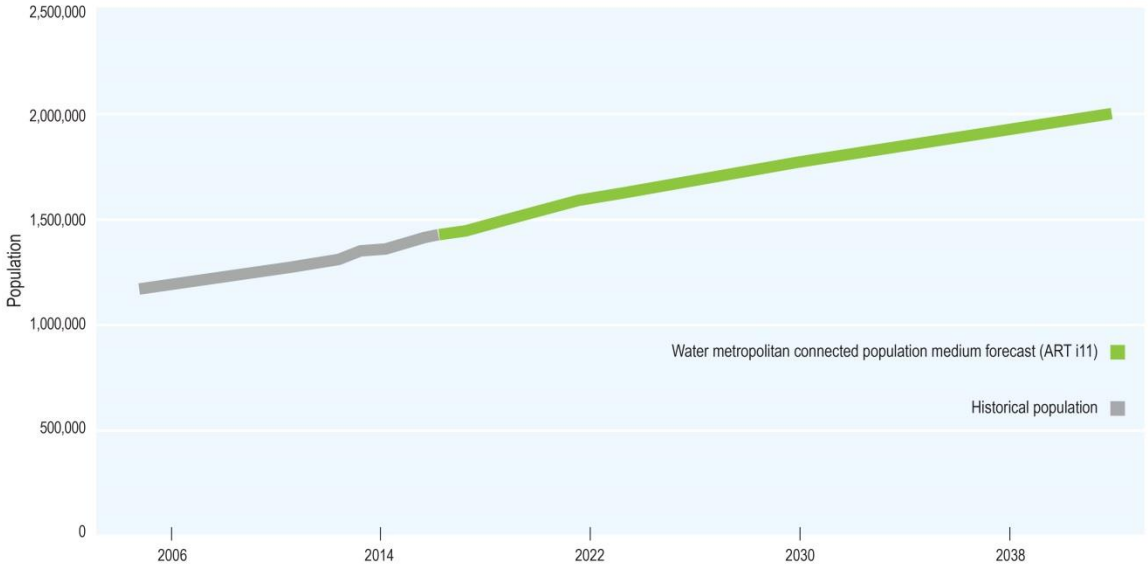
We also provide water and wastewater treatment services for Tūākau and Pōkeno in the Waikato, so they are included in this plan as appropriate. However, it excludes the Papakura network operated under contract by Veolia Water as, although they do not own the assets, they carry out the asset management planning functions for our assets in their area under the contract.

We break down our asset management planning into three interrelated areas: growth, renewals and levels of service. Normally, new assets will address more than one of these interrelated areas. For example, if we are renewing a pipe because of its condition, we also consider the long-term requirements of the asset with respect to growth and levels of service before deciding how to proceed with the renewal.

Growth and demand

As Auckland grows, so too will its demand for water. The population serviced by the metropolitan water system is based on Auckland Council's ART i11 growth forecast dated July 2017. The medium growth projection of connections to the metropolitan water supply system is shown in **Figure 11** and is forecast to increase to 1.97 million people by 2038, and to 2.3 million people over the next 35 years. This means there will be an additional 320,000 dwellings and 270,000 jobs in Auckland.

Figure 11: Auckland metropolitan serviced population forecast 2018 - 2038



Similarly, for wastewater, the volume of wastewater to be treated will increase as Auckland grows. The medium growth projection of connections to the wastewater system is forecast to increase to 2.04 million people by 2038. Approximately 2.2 million people will be connected to our wastewater networks over a 35-year period, although there will be some spatial variation between the water and wastewater services; this is because in some areas we supply customers only water, and others only wastewater.

Currently, the gross per capita water consumption, which includes both residential and non-residential, is 272 litres per person per day (L/p/d). We are implementing demand management initiatives to reduce this to 253L/p/d by 2025. Beyond 2025, we assume the per capita consumption will remain at 253 L/p/d. We also assume we will reduce the volume of water loss in the network to less than 12% of total network volume by 2040. These trends and targets are illustrated in **Figure 12**.

Figure 12: Gross per capita water consumption

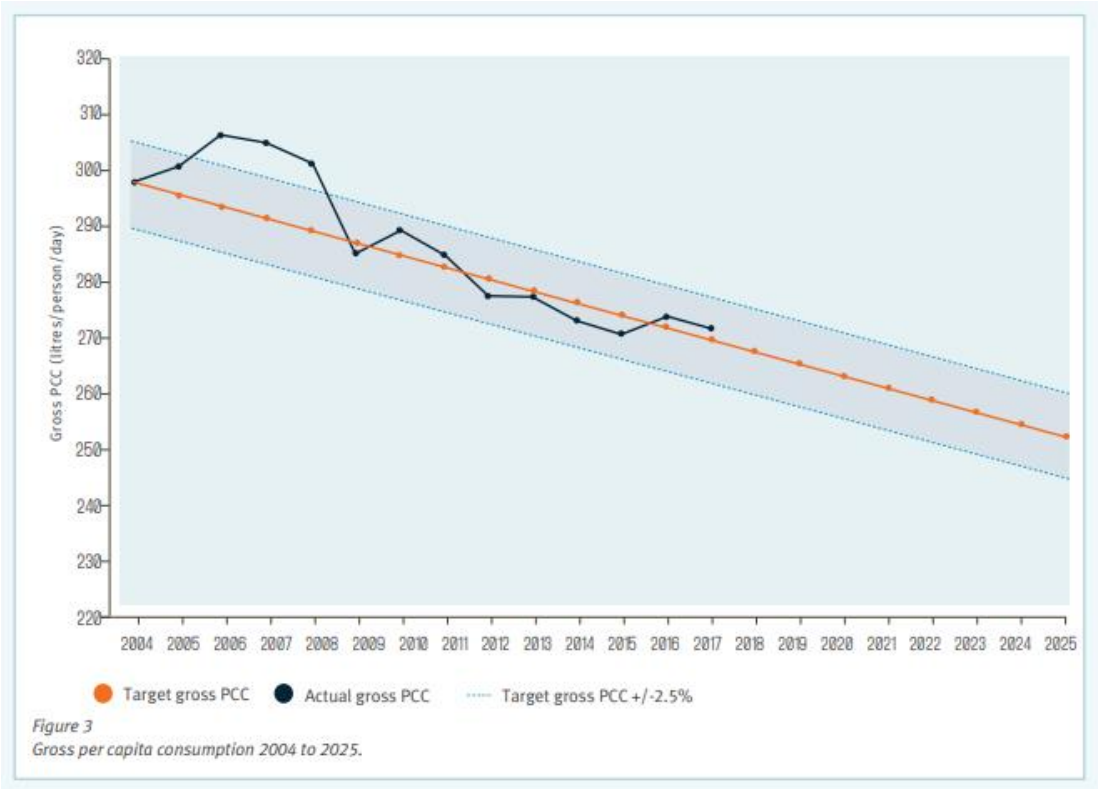


Figure 3
Gross per capita consumption 2004 to 2025.

Auckland's current average daily demand for water is 400MLD. Based on council's forecast population growth, as well as on our gross per capita consumption and water loss in the networks' targets, the average demand for water is projected to increase to 507 MLD by 2038 as shown in **Figure 13**.

Figure 13: Source augmentation

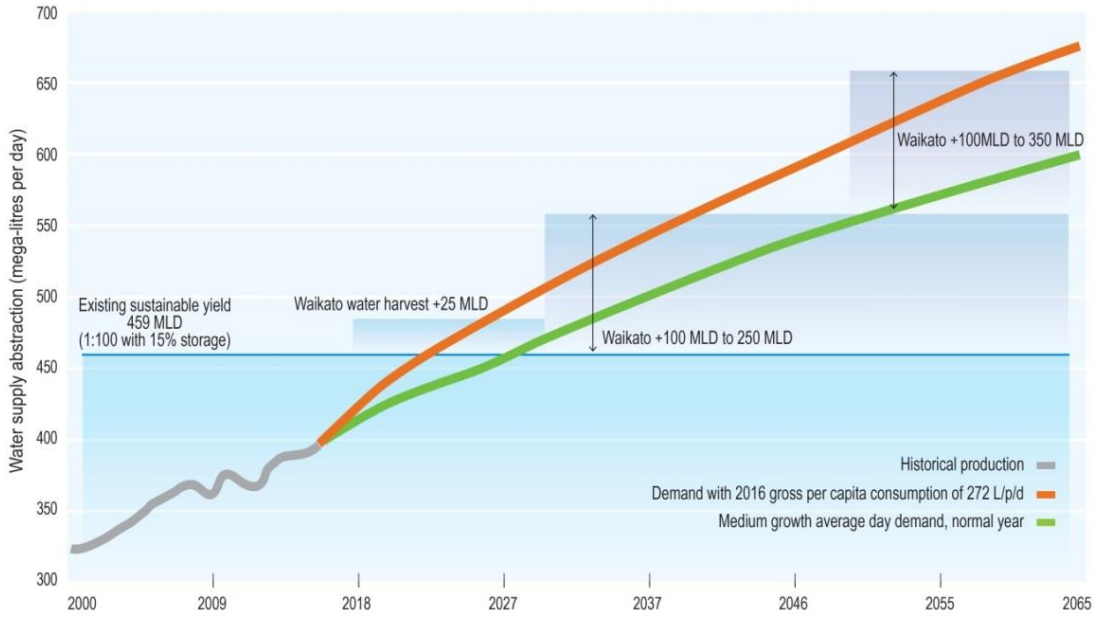


Figure 13 also shows our expected new and augmented water sources and the volumes expected to be required to service this future demand.

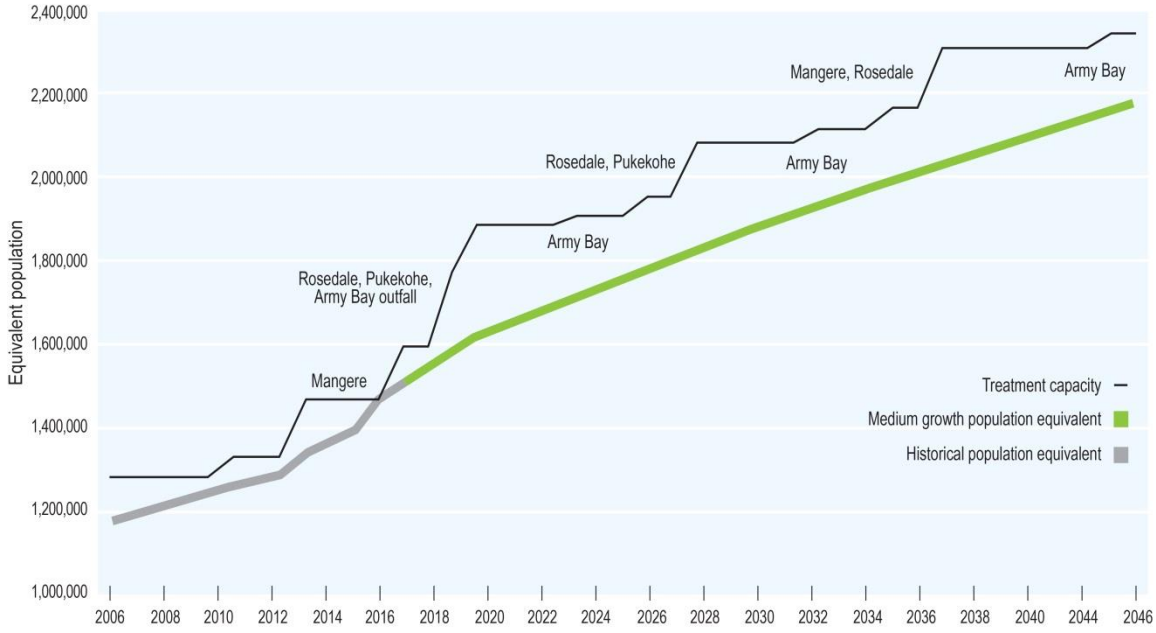
The gross per capita wastewater flow is currently 291L/p/d averaged across the region. This figure is based on the annual volume of wastewater treated at the treatment plants throughout the region. It includes wet weather flows largely unrelated to population growth. These wet-weather flows happen when rainwater and groundwater enter our wastewater pipes. This is called I&I. See section **6.1.11 Inflow and infiltration control.**

To make the best use of our existing assets and defer capital expenditure, we will be removing as much stormwater and groundwater from our networks as possible. We are actively working with Auckland Council to achieve this.

Demand management initiatives are being implemented to reduce the per capita water consumption. As dry-weather wastewater flows are related to water consumption, the gross per capita wastewater production is also expected to reduce. However, wet-weather flows are affected by, but indirectly related to, population – so any increasing volumes of stormwater entering the wastewater system in the combined and soakage areas will erode this benefit.

Based on our water management initiatives, and their expected effect on the region's wastewater production, we have programmed upgrades at our four main wastewater treatment plants (Māngere, Rosedale, Army Bay and Pukekohe). The upgrades are shown below in Figure 14. The first step-change relates to a major project at Māngere that was completed in early 2018. Further work is being carried out at our Rosedale, Pukekohe and Army Bay plants in the first three years of the AMP.

Figure 14: Wastewater treatment plant capacity augmentation



Resilience and asset performance

Our customers expect water and wastewater services to be available 24/7. To provide this, our services must be reliable and resilient to changing conditions. Resilience in terms of water and wastewater infrastructure is generally interpreted as the ability of the systems to recover from difficulties quickly and easily, or the ability of the assets to maintain their service capability over a wide range of operating conditions.

For us, this means keeping service interruptions to a minimum year-round.

Overall, our water network has a high degree of resilience, allowing customers largely unrestricted access to safe drinking water throughout the year. There are multiple sources of raw water, connected to multiple treatment facilities located across Auckland. The water network is highly connected, with several ways of moving large volumes of water around the region to a number of storage reservoirs serving local demand. Local water pipes serving individual customers are also highly interconnected, limiting the numbers of customers who might experience service interruptions.

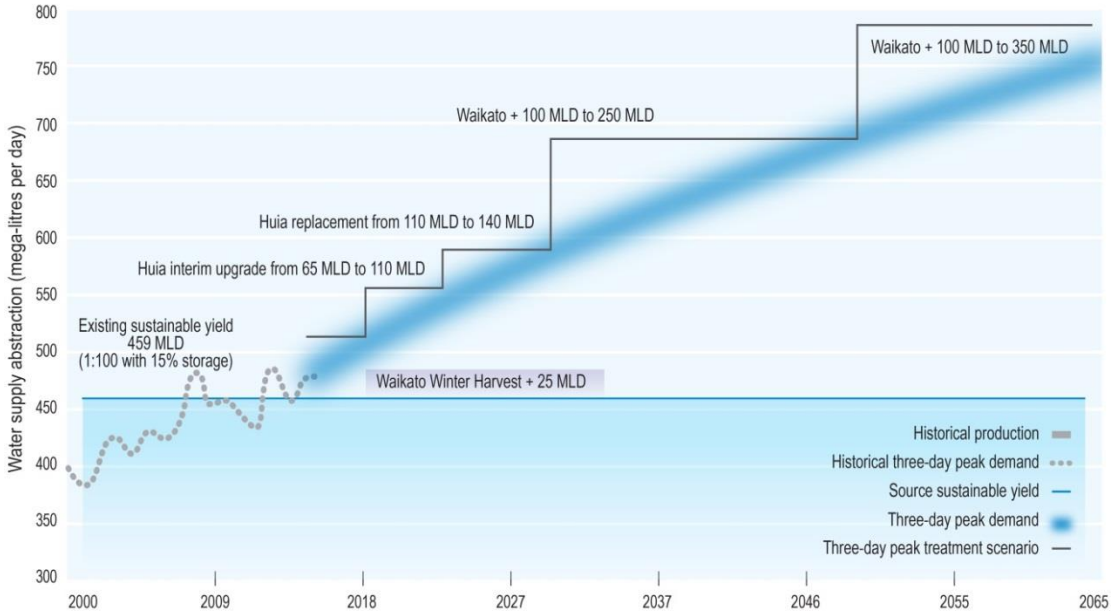
Two of our key resilience measures are our three-day peak demand and our average daily treated water storage volumes.

Our water treatment plants and reservoirs have a designed capacity to let us meet peak-day demands, not just average demands.

The three-day peak demand is the average demand observed over the highest-use three-day period in a year, generally during summer. The three-day peak requires a more sustained high performance from the water treatment plants and treated water storage network. It is a general measure for how much water must be treated over the three days and how quickly the water stored in our reservoirs will be used.

The three-day peak treatment augmentation scenario shown in **Figure 15** (black line) assumes a scenario of an algal bloom affecting our western and southern dams and a one-hour power outage affecting our Waikato Water Treatment Plant. This would limit production at four major treatment plants: Ardmore, Huia, Waitākere and Waikato.

Figure 15: Water supply three-day peak capacity augmentation



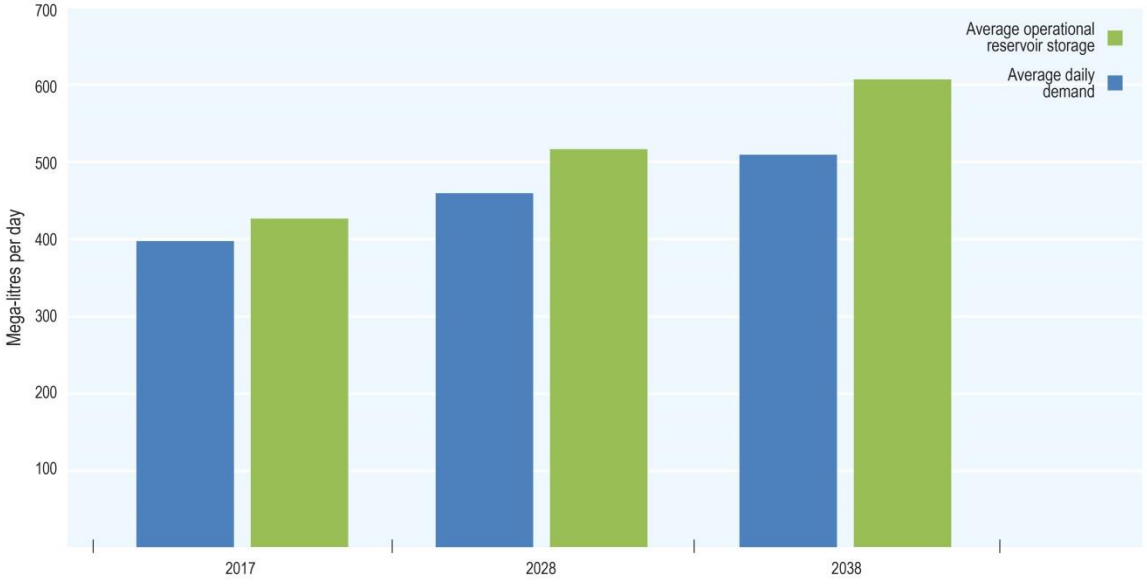
The metropolitan three-day peak demand is currently about 480 MLD and is projected to increase to 630 MLD by 2038 (blue line on the augmentation graph).

For our storage reservoirs, the Ministry of Health's grading process requires us to have at least 24-hour treated water storage as an operational contingency to supply disruption in any specific water supply zone.

Our current average day storage demand is around 400ML and is programmed to increase to about 460ML and 510ML, by 2028 and 2038 respectively.

The average day treated water storage graphs in **Figure 16** show that our 24-hour storage is maintained for the overall system. Planned additional treated water storage in the next 20-year period will increase the available storage buffer and will focus on the strategic shortfalls within the south and north-west of the region.

Figure 16: Treated water storage



However, there is a reliance on the Ardmore Water Treatment Plant, which typically treats between 60% and 70% of all of Auckland's water. During the Tasman Tempest in March 2017, turbidity of the raw water at our Hūnua dams increased. This reduced production at the Ardmore plant and in turn reduced the total water volumes that could be delivered to our customers. Aucklanders were asked to play their part and voluntarily reduce daily consumption, so that further restrictions did not have to be considered. Process improvements are being implemented as a result of the Tasman Tempest to manage our sources and supply if similar events reoccur.

Watercare's wastewater network is resilient also, largely due to the type of network it is. Wastewater flows are collected from houses and commercial premises, and transferred through a gravity pipe network to single points of treatment. Wastewater pipes are progressively larger in size as they approach the treatment plant.

The capacity of wastewater networks is generally identified by the instantaneous hydraulic capacity, measured in litres per second (L/s). When the flow rate increases instantaneously – for example, during periods of heavy rain – the network will overflow if the volume exceeds the capacity of the pipes. Our focus is on understanding what causes overflows and reducing their likelihood and impact. Our wastewater networks are designed for resilience. The pipes are sized for an ultimate expected population, based on the current planning rules, and allow for some deterioration, and subsequent infiltration eroding capacity, as they age. This means there is normally significant capacity at the start of their lives, which reaches its maximum over time as growth occurs and the pipes age.

Our pump stations are designed to cope with wet-weather flows and store wastewater during significant events like power outages. However, they may not always be adequate to handle flows during extreme-weather or other events. In these situations, the wastewater network is designed to overflow into the environment at EOPs to minimise impacts on public health and well-being.

Our wastewater networks are not interconnected. For example, if there was an issue at Māngere Wastewater Treatment Plant, wastewater could not be conveyed to the Rosedale plant for processing. Therefore, we achieve resilience at each plant by duplicating processes and/or by providing additional capacity alternative processes. Some processes can be bypassed while maintaining high treatment standards.

Level of service (regulatory)

Our customers expect safe, reliable service at a reasonable cost over time, and they expect us to care for our natural environment.

Legislation governs where and how our water and wastewater services are delivered. From time to time, we need to adjust our business practices to account for changing legislative or consenting requirements.

Our obligations to provide these services for Auckland are set out in Part 5 section 57(1) of the Local Government (Auckland Council) Act 2009. The Act requires, among other things, that we, as an Auckland water organisation:

a) must manage our operations efficiently with a view to keeping the overall costs of water supply and wastewater services to its customers (collectively) at the minimum levels consistent with the effective conduct of its undertakings and the maintenance of the long-term integrity of its assets; and
b) must not pay any dividend or distribute any surplus in any way, directly or indirectly, to any owner or shareholder; and
c) is not required to comply with section 68(b) of the Local Government Act 2002; and
d) must have regard for public safety (for example, the safety of children in urban areas) in relation to our structures.

In addition, legislation prescribes how the water and wastewater networks are managed, to ensure that public health and the environment is protected.

Table 5 lists the Acts of Parliament that affect the delivery of the water and wastewater services and provides a summary of the specific requirements under these Acts.

Table 5: Legislative requirements

Legislation	Requirement
Local Government Act 2002	• Obligation to maintain public water services, unless that service supplies water to 200 or fewer persons. • Obligation for council to adopt a significant policy setting out (among other requirements) a list of assets council considers to be 'strategic assets'. Strategic assets are those assets vital for delivery of council's services to the community. Therefore, council has determined the water and wastewater schemes to be 'strategic assets'. • Undertake assessments of water and sanitary services • Not use the water services assets as security, or divest ownership to a non-local government organisation, lose control of, sell, or otherwise dispose of the significant infrastructure for providing water services • Not restrict or stop water supply to a property unless all criteria under the Act are met
Local Government Act 1974	• Obligation to provide fire hydrants in the public water supply networks
Local Government (Auckland Council) Act 2009	• Local activities must be identified in the Long Term Plan (LTP) • Manage water and wastewater operations efficiently to keep costs to customers at a minimum while maintaining effective management and maintenance of the long-term integrity of its assets • Must not pay any dividend or distribute any surplus in any way, directly or indirectly, to any owner or shareholder • Give written notice for road opening (unless for emergency work) • Must have regard for public safety in relation to its structures
Health Act 1956	• Improve, promote and protect public health • Provide adequate supply and monitoring
Health and Safety at Work Act 2015	• The main purpose of this Act is to provide for a balanced framework to secure the health and safety of workers and workplaces
Health (Drinking Water) Amendment Act 2007	• Develop and implement Water Safety Plans • Take all practicable steps to comply with the Drinking Water Standards for New Zealand
Building Act 1991	• Enforce the provisions of the Building Code in relation to safe and adequate water supplies
Resource Management Act 1991	• Promote sustainable management of natural and physical resources • That the taking of water and the discharge of wastewater to the natural environment are undertaken in compliance with resource consent conditions

Legislation	Requirement
Civil Defence Emergency Management Act 2002	• Requires lifeline utilities to ensure they are able to function to the fullest possible extent, and have plans in place, to cope during an emergency • Participate in/provide information for Civil Defence Emergency Management strategy and plans

The Resource Management Act 1991 promotes the sustainable management of the environment. Resource consents are a legislative requirement for activities that may have an impact on the environment.

Our business activities are intrinsically linked to the natural environment. Water sources must have sufficient volume and reliability to provide water for Auckland and they must be protected from overuse. For the wastewater system, receiving environments must have the capacity to accept treated wastewater discharges without adverse effects, and wastewater discharges from the network must be minimised. Where possible, we work to improve the quality of the receiving environment. Integrating environmental considerations into everything we do is key to our role as a trusted iwi partner and community organisation. We need to keep our harbours, estuaries and freshwater ecosystems healthy so Aucklanders can continue to enjoy a safe, clean environment.

Protection and enhancement of the natural environment manifests itself in a regulatory framework. Meeting our legal and regulatory obligations are baseline requirements for our organisation. Our assets are subject to a large number of consent conditions, and we are committed to complying with regulatory conditions at all times.

Resource consents have specific conditions associated with the consented activity, including operational, monitoring and compliance reporting requirements.

As a water and wastewater service provider, we have a number of resource consents associated with:

- Water abstraction from a source for the purposes of potable water supply
- Discharges from water and wastewater treatment plants
- Discharges from water and wastewater networks
- Infrastructure construction activities.

We use a consent management system to monitor the performance of our water and wastewater systems to make sure we comply with the conditions of our consents. Before each consent expires we re-examine the need for the consent and the abstraction or discharge is assessed against the planned growth for the region to be serviced. Our consents are renewed as needed and in consultation with any affected customers.

The assessment of options for resource consents consider the cultural, social, environmental, technological and cost implications to determine our preferred outcome. Typically we seek a

consent period of 35 years to give us enough certainty to carry out our long-term planning and to support the associated financial investment decisions.

Through the consenting process and the corresponding consultation involved, we can assess community expectations and adjust decisions to better align with these expectations. This process also enables us to plan for similar expectations in any future consents. This may impact on our future operations and maintenance procedures, capital upgrade projects, cost profiles and price path outcomes.

To allow for this, we have agreed on an adaptive management approach to our Network Discharge Consent (NDC). This consent enables us to define network improvement projects in six-yearly stages, prioritising the most frequent overflows and those in private property. We are required to submit a report to council every six years that describes improvements we propose, those carried out, and the improvements we will implement in the following six-year period. Deviations from the plan are also discussed and receiving environment impacts assessed. Changes to the receiving environment classification can be accounted for, and improvements reprioritised as required. In a similar way, changes to growth areas can be allowed for.

6. Operations and maintenance strategies

Our water and wastewater systems are operated to ensure that our customers receive the expected levels of service and to make sure that we comply with regulatory and resource consent conditions in a cost-effective manner.

Outside of depreciation, our main operating costs for both water and wastewater systems are energy (power and gas), chemicals and maintenance. We have developed our operational strategies to minimise these costs and maximise value for our customers.

We have ambitious targets to reduce our carbon footprint. We work to minimise the impact of our activities and contribute to the restoration of Auckland's environment. From recycling and composting our office waste, to reusing biosolids and restoring habitats, we work hard to enhance nature and protect biodiversity. We are looking at our treatment plants, wastewater plants in particular, as resource recovery plants. For example, biosolids are a product of the nutrient-rich, organic sludge produced when we treat wastewater. We are exploring opportunities around extracting valuable end products from the biosolids, creating bio-polymers, safe-to-use compost and phosphorus-rich fertilisers.

We are also looking at ways to recycle wastewater at our sites, for both drinking and non-drinking water purposes. Currently, the volume of treated effluent reused at Māngere and Rosedale treatment plants is around 34MLD. This is the equivalent of the water used by over 130,000 Aucklanders.

In addition, we partner with local organisations to:

- Promote awareness about water and wastewater

- Sponsor Waikato RiverCare, which undertakes riparian restoration on the lower Waikato River preparing, planting and maintaining areas of native plant habitat
- Sponsor the Harbour Clean-up Trust, which removes litter from Auckland's harbours and inner-gulf islands
- Sponsor the Trees for Survival programme, which involves young people growing and planting native trees to restore natural habitats by helping landowners to revegetate erosion-prone land, improve stream flow and water quality, and increase biodiversity
- Help customers who are struggling to manage their water costs, through the Water Utility Consumer Assistance Trust
- Offer free lessons to teach children about water and their local environment with the Watercare education programme
- Restore former forestry planting with native trees within our water source catchments.

There are several differences in the operational strategies between water and wastewater services.

Water supply

The water sources are operated to make sure that the water we supply to customers in Auckland is safe to drink and makes best use of our water sources, treatment plants, reservoir storage and pump stations to:

- Maintain compliance with the Drinking Water Standards for New Zealand (DWSNZ) and 'Aa' grading from the Ministry of Health
- Optimise the abstraction of water from the water sources in accordance with the resource consents and provide water compensation flows back to rivers and streams to comply with environmental consents
- Maximise the efficient use of available water resources
- Maximise the use of gravity water sources
- Use the highest-quality water sources to minimise chemical costs
- Operate our water network to minimise energy use costs
- Manage peak loads to make sure peak demand does not happen at the same time across the region
- Maximise hydro-generation potential at our dams.

Wastewater

Our wastewater operating costs are considerably greater than our water supply operating costs. Wastewater conveyance and treatment costs are affected by the entry of stormwater or groundwater into the networks, as the increased volumes result in increased pumping and treatment (power and chemicals) costs. In the event that overflows occur from our wastewater network, increased volumes lead to more expensive clean-up costs.

Chemical use is a significant cost in wastewater treatment. To minimise this expense, we make sure that our treatment processes work in the most efficient way possible. As well as chemical use in treatment plants, there has been an increasing need for chemicals in the network itself to control hydrogen sulphide (H_2S) odour issues. Odour is a particular nuisance in areas that are relatively remote, when the wastewater sits in the pipes for a long time. Examples of this

include the satellite systems of Kumeu-Huapai, where the pipe lengths are long and the wastewater flow rates are still low. As a result, our operating costs for this part of the wastewater network are higher while revenue is lower – due to fewer-than-planned connections.

The operational activities for the water and wastewater systems are summarised below, in Table 6.

Table 6: Operational activities

Asset group	Operational activities	Standards and specifications
Water sources and treatment plants	Water abstraction rates monitored through telemetry	Resource consent conditions
	Water quality monitoring	• DWSNZ • Watercare's water safety plan
	Process monitoring to allow optimisation of processes and cost minimisation	
	Treatment plant operation	Standard operating procedures
Water networks	Reducing non-revenue water • Leak detection • Minimum night-flow analysis • Create smaller district metered areas • Meter replacement programme • Pressure management	
	Water quality monitoring	DWSNZ
	Flushing	In accordance with flushing programmes and operating manuals
	Backflow prevention auditing	AS2845.1:2010 Water New Zealand Backflow Group – Backflow Code of Practice for Water Suppliers
Wastewater treatment plants	Receiving environment monitoring	Resource consent conditions
	Resource consent conditions	Monitoring of wastewater discharge

Asset group	Operational activities	Standards and specifications
	Discharge monitoring	Resource consent conditions
	Process monitoring to allow optimisation of processes and cost minimisation	
	Treatment plant operation	Standard operating procedures
Wastewater networks	Overflow monitoring (via telemetry) of pump stations and designated manholes	Resource consent conditions
	Response to and clean up of wastewater overflows	Agreed levels of service
	Reducing wastewater overflows from illegal connections	Inflow and infiltration investigation
	Trade-waste monitoring	Inspections at trade-waste customer properties

6.1. Operational programmes and initiatives

Some of our operational programmes and initiatives to improve efficiency include:

6.1.1. Water supply pressure, flow and water source levels monitoring

This includes remote and manual monitoring of bulk meters and flow meters for billing, network analysis and modelling, operations and leak detection. Pump stations, reservoirs and treatment plants are alarm-monitored for low/high pressure and water levels, faults, power failures and water quality deterioration. The system enables remote control of pumps based on reservoir levels. Rainfall stations, dam-level recorders and in-stream weirs record water levels for use in dam safety surveillance, consent compliance reporting, headworks operation and drought security analysis.

6.1.2. Water supply interruption management

During unplanned outages, customers are supplied with bottled water or water from our 'Oasis' trailers or water tankers. Customers are notified in advance, where possible, of planned water supply shutdowns.

6.1.3. Water source management

We operate our water sources to ensure compliance with consent conditions (regarding allowable volumes of water takes), to optimise the use of energy by minimising pumping and water treatment costs and maximising hydro-generation potential, and to provide volumes within the capacity limitations of the treatment plants, pipelines and pump stations.

We also manage our water sources to minimise the effects our operations have on the environment. Our lakes are kept full during winter, and we use the Waikato River source when

it is in full winter-flow conditions. In summer, when the river levels fall, we use more water from our dam sources.

In addition, we manage our dams according to their characteristics. The Hūnua dams are of a large-capacity type, with relatively small catchments. They fill slowly, but sustain use for longer. The Waitākere dams are the opposite, with small capacities and large catchments, filling quickly, but unable to sustain prolonged use. We actively manage the dams to make best use of these characteristics.

6.1.4. Pressure management

Pressure management across our water supply zones ensures that our water networks work within minimum and maximum water pressures to protect the network and reduce leakage. Pressure management initiatives will be further considered as part of our demand management and leak reduction programmes.

6.1.5. Water quality management

We carry out planned and routine sampling - using portable instrument panels - and testing throughout the region in accordance with the DWSNZ. Reactive water quality tests and flushing are carried out in response to customer water quality complaints. Routine flushing is undertaken in areas where we know repeat problems are likely to occur.

6.1.6. Backflow prevention

All of our commercial and industrial customers have to have a certified backflow prevention device installed at the boundary of the property, to prevent contaminants entering the public network from private connections. We carry out a monitoring and enforcement role for these devices, to meet the requirements of the DWSNZ.

6.1.7. Leak detection and management

Real-time monitoring and telemetry devices are used to monitor night-time flows to detect when abnormal flows occur in a water supply zone. The telemetry also triggers alarms if the monitoring suggests variances from expectations. The monitoring and telemetry devices are used in our transmission watermain and chamber inspection programmes, as well as during our reactive inspections.

Water leaks are a primary cause of non-revenue water or water losses. The management of non-revenue water volumes is a key focus for us, as significant water loss would require us to invest in new water supply capacity earlier than otherwise would be necessary.

6.1.8. Water meter management

Commercial water meters are monitored (some remotely) and replaced proactively, based on age and consumption. Domestic water meters are replaced when they fail or when they reach 20 years.

We installed smart meters in Waiuku in 2016 to better understand and rectify the high volume of water loss in that area. The data from the smart meters will help to identify leaks and provide information about usage patterns.

The Waiuku trial was undertaken with only one smart device and one method of communication. Watercare is working towards identifying the cost / benefit of using smart meters but does not have that information currently. While the purpose of the trial was not to test that particular technology it has highlighted some important cost considerations. For example a mechanical meter has the life span of 20 years whereas a smart device (depending on the product, the communication method and the speed of technology change) can last from two to ten years. As well as the cost of the equipment, labour cost also needs to be considered. The management of smart devices is also more demanding of staff time from installation to ongoing operations and maintenance. They are not an install it and leave it device. When comparing the cost of billing via manual reads to smart data the cost of audits and estimations due to devices being off-line needs to be considered.

A separate trial has been proposed to test the value of smart meters with 100 commercial customers. At the completion of the trial we will assess the smart meter cost / benefit.

6.1.9. Wastewater flow monitoring and control

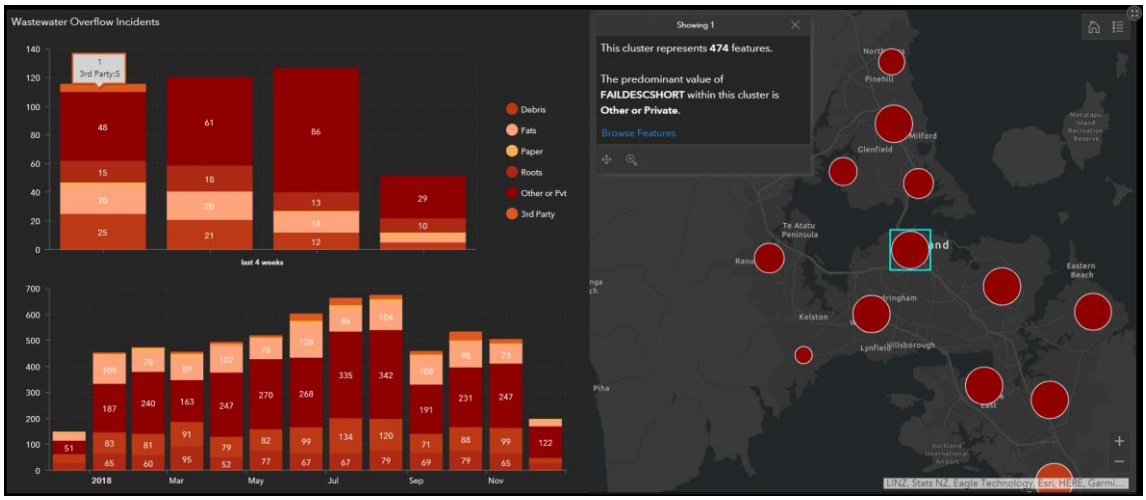
Our wastewater pump stations are continuously monitored for pump run-times, flows, wet-well levels, storage operation and overflow activation. Monitoring allows for pumping rates to be adjusted according to downstream conditions and enables us to use the storage to minimise issues. It also allows us to respond as quickly as possible to potential overflow incidents and to facilitate clean-up if needed.

6.1.10. Wastewater overflow management

Overflows are caused by stormwater and groundwater entering our wastewater pipes thus reducing their capacity for wastewater, blockages (caused by fat build-up or root intrusion) or collapses, or breaks in the pipes from third-party damage. We use a number of methods to avoid and minimise overflows, including I&I detection and education campaigns, regular pipe flushing, enzymes to reduce fat accumulation, strict trade-waste management and monitoring, network enhancements and investigation of repeated blockages.

We are able to monitor where overflows have occurred and what their causes are. The screenshot in **Figure 17** shows, on the left, the number of overflow incidents over time and their cause. On the right, each dot represents a number of events. Drilling down on a dot takes you to individual events. Armed with this information we are better able to target remedial programmes and customer communications.

Figure 17: Location of overflows and their causes



6.1.11. Inflow and infiltration control

Auckland has sewer networks in some of the earliest established suburbs on the isthmus where a single pipe network transfers both stormwater and wastewater. This is known as the combined network. Whilst the combined network has the advantage of requiring only one pipe to convey both stormwater and wastewater; it has only a limited capacity to convey storm flows and as such it regularly overflows during rainfall events. To ensure that these overflows occur in a controlled manner, rather than occurring in private homes or on private properties, dedicated engineered overflow structures were constructed at points along the network so that during rainfall events, the excess flow could be safely discharged to the local receiving environment and prevent surface flooding.

Modern wastewater systems are designed to separate wastewater flows from stormwater flows by providing separate pipe networks. However, we should expect low levels of stormwater or groundwater ingress (I&I) into the wastewater pipe system. I&I into the separate sewer network can result in wet weather overflows when the hydraulic capacity of the asset is exceeded. The additional stormwater can increase flows to an extent where the capacity of the network is no longer sufficient. This can result in excess flows which need to be discharged to the environment during significant rain events to prevent backup of wastewater in the system and overflows in houses and on private property. Such discharges normally occur at specially constructed EOPs which are designed to overflow in a controlled way into a receiving environment, however they can also discharge unintentionally to land, either public land or private property.

During wet weather periods a sewer network may receive higher levels of inflow into the system through the following mechanisms:

Inflow which is the direct entry of stormwater into private drains (private drains are private pipes that convey wastewater from buildings to the public wastewater system), either through

a downpipe from the roof connected to the gully trap, or a low gully trap that allows water from the hard stand to flow into it.

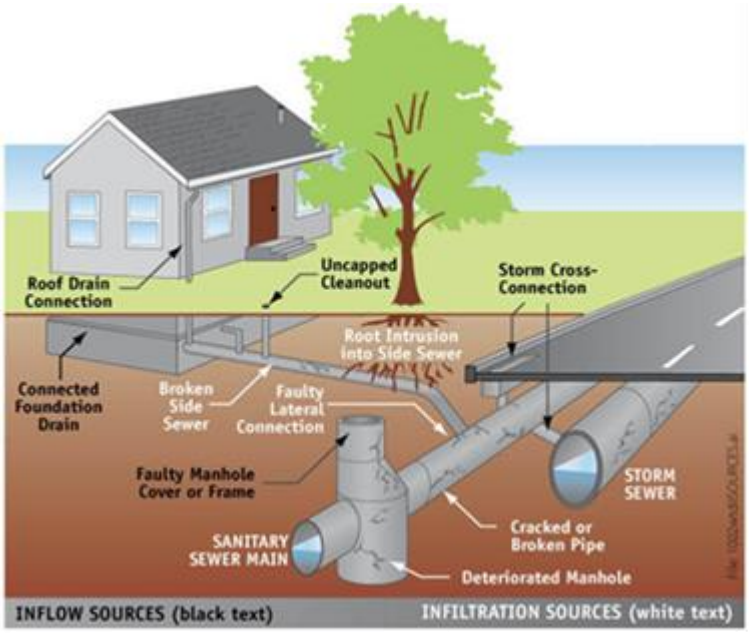
Infiltration refers to the water (groundwater) that enters the wastewater pipe system through cracks, joints, broken or poorly constructed pipes. This occurs in both public and private wastewater pipes.

The extent of I&I usually depends on the location and age of the pipes, the pipe material used and the ground conditions.

Experience within Auckland has shown that between 50-60% of I&I comes from private sewers (also known as "laterals"), and that correcting these defects is necessary to achieve a reduction in wet weather flows through the implementation of an I&I programme.

Figure 18 below shows the sources of inflow and infiltration.

Figure 18 : Sources of Inflow and Infiltration



For separate sewer networks, a dedicated network improvements and I&I, team has been set-up to proactively remove stormwater and improve network performance.

The reactive I&I programme targets wet weather overflows which cause operational issues that need to be addressed urgently. It targets illegal connections and low lying gully traps. That is, sources of direct inflow which able to be rapidly and inexpensively identified and remedied.

The planned I&I programme follows a more detailed catchment investigation and analysis and involves the identification of all private defects (both above ground and private drains) and also a full investigation and rehabilitation of the public network and manholes.

For I&I control through the removal of stormwater runoff in combined sewer networks, we are building on our foundation programmes of work. These include the Central Interceptor and Newmarket Gully projects which will provide additional wastewater transmission capacity to alleviate the high frequency combined sewer overflow (CSO) discharges. A complimentary programme of work called the Western Isthmus Water Quality Improvement Programme (WIWQIP), was approved as part of Auckland Council's 2018-2028 Long-term Plan process. Watercare and Auckland Council's Healthy Waters are developing catchment specific improvement programmes to:

- provide new stormwater enhancements to enable separation and local catchment augmentation
- alleviate local catchment uncontrolled discharges
- optimising the benefits of the wastewater transmission solutions to meet growth needs
- achieve discharge consent targets

Our priority over the next 10 years will be to undertake wastewater catchment improvement works in Westmere, Avondale, Freemans Bay, Grey Lynn, Herne Bay, Meola, Motions, Oakley, Pt Chevalier, St Marys Bay and Waterview in association with Auckland Council, Healthy Waters. The location of these catchments are shown in **Figure 19.**

The implementation of all I&I programmes aim to reduce peak wet weather flows and volumes. In some cases this can lead to the deferral / reduction of capital expenditure for network and treatment plant assets. It also has an effect on the prioritisation of asset renewals programmes.

The I&I programmes can also result in the following benefits:

- Improved customer perception and environmental outcomes resulting from a reduction in wet weather overflows.
- Reduction in operational expenditure.
- Improved Wastewater Treatment Plant compliance.
- Compliance with Network Discharge Consent.

In conjunction with our I&I programmes, customer education and communications have raised awareness of the effects of stormwater on the wastewater network (and ultimately, their environment) along with awareness that incorrect or faulty private drainage contributes to this.

Figure 19 : Western Isthmus water quality programme

6.2. Maintenance planning

Our maintenance planning is centred on delivering sustainable, cost-effective, reliable asset performance to ensure the delivery of water and wastewater services to our customers in the Auckland and northern Waikato regions.

Our maintenance is programmed in two ways:

- General maintenance, which covers day-to-day planned and minor unplanned maintenance required to keep the treatment plants and network operational
- Rehabilitative maintenance of items that reach the end of their economic lives.

We prioritise our maintenance schedules based on reliability-centred maintenance (RCM) principles. RCM is focused on a risk profile developed largely from analysis of previous failures and factors such as equipment age, repair time and availability of spares. The RCM approach is applied to our most critical assets, normally associated with our treatment plants and transmission networks.

For non-critical assets, an 'unplanned' maintenance approach is used where they are repaired or replaced when they fail. We monitor planned and unplanned maintenance activities to achieve a lowest whole-of-life-cost maintenance strategy.

Table 7 lists the planned and unplanned maintenance activities for our water and wastewater services.

Table 7: Maintenance activities

Asset group	Maintenance activities	Standards and specifications
Planned maintenance		
Water networks	Meter testing	Manufacturer's specifications
	Valve and hydrant inspections	Operated to identify maintenance needs
	Pump station and reservoir inspections	Bulk network – RCM-based programme logged in asset management system Local networks – routine pump/electrical testing to manufacturer's specifications
	Pipe and structural condition surveys	Planned programmes
Wastewater networks	Sewer cleaning and siphon flushing	Planned programmes
	Pipeline closed-circuit television (CCTV) inspections	Planned programmes
	Inflow and infiltration testing	Flow model calibration Planned programmes for inspections of properties
	Critical asset inspections (pipe bridges, suspended sewers, control valves, outfalls, siphons)	Planned inspection programmes
All pump stations and treatment plants	Planned preventative maintenance programmes	Bulk network – RCM-based programme logged in the asset management system Local networks – routine inspections/cleaning

Asset group	Maintenance activities	Standards and specifications
	Pump overhauls and electrical testing	Manufacturer's specifications
	Safety inspections of lifting beams and backflow preventers	Manufacturer's specifications
Unplanned maintenance		
Water network asset	Repair broken mains/pipes	Reactive maintenance is carried out in accordance with the key performance indicators (KPIs) set in the maintenance contracts
	Repair/replace broken/under-reading meters	
	Repair/replace leaking valves and hydrants	
	Flushing in response to water quality complaints or identified problems	
Wastewater network assets	Repair broken pipes and blockages	
Treatment plants/ reservoirs/pump stations	Repair plant/equipment failures	Manufacturer's specifications

6.3. Condition and performance assessment programmes

Condition assessment practices have been developed to assist with renewals planning and are described in Table 8.

Table 8: Condition assessment practices

Asset group	Condition assessment practices
Water system	
Water supply dams	• Annual investigation and inspection of each dam to report on its safety performance • Five-yearly independent dam safety assurance audit to evaluate dam condition • Routine monitoring and assessment to ensure dam condition is maintained
Water treatment plants	• Visual inspections by on-site operators • Detailed, scheduled condition inspections by the maintenance team
Treated water reservoirs	• Findings of visual inspections, conducted by operations and maintenance personnel, trigger in-depth condition assessments, such as structural assessments

Asset group	Condition assessment practices
Water pump stations	• Regular routine inspections (in conjunction with maintenance work) • Vibration monitoring, thermography and leak detection testing to determine likely failure of bearings in motors and pump units • Monitoring of motor insulation to ensure integrity and detect evidence of potential early failure • Testing of pump station efficiency, in terms of actual pump rate compared to design pump rate • Annual inspection of all lifting beams and gantry cranes to check the integrity of the fixing bolts, supports, wire ropes and chains to comply with statutory requirements
Water transmission pipes	• Pipe sample analysis (pipe samples are cut when the pipe is exposed during maintenance or repairs) • Condition grade assessment by the contractor when maintenance or repairs are undertaken • Analysis of pipe performance (breaks/leaks) to interpret condition • Use of condition assessment technology called JD7 for pressurised watermains while in service
Water network pipes	• Spot inspection and condition grade assessment by maintenance contractor as part of pipe repair • Analysis of pipe performance (breaks/leaks) to interpret condition
Valves and hydrants	• Tested (operated) and maintained at varying intervals • NZ Fire Service hydrant inspections
Wastewater system	
Wastewater treatment plants	• Visual inspections by on-site operators • Detailed, scheduled condition inspections by the maintenance team
Wastewater pump stations	• Regular routine inspections (in conjunction with maintenance work such as wet-well washing to remove fat build-up) • Vibration monitoring, thermography and leak detection testing to determine likely failure of bearings in motors and pump units • Monitoring of motor insulation to ensure integrity and detect evidence of potential early failure • Testing of pump station efficiency, in terms of actual pump rate compared to design pump rate • Annual inspection of all lifting beams and gantry cranes to check the integrity of the fixing bolts, supports, wire ropes and chains to comply with statutory requirements

Asset group	Condition assessment practices
Wastewater transmission pipes	• Scheduled crew inspections • Pipe sample analysis (pipe samples are cut when the pipe is exposed during maintenance or repairs) • Condition grade assessment by the contractor when maintenance or repairs are undertaken • Analysis of pipe performance (breaks/leaks) to interpret condition • Specialist pipe bridge and rising main inspections • CCTV, sonar, laser profiling and walk-through inspections
Wastewater network pipes	• Spot inspection and condition grade assessment by maintenance contractor as part of pipe repair • Analysis of pipe performance (breaks/blockages) to interpret condition • Pipe bridge inspections • CCTV inspections

7. Asset renewal strategy

As infrastructural assets age, we normally see a decline in their performance, sometimes to the point of asset failure. Asset failures can cause service interruptions and may pose a risk to public health and safety. We have developed asset replacement and rehabilitation programmes to monitor the condition and performance of assets in order to estimate the end of their useful economic lives. Asset renewal decisions are based on a risk assessment of the likelihood and consequence of failure, taking into account the asset's age and life expectancy, condition, performance, system resilience and criticality.

7.1. Critical facilities and assets

Our critical facilities and assets are those which cannot be allowed to fail because the consequences of a failure are too high. Criteria to identify which facilities and assets are critical include:

- Health and safety risk
- Number, type and duration of customers affected
- Environmental consequence of the asset failure
- Regulatory, resource consent and drinking water quality compliance
- Size and location of the asset
- Complexity of repair and outage duration.

We have adopted the following approach to the renewal of assets:

- Renewal programmes are developed for critical assets
- Non-critical assets are replaced on failure.

7.1.1. Plant assets

Plant assets include water source assets, treatment plants, pump stations and reservoirs. These are generally accessible assets and have inspections and planned maintenance programmes. The plants have dual process streams to provide redundancy and resilience, where feasible. Mechanical and electrical assets in these facilities have duty and stand-by provision to reduce the criticality of individual assets. Renewal of plant assets are planned based on the observed performance of the assets in operation and as a result of regular inspections.

7.1.2. Transmission assets

The transmission assets convey substantial quantities of water or wastewater across the region. The failure of these assets can have a significant impact on a large number of customers, the environment or on public health and safety. All of our transmission assets are classed as critical assets. They are assessed and scheduled for renewal based on age, condition, performance and risk of failure, on an individual basis.

7.1.3. Local network assets

The local network assets generally comprise smaller-diameter pipes. The impact of these assets failing is typically much lower than a transmission asset failure, due to the limited number of customers affected and reduced environmental or public health and safety impact. Most network assets are considered to be non-critical and are allowed to fail a number of times before they are replaced. The consequence of failures is managed via the maintenance contracts' response KPIs.

A subset of network assets is regarded as critical based on their location and the type of customers serviced. We treat these assets in the same way as our transmission assets.

Condition assessments are carried out when local network pipes are exposed as part of a repair or during operational routines like carrying out a CCTV inspection due to a wastewater pipe blockage or as part of a request to build over the asset.

7.2. Pipe asset age profiles

Pipes make up more than 64% of the gross replacement value of our infrastructure assets. It is important that we have a renewal strategy which addresses the uncertainty surrounding these buried assets.

The charts below - **Figure 20**, **Figure 21** and **Figure 22** - provide an overview of the age class distribution of our pipe assets.

Major development occurred in the 1960s due to the construction of the trunk interceptor system to take wastewater to the new Māngere Wastewater Treatment Plant and following the opening of the Auckland Harbour Bridge and development of the North Shore area. This can be seen in the age and cost profiles shown below.

Figure 20: All Watercare pipe assets

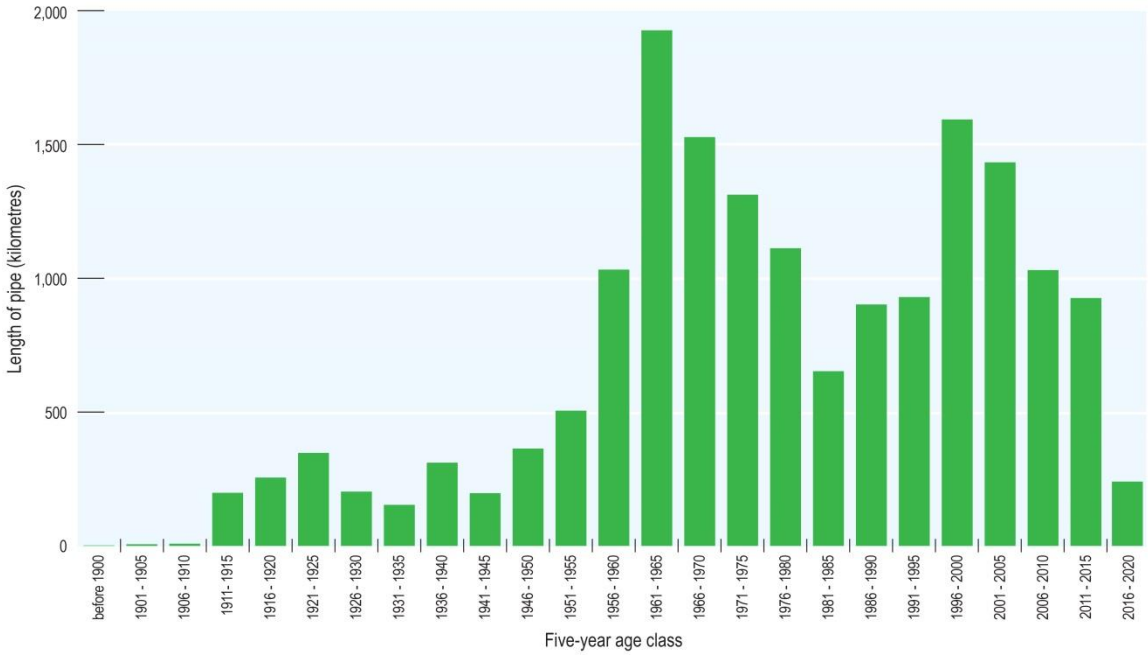


Figure 21: Water and wastewater transmission pipes

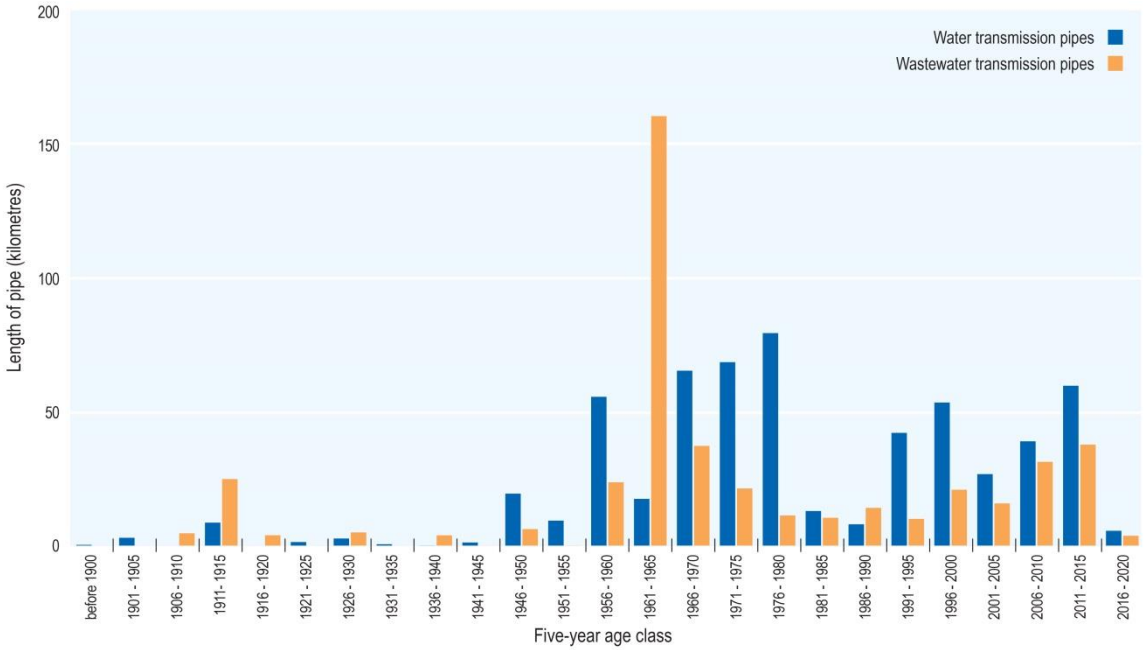
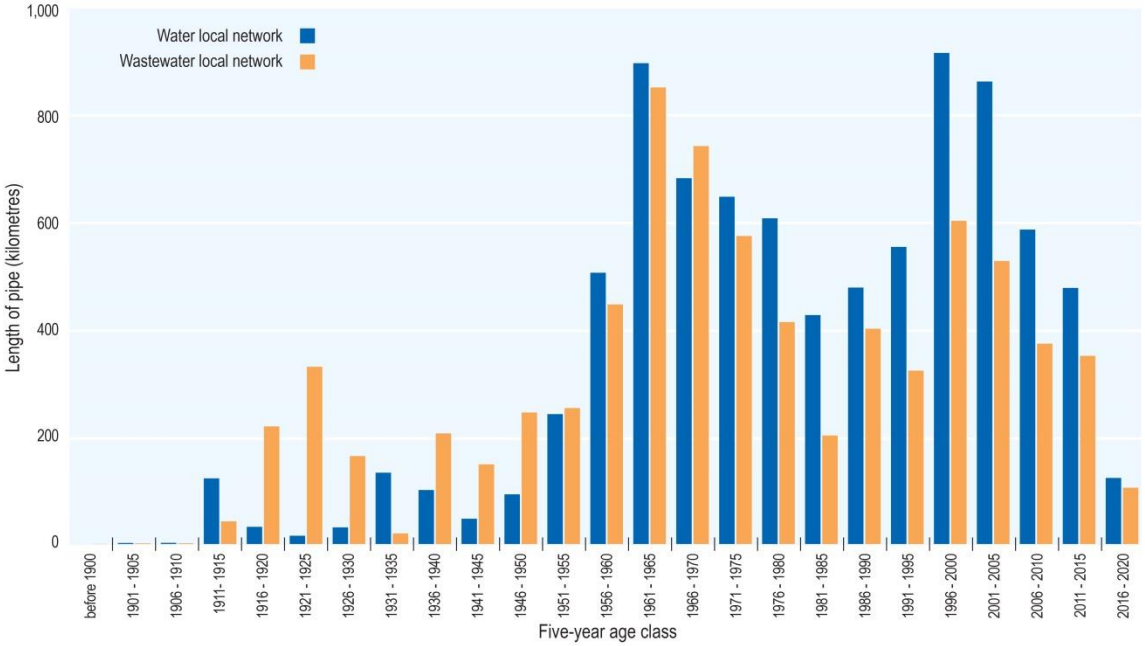


Figure 22: Water and wastewater network pipes



7.3. Asset renewal capital expenditure expectations

Section 10 outlines our current investment expectations for our asset renewals during the next 20 years. The replacement of transmission assets is based on condition assessments, with the frequency of the inspections increasing as each asset deteriorates or its performance declines. For local network assets, which are subject to a 'run-to-failure' philosophy, a probable failure rate is applied based on the diameter, pipe material and expected life. The statistical modelling of local network asset replacements will continue to be refined as further fault analysis and condition assessments are undertaken.

8. Water strategic programmes

Our water asset strategy outlines the significant programmes required to meet Auckland's future growth. These programmes include source augmentation, water treatment upgrades and water transmission initiatives. They have been grouped by geographic area and first and second decades.

8.1. Southern

8.1.1. First decade

Currently between 65% and 75% of Auckland's annual water supply needs come from our southern sources, depending on weather conditions and dam levels. The Waikato River is the preferred source to meet additional water needs during the next 30-plus years. Pumping extra water in the existing Waikato 1 Watermain will increase the volume of water to the Redoubt Road reservoirs, while new treated water reservoirs at Runciman Road (50ML) and Redoubt Road (50ML) will provide strategic storage to buffer daily and peak demands.

8.1.2. Second decade

An increase in the Waikato River take to 200 MLD is required around 2033, to maintain Watercare's security of supply standard. A consent application has been lodged for an additional take and awaits processing by Waikato Regional Council. An associated water treatment plant capacity upgrade to treat 250MLD will meet the projected peak demands and provide system resilience.

Provided that the Waikato Watermain can be boost-pumped to achieve a flow of up to 250MLD to the Redoubt reservoirs (25MLD anticipated to service Franklin), the option exists to either defer or reassess the Waikato 2 Watermain construction, depending on the location of the adjacent metropolitan water source.

Additional treated water reservoirs at Runciman Road (50ML) and Redoubt Road (50ML) will provide further strategic storage to buffer daily and peak demands.

Wastewater treated to drinking water quality will be considered too, as an alternative to increasing the take from the Waikato River.

8.2. North-west

8.2.1. First decade

The ageing Huia Water Treatment Plant will be replaced with a new 140MLD-capacity plant to help meet peak demand and improve the current system resilience. An additional reservoir (50ML) associated with the new Huia plant will be essential to increase the treated water storage for West Auckland. Extra pumping to take water from the south to the west will be required to provide redundancy against a Huia plant outage.

The North Harbour 1 Watermain is currently our only transmission watermain conveying water from the west to the north across the Greenhithe Bridge. The North Harbour 2 Watermain will be an alternative way to service customers in the west and north, as well as provide redundancy and improved transmission capacity.

8.2.2. Second decade

The replacement of the ageing Waitākere Water Treatment Plant and additional treated water storage (25ML) will assist in meeting peak demand periods and improve the system resilience in the western region.

8.3. Central

8.3.1. First decade

The completion of the Hūnua 4 Watermain to the Khyber reservoirs will improve our ability to move water from the southern region to the central region, while providing additional redundancy to the Hūnua 3 Watermain. Reinstatement of the Khyber 2 Reservoir (12.5ML) will increase the strategic storage within the central region.

8.3.2. Second decade

A planned upgrade of Ponsonby reservoirs (13ML) will provide additional resilience to the central business district's (CBD) supply zone.

8.4. North Shore

8.4.1. First decade

Planned boost-pumping of the existing North Shore watermains across the Auckland Harbour Bridge will improve the conveyance of water to the North Shore until the new Waitematā Harbour crossing is available.

The area serviced by the Pinehill Reservoir has a very high local demand. A new transmission watermain connection with boost pumping from Albany reservoirs to Pinehill Reservoir is currently being built to provide additional resilience to this supply zone.

8.4.2. Second decade

A new harbour crossing coinciding with the planned New Zealand Transport Agency (NZTA) Waitematā Harbour crossing will improve the conveyance of water from the central region to North Shore and provide redundancy to the existing North Shore watermains on the Auckland Harbour Bridge. Based on advice from NZTA, this project is now more likely to occur in the third decade.

8.5. Hibiscus Coast

8.5.1. First decade

Increased boost-pumping of the Ōrewa 1 and 2 watermains will allow for growth in the Silverdale, Dairy Flat and Wainui areas.

8.5.2. Second decade

A new Ōrewa watermain will increase transmission capacity to the north and meet the planned growth.

8.6. Non-metropolitan water supplies

8.6.1. Warkworth

A new groundwater source has been consented for 4.3MLD and a new water treatment plant will be constructed at Sanderson Road. This will replace the current Mahurangi River source, which is constrained by minimum flow requirements, particularly during summer. Further water source augmentation is likely to be required within the next 30 years to meet the long-term population growth projections.

8.6.2. Wellsford

Wellsford is currently supplied from the Hoteo River. A potential groundwater source is now under investigation.

8.6.3. Snells/Algies

Snells/Algies is supplied from a groundwater source at present. Further water source augmentation is likely to be required within the next 30 years to meet the long-term population growth projections.

8.6.4. Helensville, Muriwai, Waiuku and Bombay

Source augmentation to service these communities will require further investigation.

Helensville is currently supplied from surface water (Mangakura Dam) and a spring (Sandhills).

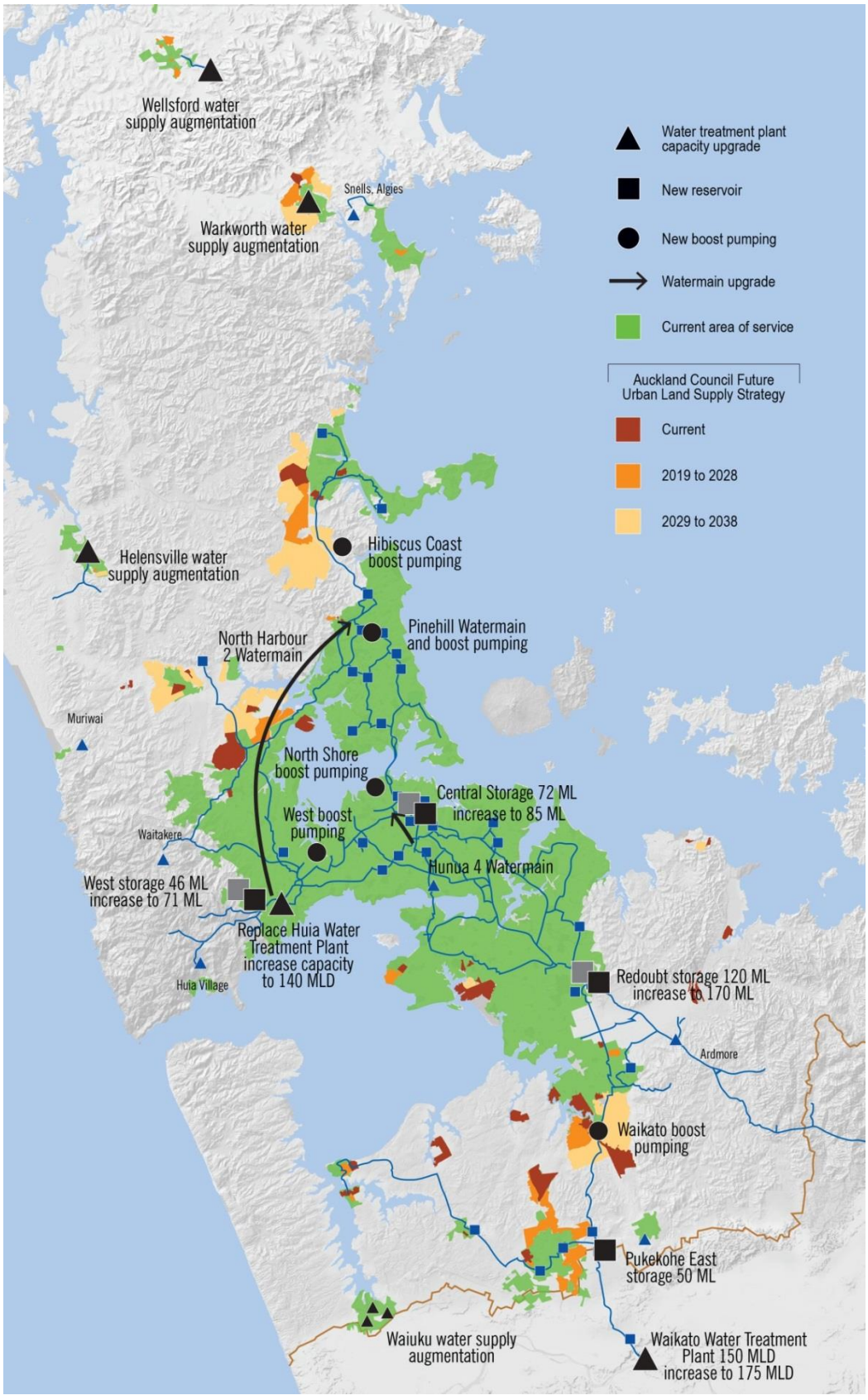
At present, Waiuku is supplied from a groundwater source via three water treatment plants. A new water take consent has recently been granted, and we have investigated the water demand in Waiuku and have implemented a leak reduction scheme to make the best use of the current supply sources.

The Muriwai water take consent expires in 2020. We will be renewing this consent in line with statutory timeframes, allowing for any expected growth in the area.

The Bombay water take consent expires in 2027. We will be renewing this consent in accordance with statutory timeframes, taking into account any expected growth in the area.

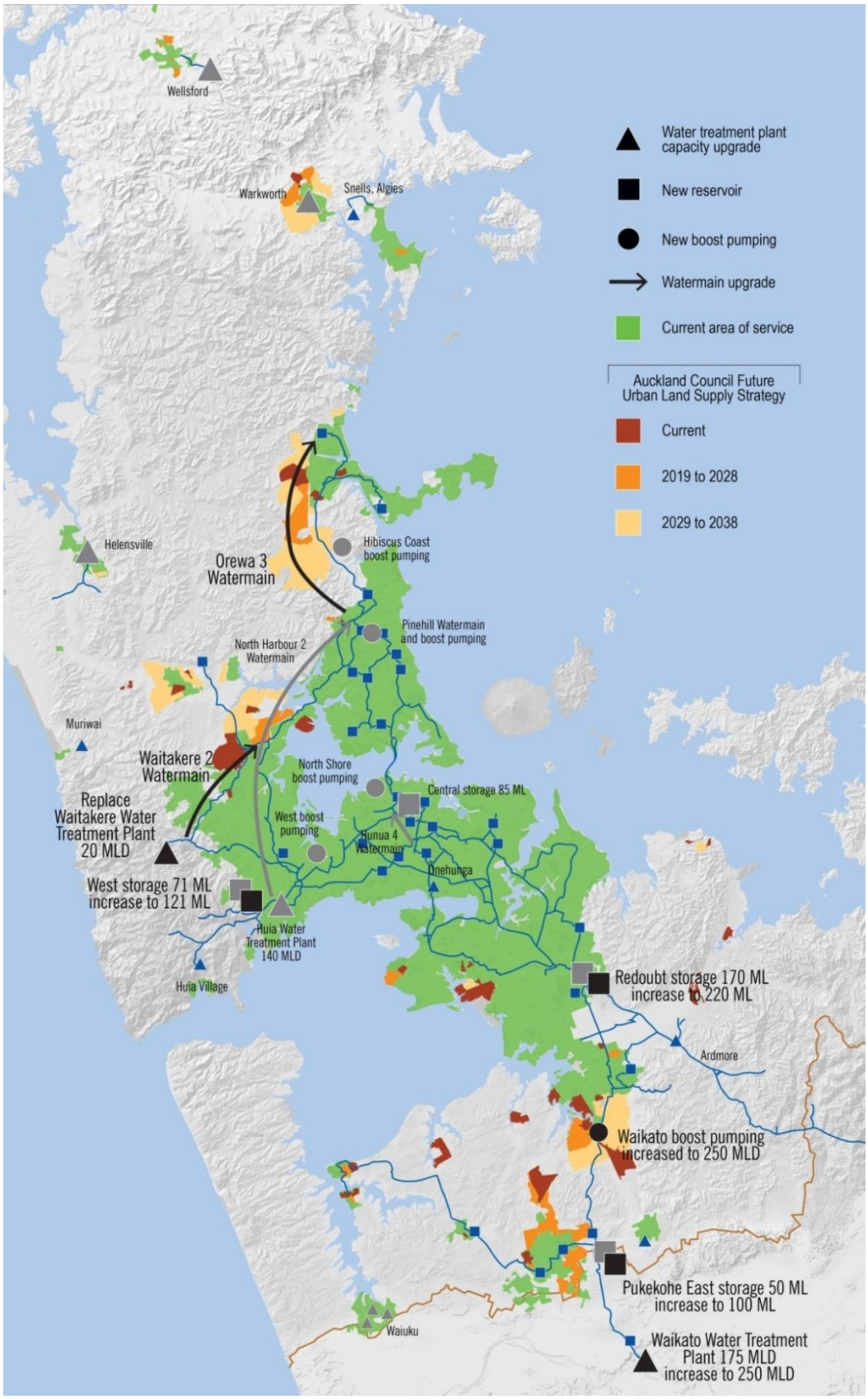
Figure 23 and **Figure 24** show the strategic water programmes to meet Auckland's projected growth in the first and second decades respectively.

Figure 23: Strategic water programmes 2019 - 2028



Note: The term “current” in this figure relates to the financial year 2017/2018.

Figure 24: Strategic water programmes 2029 - 2038



Note: The term "current" in this figure relates to the financial year 2017/2018.

9. Wastewater strategic programmes

The wastewater asset strategy outlines our significant programmes required to meet Auckland's future growth. These initiatives include regional and sub-regional connectivity, wastewater treatment upgrades and wastewater transmission upgrades. They have been grouped by wastewater catchment and first and second decades.

9.1. Māngere Wastewater Treatment Plant catchment area

9.1.1. Māngere Wastewater Treatment Plant

The Māngere Wastewater Treatment Plant treats and disposes of wastewater from approximately 76% of Auckland's population, currently estimated to be 1.15 million people. In 2016/17, the plant discharged 128,600,000 cubic metres (m^3) of highly treated effluent into the Manukau Harbour, a daily average of 352,000m^3 per day (m^3/d).

The treatment plant has a current discharge consent that includes the following limits:

- Maximum daily inflow and discharge volume of 1,209,600m^3/d
- Instantaneous maximum discharge flow rate of 25 cubic metres per second (m^3/s)
- Annual daily average inflow volume of 390,000m^3/d.

Using the current gross per capita production of around 290 litres per person per day and the average daily inflow limit, this equates to a capacity of approximately 1.34 million people, assuming there are no storage facilities at the plant.

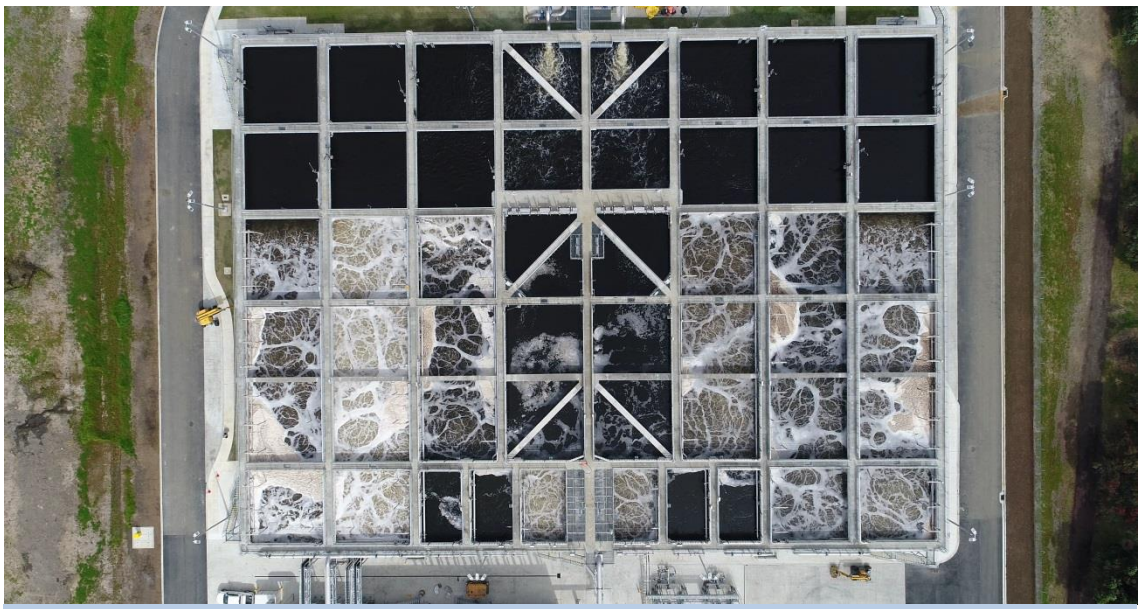
Our Māngere discharge consent is valid until 2032. Under the medium growth scenario, a consent renewal would be driven by population pressures rather than consent expiry date, as the plant will reach its estimated population capacity before the consent expires. To maintain compliance at the Māngere Wastewater Treatment Plant and to allow for growth in metropolitan Auckland as the population increases, flow will be diverted to the Rosedale Wastewater Treatment Plant to use its discharge capacity. Over the period of the AMP, the wastewater flow equivalent to around 170,000 people will be diverted from the Māngere catchment to the Rosedale plant. At the same time, hydraulic processes at the Māngere plant will be upgraded to the discharge limit of the consent.

We are currently assessing the hydrodynamic processes of the Manukau Harbour using advanced modelling systems, to quantify the nutrient and contaminant loads in the harbour and their likely sources. This will help us better assess the effects our highly treated wastewater discharges have on the harbour, in relation to other land-use types across the harbour catchment. We will use the modelling information to work with mana whenua and Auckland Council to set up an environmental improvement plan for the harbour.

First decade

In addition to plant renewals, process optimisation and improvements, our programme of works and investment planned for the Māngere Wastewater Treatment Plant includes:

- A thermal hydrolysis plant is being built to enhance pre-treatment for anaerobic digestion to meet Watercare's health and safety policy requirements, improve plant performance in terms of consent compliance, improve biosolids quality, reduce the footprint of future assets to meet growth requirements, and optimise asset life-cycle cost
- Solids stream upgrades involving the installation of new plant and equipment in order to increase solids stream processing capacity to cater for growth in the region and to replace ageing assets (sludge tanks)
- Wet-weather treatment upgrades to treat additional wet-weather volumes expected to be introduced following the completion of the Central Interceptor tunnel
- Commencement of the Māngere Wastewater Treatment Plant discharge consent renewal process ahead of its expiry in 2032.



Biological nutrient removal (BNR) upgrades, Māngere
This is an aerial view of the completed BNR upgrade. The construction of a new BNR plant at Māngere will provide additional BNR capacity to cater for projected growth in population. The plant's increased capacity will ensure the highest-quality treated wastewater continues to be discharged into the Manukau Harbour, even during heavy rainfall. Earthworks began in 2013 and the $144 million dollar BNR plant was completed in 2018.

Second decade

The second decade will include:

- Further solids stream upgrades
- Additional wet weather treatment facilities if required
- Completion of the plant's discharge consent renewal.

9.1.2. Māngere catchment

The Māngere catchment comprises 5,500km of wastewater network (including rising mains) and 281 pump stations. Within this catchment there are 184 pump station and network EOPs

that overflow more than our NDC target of no more than 2, on average, wet-weather overflow events per EOP per year. Around 60% of these overflows are in the combined wastewater/stormwater network, with the remaining 40% in the separated network.

The Māngere catchment has a proportion of the network that is a combined system, around 15,000 customers. the combined newtwork system, which dates from the early 1900s, was designed to collect both wastewater and stormwater in a common pipe. These flows are currently collected and transferred to the Ōrākei Main Sewer through the CBD to the Eastern Interceptor at Ōrākei Domain, then around East Auckland and Māngere to the treatment plant.

As growth occurs in central Auckland, by around 2030, dry-weather wastewater flows are forecast to begin to exceed the pipe capacity of the Ōrākei Main Sewer. There are also around 50 EOPs to cater for storms within this catchment. These discharge to the environment more than 50 times per year as a result of rain events. To reduce the likelihood of overflows from the Ōrākei Main Sewer in dry weather, we will have to disconnect pipework from the Ōrākei Main Sewer and reconnect it to the Central Interceptor for at least the upper section of the catchment. We have already made some adjustments in this regard, with the Avondale diversion connecting parts of Avondale and excess flows from the Ōrākei Main Sewer to the Western Interceptor.

The main strategic programme for the Māngere catchment network is the Central Interceptor. This will primarily provide for growth and will reduce overflow frequency for 48 of the 50 EOP locations mentioned above This will improve the water quality in the Waitematā Harbour.

The Central Interceptor will divert the upper portion of the Ōrākei Main Sewer catchment flows directly to the Māngere Wastewater Treatment Plant. This will not only create capacity in the Ōrākei Main Sewer but also free up capacity in the downstream Eastern Interceptor. This will allow for growth in central and south Auckland via the Howick, Tāmaki East and Southern interceptors (refer to **Figure 25**).

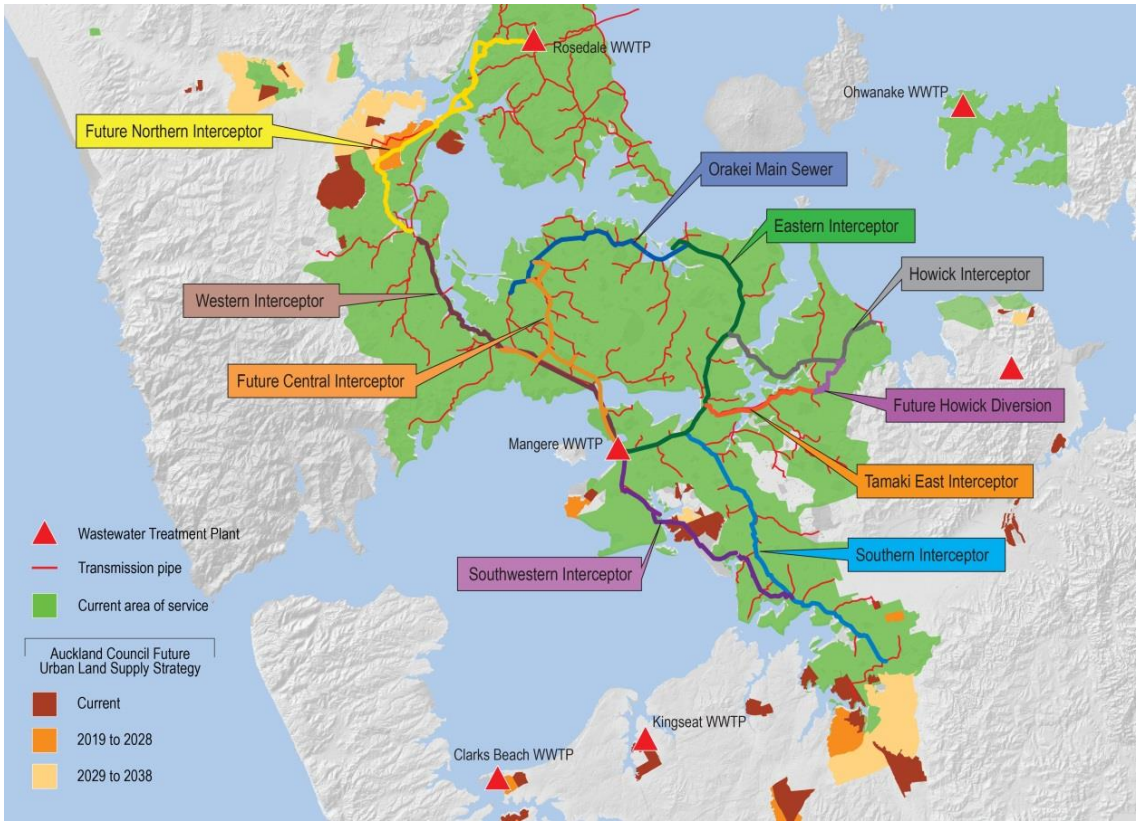
The Central Interceptor will reduce the environmental risk of damage or failure of the existing wastewater pipeline that passes under the Manukau Harbour. Built in 1964, this pipeline is reaching the end of its operational life. Failure of the pipeline could result in a significant discharge of untreated wastewater into the Manukau Harbour.

The Central Interceptor will also help to decrease combined wastewater/stormwater overflows to local waterways and the Waitematā Harbour. Our continued reliance on the wastewater system for stormwater collection is not sustainable for a growing, compact city. Stormwater entering the wastewater system reduces capacity to service population growth and, once mixed with wastewater, needs to be conveyed to and treated at the Māngere Wastewater Treatment Plant. With climate change expected to increase the intensity of rainfall and further urban densification resulting in a greater number of hard-surfaced areas, the wastewater system will be increasingly overloaded. This will cause ongoing overflows to the Waitematā and Manukau harbours.

To make the best use of the capacity the Central Interceptor brings, we are working with Auckland Council in developing a 10-year programme of works to improve the water quality in

Auckland's western isthmus urban waterways, our streams and ultimately our harbours. The Western Isthmus Water Quality Improvement Programme uses the enabling works of the Central Interceptor to investigate a combination of wastewater and stormwater options in each catchment to reduce the volume and frequency of overflows from the combined and wastewater networks. This will primarily involve removing as much stormwater from the wastewater network as possible. In addition to the $1.5 billion in capital works we are funding and undertaking in this area over the next 10 years, Auckland Council has allowed around $300 million during this period for their share of the separation works to reduce overflows to the environment. This is to be funded through the Auckland Council's water quality targeted rate.

Figure 25: Māngere catchment wastewater interceptors



There is significant intensification occurring in our eastern city catchments. The Tamaki Regeneration Company (TRC) is significantly increasing dwellings in the area. They are looking for at least a three-fold increase in dwelling numbers for Housing NZ, at a minimum maintaining the existing social housing stock in the area, while providing additional housing for rent and private sale. We are working with the TRC, especially around the wastewater capacity, to minimise any adverse effects of the redevelopment on our network and the environment. In particular, we are looking at replacing old drainage pipes that connect each house to our network, as this area is highly influenced by wet-weather. Where the public wastewater pipes are under capacity after reductions in wet-weather flows, we are working with the TRC to undertake necessary upgrades.

We are anticipating significant growth in the south of the region, with future urban zoned land in Takānini, Papakura, Hingaia, Opaheke/Drury and Drury West. The Future Urban Land Supply Strategy (FULSS) has recently been refreshed, and changes to the timing of Auckland Council's structure planning have been made. Generally, plans for Drury West and Opaheke/Drury have been accelerated, while those for Takānini have been deferred. Drury West has also been split into two stages, with stage 1 being accelerated and stage 2 deferred. Stage 2 will occur in a similar timeframe to Opaheke/Drury. The southern area has also been identified by Auckland Council and central government as a potential area to provide houses quickly. A Special Purpose Vehicle to enable fast-paced housing development has been discussed.

The Hingaia Peninsula, which has Special Housing Area (SHA) status, and Drury West will be serviced by the Hingaia Pump Station, which connects to the Southern Interceptor. Augmentation of the Southern/South-Western Interceptor from Bremner Road via Hingaia to Manurewa will be timed to service growth. We will also be investigating the potential to integrate with water source solutions to provide greater resilience in the water and wastewater networks.

First decade

- The Central Interceptor is scheduled to start in 2019 with the tunnel, pump station and link sewers being completed by 2025.
- A stormwater/wastewater separation programme within the Western Isthmus catchments will be implemented, to reduce combined sewer overflows to the environment.
- As part of the Southern Interceptor augmentation, the Hingaia Pump Station and initial network upgrades will be constructed. Developers will fund the Bremner Road Pump Station, to allow Drury West servicing to begin. This will allow continued growth in the southern areas of the region.

Additional programmes to solve residual capacity issues will be identified and carried out during this period including:

- Howick diversion
- Ōtara catchment upgrades
- Newmarket Gully.

Second decade

The above programmes continue in the second decade as follows:

- Further augmentation to the Southern Interceptor, including an upgrade of the Bremner Road Pump Station and duplication of the pump station's rising mains.
- Further Ōtara and Newmarket network upgrades.
- Additional programmes to solve residual capacity issues will be identified and carried out during the period.

9.2. Rosedale Wastewater Treatment Plant catchment area

9.2.1. Rosedale Wastewater Treatment Plant

The Rosedale Wastewater Treatment Plant treats and disposes of wastewater from approximately 17% of Auckland's population, currently estimated to be 251,000 people. In 2016/17, the plant discharged 22,900,000m^3 of highly treated wastewater into the Hauraki Gulf (off Mairangi Bay), a daily average of 63,000m^3/d.

The treatment plant has a current discharge consent that limits the instantaneous maximum discharge flow rate to 6m^3/s, as well as limits on nutrient load concentrations. At present, the instantaneous maximum peak flow from the outfall is only 3m^3/s. Consequently, we expect that the existing outfall has capacity for approximately 480,000 people.

The discharge consent is valid until 2030. As growth occurs across the region and flow is diverted from the Māngere Wastewater Treatment Plant catchment to the Rosedale plant, treatment processes and hydraulic capacity at the plant will be upgraded to maximise the use of the existing outfall. We will apply for a new discharge consent no later than 2029[4] to make allowance for additional growth in the catchment.

First decade

In addition to plant renewals and process optimisation and improvements, the programme of works and investment planned for the Rosedale Wastewater Treatment Plant include:

- The first plant upgrade will be completed, including a primary sedimentation tank, an additional biological treatment reactor, a thermal hydrolysis plant and a capacity increase for the pond link pipework.
- The Rosedale Wastewater Treatment Plant discharge consent renewals process will begin.

Second decade

The second decade will include:

- Further upgrades to the plant to provide additional capacity for growth and diversion of flows from Māngere
- Completion of the plant's discharge consent application.

9.2.2. Rosedale catchment

The Rosedale catchment comprises 1400km of wastewater network (including rising mains) and 91 pump stations. The catchment has 18 pump station and network EOPs that overflow more than our NDC target of no more than 2, on average, wet-weather overflow events per EOP per year. The Rosedale catchment is a fully separated wastewater network. There are no combined networks.

[4] Despite the discharge consent expiring in 2030, we can continue to operate under the existing consent conditions provided the application for the new discharge consent has been lodged before that date.

As part of the North Shore trunk sewer and pump station upgrade programme, the following work is planned or underway to resolve overflows at the locations identified above:

- Wairau Pump Station and rising main upgrade
- Sidmouth Pump Station and rising main upgrades, including the East Coast Bays Branch Sewer upgrade
- Fred Thomas Drive Pump Station and rising main upgrades
- Alma Road Pump Station diversion
- Northcote Sewer upgrades
- Chelsea Pump Station upgrades
- Shoal Bay inflow and infiltration investigation.

The Northern Interceptor will be built to divert flow from the upper portion of the Western Interceptor to the Rosedale Wastewater Treatment Plant. The first phase of the Northern Interceptor will take flow from the existing Hobsonville Pump Station to Rosedale by 2021. The second phase, from Westgate to Hobsonville Pump Station to enable growth in Whenuapai and Redhills, is being advanced as part of the Government's Housing Infrastructure Fund. Further boost pumping and extensions to the Northern Interceptor will be phased to accommodate growth, and the Concourse storage tank flow will be diverted from the Western Interceptor to the Northern Interceptor by 2036. We will build a second Hobsonville Pump Station and duplicate the rising main from Hobsonville to Rosedale, timed for 2036.

First decade

In addition to the general renewals and process improvements:

- The Northern Interceptor from Westgate through to Rosedale will be completed.
- The North Shore trunk sewer and pump station upgrade programme will continue in the Wairau Valley, Castor Bay, Stanley Point and Birkdale wastewater catchments
- An interim pump station will be constructed to service the first stages of the Redhills SHA development.
- A new transmission pump station will be constructed on Brighams Creek Road and be connected to the phase2 Northern Interceptor network to service growth in Whenuapai, Redhills, Kumeu, Huapai and Riverhead.

Second decade

- Further phases for the Northern Interceptor programme will be completed.

Glen Eden Wastewater Storage Tank and Pipeline
This picture shows the construction of a 20-metre-wide storage tank in Glen Eden that will cater for population growth and increase underground storage to deal with increased flows during wet weather. The project will help to protect local waterways and includes three new pipelines to increase network capacity. Construction was completed in 2018.

9.3. Army Bay Wastewater Treatment Plant catchment area

9.3.1. Army Bay Wastewater Treatment

The Army Bay Wastewater Treatment Plant treats and disposes of wastewater from around 3% of the Auckland's population, currently estimated to be 49,300 people. In 2016/17, the plant discharged 4,070,000m^3 of treated effluent into the Whangaparaoa Passage, a daily average of around 11,000m^3/d.

At present, the treatment plant's outfall pipe has a flow limitation of around 300L/s compared to a peak wet-weather inflow of up to 750L/s. Wet-weather flows are currently stored through the treatment plant and wastewater network to ensure overflows do not occur at the plant, which is located next to Shakespear Regional Park.

The treatment plant has an existing discharge consent that limits the maximum daily discharge from the treatment plant to 32,147m^3/d, as well as limits on nutrient load concentrations. Allowing for the high wet-weather flows, this equates to approximately 60,000 people.

The outfall pipe is currently being upgraded. Treatment process upgrades will be timed to accommodate growth and the renewal of the discharge consent. The discharge consent is valid until 2021, with the new consent application was lodged in late 2018, with the hearings likely to be in 2019.

First decade

In addition to plant renewals and process optimisation and improvements, the programme of works and investment planned for the Army Bay Wastewater Treatment Plant include:

- Completion of the new outfall
- Renewal of the plant's discharge consent for around 180,000 people
- The first upgrade of the plant will be completed.

Second decade

The second decade will include further upgrades to the plant to provide capacity for growth.

9.3.2. Army Bay catchment

The Army Bay catchment comprises approximately 450km of wastewater network (including rising mains and low-pressure sewer mains) and 42 pump stations. The Army Bay catchment is a separated system and has five pump station and network EOPs that exceed our target of fewer than two discharges per overflow point per year as set out in the NDC.

The Army Bay catchment network is a highly pumped network, with long rising main lengths. This design can result in odour complaints due to long travel times of sewage. In addition, due to the flow constraints currently at the treatment plant, the network requires us to manually operate it to minimise overflows. To limit flows at the plant, pumps are manually turned off to use storage capability across the network.

Significant growth is proposed in Wainui and Siverdale West. Residential land in Wainui is programmed for immediate development, with commercial land in Silverdale undergoing structure planning that started in 2018, with development expected in the first decade of our AMP period. These developments will require upgrades across our wastewater network. The wastewater network model is currently being updated to enable the development of catchment-wide network solutions to remove the constraints.

A provision for these upgrades has been included in the first and second decades, but may need to be brought forward due to the early release of the land in the Silverdale West area of Ōrewa. This will present challenges in terms of both water and wastewater servicing and may require further funding to be brought forward in the AMP to accommodate this growth.

9.4. Pukekohe Wastewater Treatment Plant catchment area

9.4.1. Pukekohe Wastewater Treatment Plant

The Pukekohe Wastewater Treatment Plant treats and disposes of wastewater from approximately 2% of Auckland's population, currently estimated to be 33,800 people. In 2016/17, the plant discharged 3,400,000m^3 of treated effluent into the Waikato River, a daily average of around 9300m^3/d. The plant's catchment also includes the north Waikato towns of Tūākau and Pōkeno, as well as a large trade-waste component. The trade waste flow makes up around 50% of the plant's biochemical oxygen demand (BOD); this is expected to increase as industries in the region expand, particularly in Pōkeno.

We have recently been granted resource consent by Waikato Regional Council to increase the discharge from the plant to cater for growth. We will be carrying out treatment process upgrades to expand the plant capacity to an equivalent population of around 60,000 people, which will be completed by 2019. Further expansion will occur in the second 10-year period, timed with growth in the connected communities.

9.4.2. Pukekohe and North Waikato catchments

The Pukekohe catchment comprises 150km of wastewater network (including rising mains) and 14 pump stations. The network is fully separated without any pump station or network EOPs that currently exceed the NDC targets.

There is significant growth proposed in this catchment, within the SHAs and the future urban zoned land. There is also substantial expansion predicted in both Tūākau and Pōkeno with a considerable number of heavy/wet industries in both of these townships.

The Pukekohe Trunk Sewer and Pukekohe Pump Station to the Pukekohe plant have recently been upgraded to solve some overflow issues. Additional programmes to resolve residual capacity problems in Pukekohe will be identified and carried out as required. Discussions will also be undertaken with Waikato District Council regarding Tūākau and Pōkeno, and any wet-weather issues experienced by these communities will be considered and rectified.

9.5. Warkworth and Snells/Algies Wastewater Treatment Plant catchment areas

9.5.1. Warkworth and Snells/Algies wastewater treatment plants

The Warkworth and Snells/Algies wastewater treatment plants together treat and dispose of wastewater from approximately 0.6% of Auckland's population, currently estimated to be 8500 people. This population is split relatively evenly between the two plants. In 2016/17, these plants discharged a total volume of 840,000m^3 of treated effluent, a daily average of 2300m^3/d.

Resource consents for a North-East Sub-regional Wastewater Treatment Plant have been granted to enable Warkworth, Snells Beach and Algies Bay to be serviced by a new wastewater treatment plant. The new plant will be located adjacent to the existing Snells/Algies plant. The scheme will include wastewater being pumped from Warkworth to the new plant, as well as a new larger-diameter outfall pipe to the inner channel of the Hauraki Gulf, off Martins Bay to the south. Our existing Warkworth and Snells/Algies plants will be decommissioned as part of the project works. The sub-regional plant will have staged capacity upgrades, from an initial 18,000 people equivalent to an ultimate capacity of around 30,000 people.

9.5.2. Warkworth, Snells Beach and Algies Bay catchments

The Warkworth and Snells Beach catchments comprise around 100km of wastewater network (including rising mains) and 13 pump stations. The Warkworth and Snells catchments are separate wastewater-only systems with only one pump station and one network EOP that exceeds the NDC target.

There is significant growth proposed in the Warkworth catchment, within the future urban zoned land. This land is located at both the northern and southern edges of the catchment. In view of the high growth expectations, a network model will be built to enable network solutions to be developed.

Programmes to resolve capacity issues will be identified and carried out as required during the AMP period.

9.6. Waiuku, Clarks Beach and Kingseat wastewater treatment plants' catchment areas

9.6.1. Waiuku, Clarks Beach and Kingseat wastewater treatment plants

The Waiuku, Clarks Beach and Kingseat wastewater treatment plants together treat and dispose of wastewater from approximately 0.7% of Auckland's population, currently estimated to be 10,800 people. In 2016/17, these plants discharged a total volume of 1,100,000m^3 of treated effluent, a daily average of 3000m^3/d.

The Waiuku and Clarks Beach treatment plants discharge to the Waiuku Estuary, with Waiuku at the head and Clarks Beach at the mouth of the estuarine tributary. As part of Auckland Council's proposed Unitary Plan, the Waiuku Estuary has been largely classified as a significant marine ecological area, affecting discharge consent applications in this area. The Waiuku treatment plant has a current discharge consent that limits the maximum daily dry-weather discharge from the plant to 5500m^3/d, restricts the time during which discharges can occur, and limits the amount of nutrient load concentrations. The capacity of the plant equates to approximately 20,000 people. The discharge consent is valid until 2019.

The Clarks Beach treatment plant has a current discharge consent that limits the maximum daily discharge from the treatment plant to 600m^3/d, and restricts the amount of nutrient load concentrations. The capacity of the plant equates to approximately 2200 people. The discharge consent has expired, with the plant being legally operated under existing consent conditions.

In addition, a recent plan change was granted to allow development at Kingseat. The surrounding area is particularly sensitive and includes a Tangata Whenua Management Area over the Whātāpaka Creek.

A resource consent application for a South-West Sub-regional Wastewater Treatment Plant has been granted, enabling Waiuku, Clarks Beach and Kingseat to be serviced by a new wastewater treatment plant, to be located adjacent to the existing Waiuku plant. The scheme will include wastewater being pumped from Kingseat and Clarks Beach to an upgraded Waiuku plant and a new outfall pipe discharging to the Manukau Harbour at Clarks Beach. The existing plants will be decommissioned as part of the project works.

9.6.2. Waiuku, Clarks Beach and Kingseat catchments

The Waiuku and Clarks Beach catchments comprise around 80km of wastewater network (including rising mains) and 24 pump stations. The catchments are wastewater-only systems with no EOPs exceeding the NDC targets.

The wastewater networks will have some capacity to accommodate growth, but will require planning studies to optimise the use of the individual networks. No provision has been made in the AMP for network enhancements at this stage.

9.7. Waiwera, Beachlands/Maraetai and Clevedon

The Waiwera and Beachlands/Maraetai areas are currently serviced by local wastewater treatment plants.

The Waiwera wastewater network will be connected to Hatfields Beach and the Army Bay catchment. An allowance has been made in the AMP for this work. The treatment plant will be partially decommissioned as part of this project.

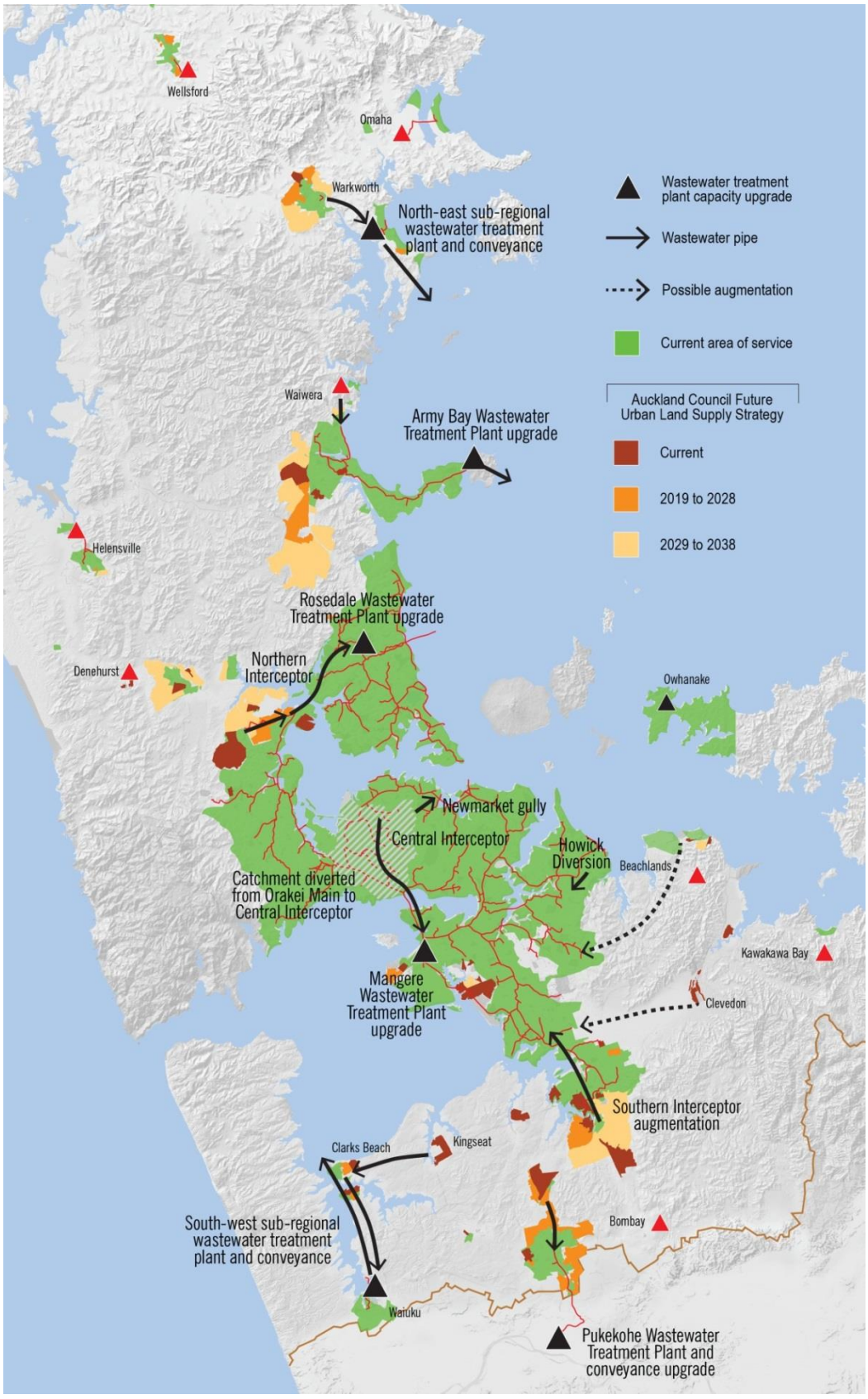
Our Beachlands plant currently has capacity for 10,000 people. Before development exceeds this capacity, a consent variation will be required to remove the plant's 10,000 people population limit and to increase the discharge allowance. Further process expansion and upgrade would then enable the plant to service around 14,000 people.

Clevedon is not currently serviced by Watercare. A scheme to convey wastewater back to Takānini is being developed and consents have been applied for. An allowance has been made in our funding models for these works; however, an infrastructure funding agreement with the developers means that the costs will be reimbursed by development interest in the Clevedon community.

No provision has been made in the AMP for Beachlands, as growth expectations for the area are within estimated tolerances of the plant. However, if growth exceeds expectations, upgrades will be scheduled and undertaken as required, including the possibility of connecting the community back to metropolitan Auckland.

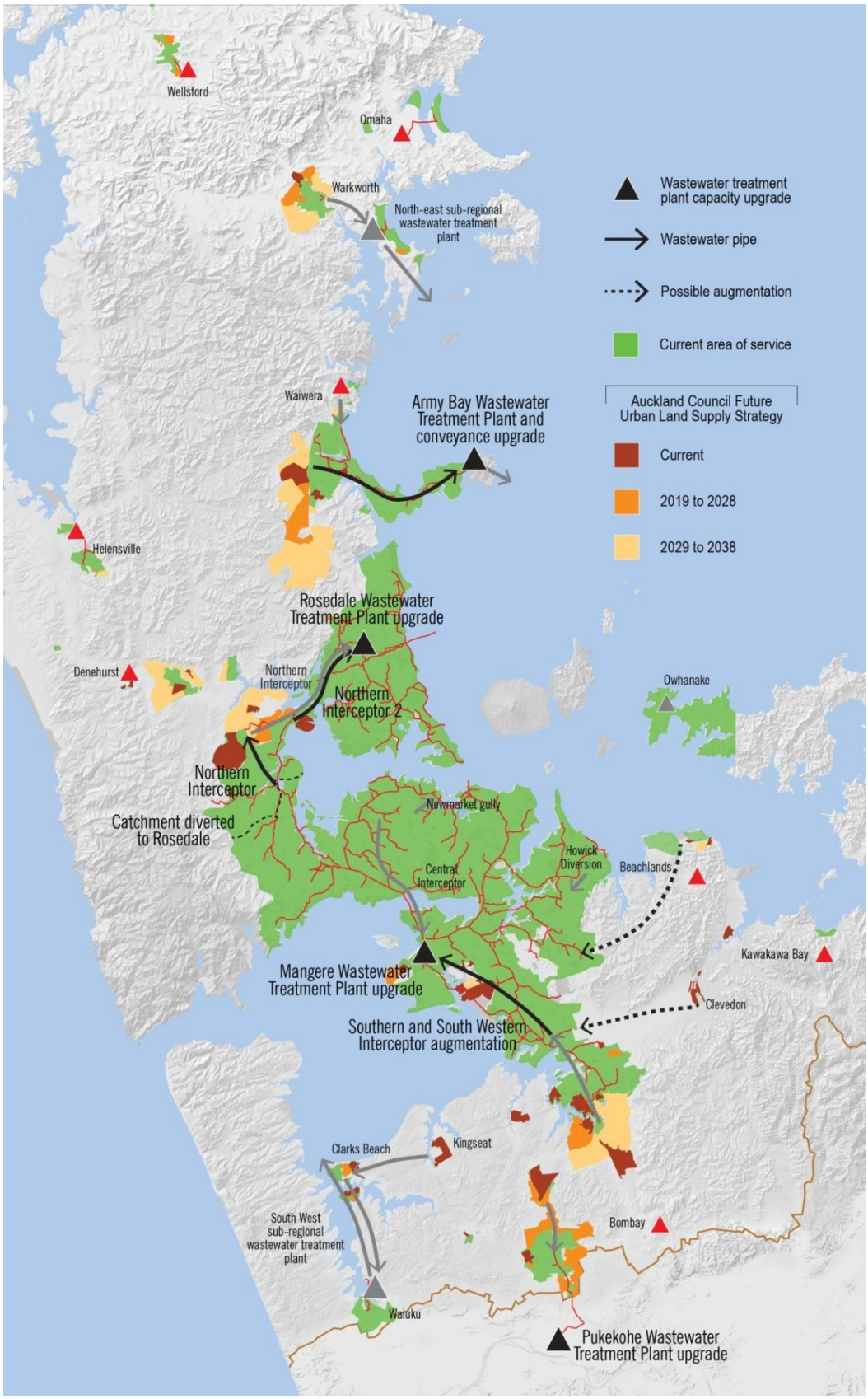
Figure 26 and **Figure 27** show the wastewater strategic programmes that have been included in the AMP to meet Auckland's projected growth in the first and second 10-year periods respectively.

Figure 26: Wastewater strategic programmes 2019 - 2028



Note: The term "current" in this figure relates to the financial year 2017/2018.

Figure 27: Wastewater strategic programmes 2029 - 2038



Note: The term "current" in this figure relates to the financial year 2017/2018.

9.8. Wastewater regional initiatives

One of our key strategic philosophies is to maximise the use of existing assets. In regard to the wastewater system, stormwater and groundwater entering the wastewater network erodes hydraulic capacity that could be used to service growth and to provide better levels of service to existing customers. The overall principle is that the wastewater system is for the conveyance of wastewater only; therefore, as much as practically possible, stormwater and groundwater will be removed from the system through sewer separation and I&I management programmes.

9.9. Wastewater catchments and network modelling

Watercare has categorised the wastewater network in terms of the wastewater treatment plant catchments.

The hydraulic network model for the Māngere catchment has recently been partially updated, with further upgrades being carried out where confidence in our initial information was low. The Rosedale, Army Bay and Pukekohe model upgrades are under way also, to improve our understanding of the wastewater networks' current operation and their future performance. This allows concept solutions to be developed and their future performance assessed. Wastewater network modelling requires a rolling programme of improvement to ensure the models are updated at least every six years.

The wastewater network currently consists of 18 treatment plant catchments, which are listed below by discharge limit. Refer **Table 9**.

Table 9: Wastewater catchments

Wastewater treatment plant catchment	Wastewater treatment plant maximum daily discharge (m^3/d)	Estimated current population serviced (ART i11)	Percentage of Auckland population (%)
Māngere	1,209,800	1,150,000	76
Rosedale	518,400 (6 m^3/s)	251,000	17
Army Bay	32,147	49,300	3
Pukekohe	8,450	33,800	2
Warkworth	8,100	4,200	0.3
Waiuku	5,500	8,700	0.6
Helensville	5,500	4,100	0.3
Snells/Algies	4,680	4,300	0.3
Beachlands/Maraetai	2,800	6,800	0.4
Wellsford	2,500	2,000	0.1
Omaha (including Point Wells and Matakana)	860	1,500	0.1
Kawakawa Bay	800	600	<0.1
Clarks (including Glenbrook and Waiau)	600	2,000	0.1
Waiwera	595	360	<0.1
Ōwhanake	80	Oneroa business area only[5]	
Kingseat	38	130	<0.1
Denehurst	14.8	90	<0.1
Bombay	5.4	15	<0.1

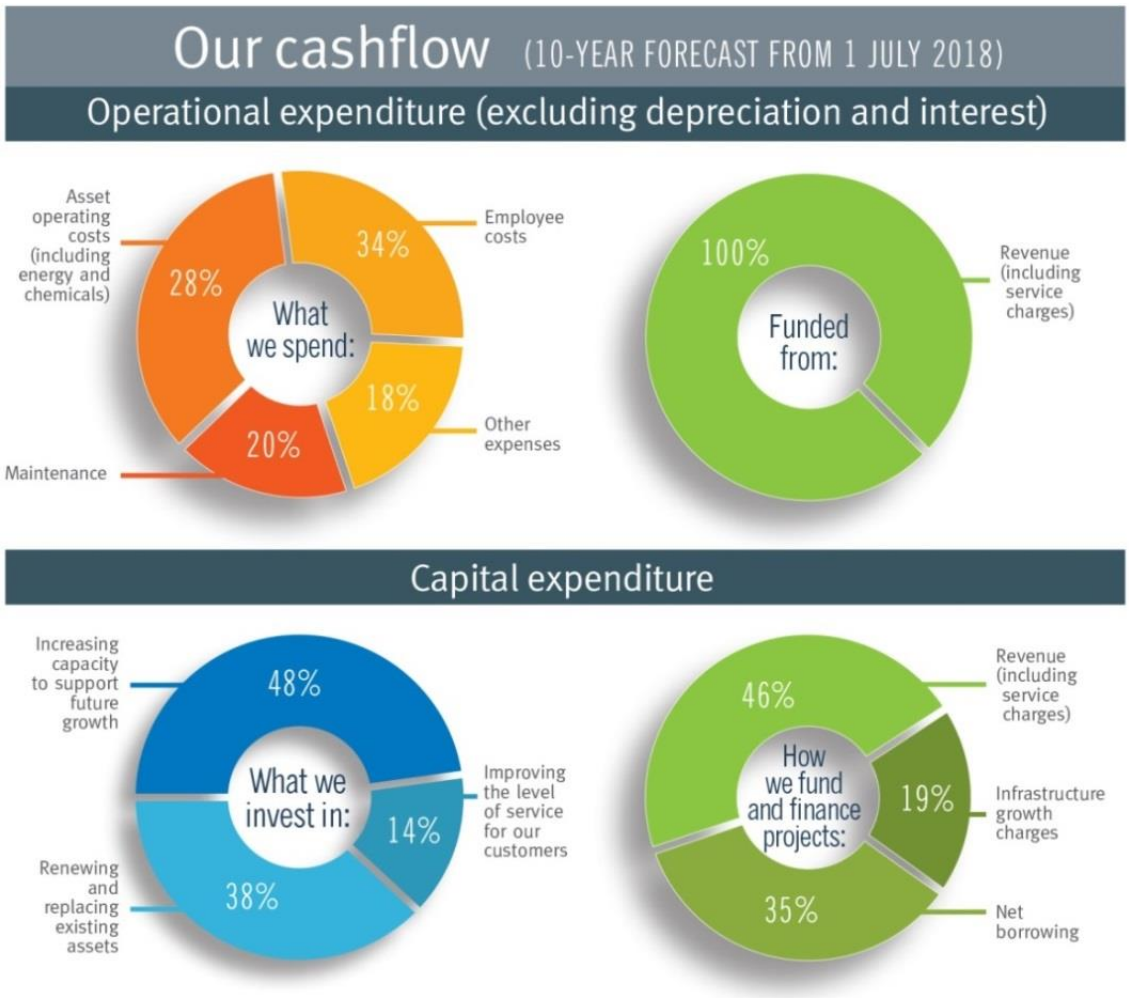
[5] The serviced population in the case of the business area will fluctuate depending on visitor numbers. There are currently 27 wastewater connections in this area.

10. Financial projections

Our board has endorsed principles which are consistent with those adopted by Auckland Council as the basis for our Revenue and Financing Policy. These can be found in our Funding Plan, aligned to the AMP, along with our funding strategies and our price path calculation methodology. Our major strategic projects and programmes and our capital and operational expenditure expectations are repeated here.

Figure 28 provides a high level breakdown of planned operational and capital expenditure over the next 10 years, to deliver reliable water and wastewater services across the Auckland region and how that will be funded.

Figure 28: Expenditure and revenue



10.1. Strategic projects and programmes

Table 10 and Table 11 show the forecast capital expenditure for the water and wastewater strategic programmes discussed in Sections 8 and 9 above.

Table 10: Water strategic programmes - $ millions (nominal)

Water strategic programme	Financial years 2019 - 2028	Financial years 2029 - 2038
North of Albany • Wellsford water supply • Helensville water supply • Hibiscus Coast boost pumping • Ōrewa 3 Watermain • Ōrewa 1 Watermain replacement	61	170
North Shore • North Shore boost pumping • Pinehill watermain and boost pumping	11	
North-West • Huia Water Treatment Plant • North Harbour 2 Watermain • West boost pumping • North West storage • Waitākere water supply • Waitākere 2 Watermain • Huia 1 and Nihotupu 1 Watermain replacement	731	201
Central • Hūnua 4 Epsom to Khyber Pass • Khyber 2 Reservoir reinstatement • Ponsonby reservoirs upgrade • Domain Reservoir replacement • Khyber 3 Reservoir replacement	102	68
Southern • Waikato Water Treatment Plant to 175MLD • Waikato boost pumping • Pukekohe East Reservoir at Runciman Road • Redoubt Road Reservoir complex expansion • Waiuku water supply • Waikato Water Treatment Plant to 250MLD	136	357
Other water programmes		
Growth • Increasing capacity to support growth	208	354
Renewals • Renewing and replacing critical assets near the end of their useful lives and non-critical assets that have failed	634	1,529
Level of service improvements • Improving the level of service to our customers	35	159
Total	1,918	2,838

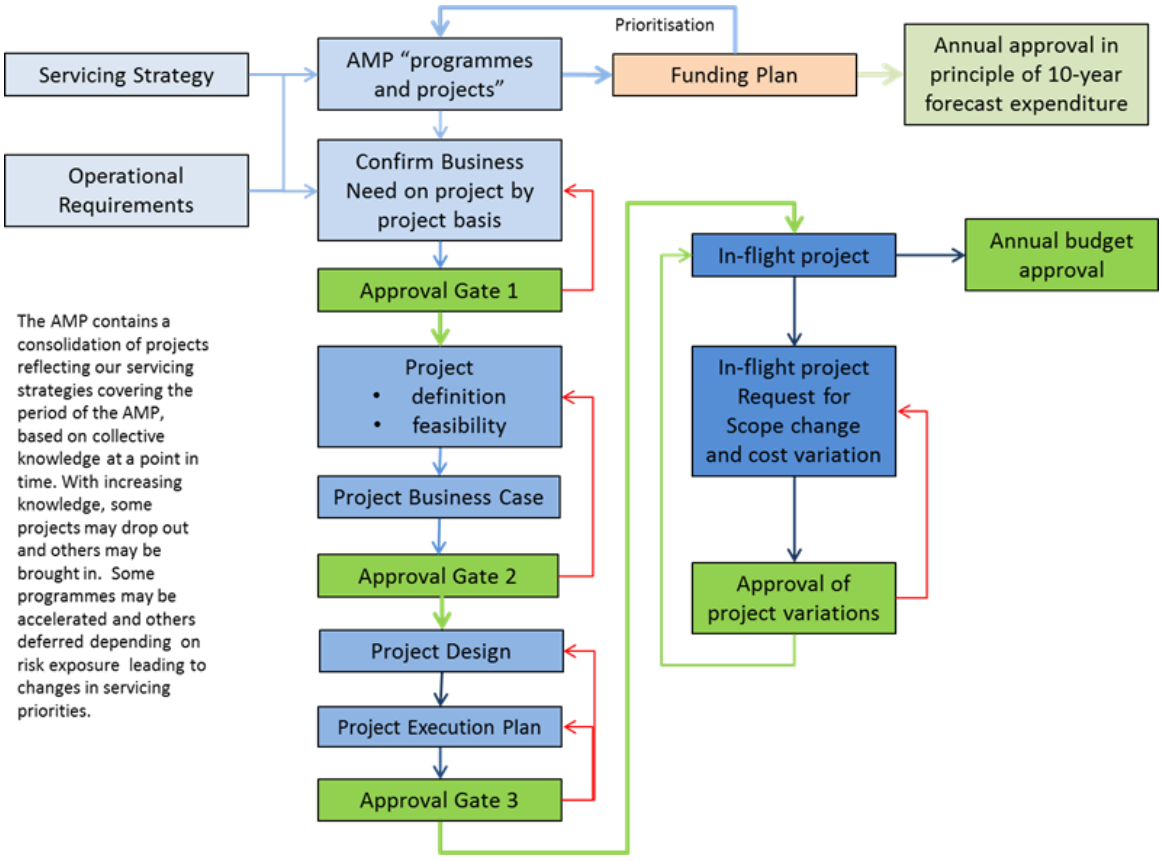
Table 11: Wastewater strategic programmes - $ millions (nominal)

Wastewater strategic programmes Treatment plants and catchments	Financial years 2019 - 2028	Financial years 2029 - 2038
Māngere		
Treatment plant		
• Biological nutrient removal (BNR) upgrade • Additional sludge digesters • Solids stream upgrades • Wet-weather treatment facilities • Consent renewals	182	142
Catchment		
• Central Interceptor • Southern Interceptor augmentation • Howick diversion • Ōtara network upgrades • Newmarket Gully	1,867	127
Rosedale		
Treatment plant		
• Treatment upgrades • Consent renewals	122	184
Catchment		
• Northern Interceptor • North Shore trunk sewer and pump station upgrades	274	334
Army Bay		
Treatment Plant	53	75
• Outfall and plant upgrade		
Catchment		
• Provision for growth	30	93
Pukekohe		
Treatment Plant	63	
• Treatment upgrades		
Catchment		
• Pukekohe trunk sewer upgrades	63	19
Warkworth and Snells/Algies		
Treatment plants	171	31
• North-East Sub-regional Plant and conveyance		
Catchments		
• Network upgrades	28	82
Clarks Beach and Waiuku		
Treatment plants	134	26
• South-West Sub-regional Plant and conveyance		

Other Wastewater Programmes		
Growth • Increasing capacity to support growth	99	241
Renewals • Renewing and replacing critical assets near the end of their useful lives and non-critical assets that have failed	509	918
Level of service improvements • Improving the level of service to our customers	29	65
Total	3,624	2,337

It is important to recognise that the presence of a programme or project in the AMP does not mean approval is a given. The capital projects approval process is set out in our Project Management Framework. There are a number of approval gates providing extra levels of governance and security. This capital expenditure approval is reflected in **Figure 29** with approval gates shown by the green boxes.

Figure 29: Capital expenditure approval process



10.2. Capital expenditure expectations

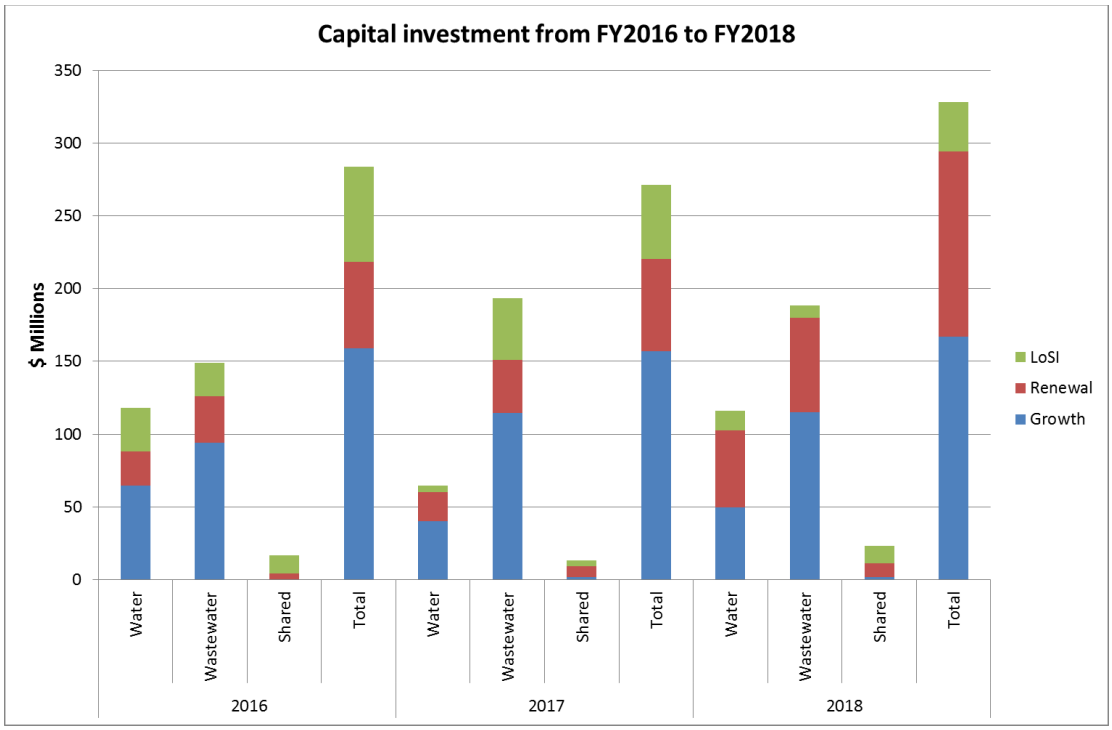
The following tables provide a view of our forward capital expenditure, however it is also helpful to provide a view of capital expenditure in the last few years to allow comparison of future investment trends with those of the past.

This is represented in Table 12 and Figure 30.

Table 12: Capital expenditure in the last 3 years

Business Area	Contributing Driver	2016	2017	2018
Water	Growth	64.7	40.0	49.8
	Renewal	23.5	20.2	53.0
	LoSI	29.9	4.3	13.4
WATER Total		118.1	64.5	116.2
Wastewater	Growth	94.1	114.8	115.2
	Renewal	31.8	36.0	64.8
	LoSI	23.0	42.4	8.6
WASTEWATER Total		148.8	193.2	188.6
Shared	Growth	0.3	2.0	2.0
	Renewal	3.9	7.1	9.4
	LoSI	12.5	4.3	12.1
SHARED SERVICES Total		16.6	13.5	23.5
Watercare	Growth	159.0	156.8	167.1
	Renewal	59.2	63.3	127.1
	LoSI	65.4	51.0	34.1
Grand Total		283.6	271.1	328.3

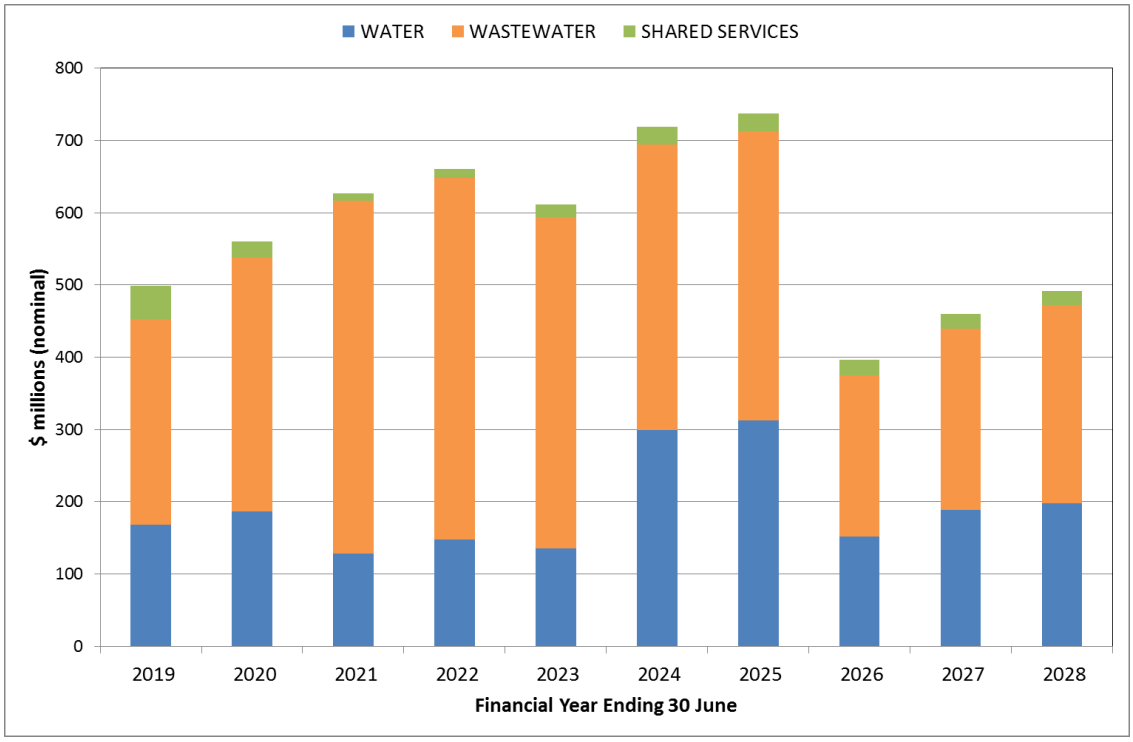
Figure 30: Capital expenditure in the last 3 years



All real dollar and nominal dollar forecasts presented below exclude capitalised interest.

Figure 31 shows a bulge in capital expenditure from 2019 to 2025. This is mainly attributed to commencement of the wastewater Central Interceptor project with the Huia Water Treatment Plant rebuild commencing around 2024.

Figure 31: Forecast capital expenditure by business area, $ millions (nominal)



The following tables, Table 13 to Table 20, provide further details of the proposed capital investment.

In the asset management plan we categorise assets and activities into those that support water services and those that support wastewater services. There are also assets and activities that support both water and wastewater areas of the business. These are categorised as Shared Services and include capital investment in services such as information systems, electrical and control systems, energy, general plant and equipment and motor vehicles.

Over the first two years of the AMP, a large part of the Shared Services capital expenditure provision is to support the Strategic Transformation Programme (STP). STP is a strategic approach to utilise the latest digital solutions and our people to transform our processes and create a better customer experience.

See also **Section 5.2 Our transformation.**

Table 13: Watercare capital expenditure forecast summary - $ millions (real - 2017/18 base)

Business Area	Contributing Driver	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	Total 2019-2028	Total 2029-2038	20-Year Total
WATER	Growth	95.8	97.7	54.5	52.3	34.5	55.3	66.0	45.3	48.2	58.0	607.6	612.2	1,219.8
	Renewal	49.7	63.7	59.8	73.6	73.6	167.7	159.8	70.2	91.8	85.3	895.2	1,055.4	1,950.6
	LoSI	16.7	12.6	1.5	2.8	6.4	22.7	23.1	2.2	2.4	2.0	92.4	76.2	168.6
WATER Total		**162.2**	**174.0**	**115.8**	**128.7**	**114.5**	**245.6**	**248.9**	**117.7**	**142.4**	**145.3**	**1,595.1**	**1,743.8**	**3,339.0**
WASTEWATER	Growth	195.2	229.7	280.0	276.3	220.0	141.2	134.4	63.3	72.8	102.3	1,715.2	763.1	2,478.3
	Renewal	64.9	60.8	79.8	71.1	88.6	105.6	87.3	75.4	84.0	65.2	782.6	634.7	1,417.3
	LoSI	15.0	36.4	79.1	87.1	78.7	77.0	96.1	34.5	32.7	33.8	570.2	10.0	580.2
WASTEWATER Total		**275.1**	**326.9**	**439.0**	**434.4**	**387.2**	**323.8**	**317.8**	**173.2**	**189.4**	**201.2**	**3,068.1**	**1,407.8**	**4,475.9**
SHARED SERVICES	Growth	2.6	2.5	1.4	2.2	3.0	4.0	4.0	3.3	3.1	3.0	29.0	25.0	54.0
	Renewal	10.5	9.9	5.7	8.7	12.1	15.9	16.0	13.3	12.3	11.8	116.2	99.9	216.1
	LoSI	31.7	9.2	2.1	-	-	-	-	-	-	-	43.0	-	43.0
SHARED SERVICES Total		**44.8**	**21.5**	**9.2**	**10.8**	**15.1**	**19.8**	**20.0**	**16.6**	**15.4**	**14.8**	**188.2**	**124.9**	**313.1**
Grand Total		**482.2**	**522.5**	**564.0**	**573.9**	**516.8**	**589.2**	**586.8**	**307.5**	**347.2**	**361.4**	**4,851.4**	**3,276.5**	**8,128.0**

2019 is the financial year from 1 July 2018 to 30 June 2019

Table 14: Watercare capital expenditure forecast summary - $ millions (nominal)

Business Area	Contributing Driver	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	Total 2019-2028	Total 2029-2038	20-Year Total
WATER	Growth	99.1	104.9	60.5	60.2	40.8	67.4	83.0	58.5	63.9	79.0	717.3	976.4	1,693.7
	Renewal	51.5	68.3	66.5	84.7	87.1	204.5	201.0	90.6	121.7	116.2	1,092.0	1,732.7	2,824.7
	LoSI	17.3	13.6	1.6	3.2	7.6	27.6	29.1	2.9	3.1	2.7	108.8	129.3	238.1
WATER Total		**167.9**	**186.8**	**128.6**	**148.1**	**135.5**	**299.5**	**313.0**	**151.9**	**188.7**	**198.0**	**1,918.1**	**2,838.4**	**4,756.5**
WASTEWATER	Growth	202.1	246.5	311.1	318.0	260.5	172.3	169.1	81.6	96.4	139.4	1,996.9	1,263.0	3,259.8
	Renewal	67.2	65.2	88.7	81.8	104.9	128.8	109.8	97.3	111.3	88.7	943.7	1,057.2	2,000.9
	LoSI	15.6	39.1	87.9	100.2	93.1	93.9	120.9	44.5	43.3	46.0	684.3	16.8	701.2
WASTEWATER Total		**284.8**	**350.8**	**487.7**	**500.0**	**458.6**	**394.9**	**399.7**	**223.4**	**251.0**	**274.1**	**3,624.9**	**2,337.0**	**5,961.9**
SHARED SERVICES	Growth	2.7	2.7	1.6	2.5	3.6	4.8	5.0	4.3	4.1	4.0	35.3	41.1	76.4
	Renewal	10.9	10.6	6.3	10.0	14.3	19.4	20.1	17.2	16.3	16.1	141.2	164.5	305.7
	LoSI	32.8	9.9	2.3	-	-	-	-	-	-	-	45.0	-	45.0
SHARED SERVICES Total		**46.4**	**23.1**	**10.3**	**12.5**	**17.8**	**24.2**	**25.2**	**21.5**	**20.4**	**20.2**	**221.5**	**205.6**	**427.1**
Grand Total		**499.0**	**560.8**	**626.5**	**660.5**	**612.0**	**718.6**	**737.9**	**396.8**	**460.1**	**492.2**	**5,764.6**	**5,381.0**	**11,145.5**

2019 is the financial year from 1 July 2018 to 30 June 2019

Table 15: Water supply capital expenditure forecast - $ millions (real - 2017/18 base)

Operational Area	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	Total 2019-2028	Total 2029-2038	20-Year Total
Water Sources	1.5	3.1	5.2	0.6	4.0	20.0	20.3	5.2	2.5	1.7	64.1	17.2	81.3
Raw Water Network	-	-	-	-	-	-	-	-	2.2	3.2	5.3	128.8	134.1
Water Treatment	33.2	18.6	9.6	14.3	28.7	100.8	101.2	6.2	6.2	20.3	339.0	283.7	622.7
Treated Water Networks	126.6	151.5	100.2	112.5	79.9	122.0	124.4	103.2	128.6	117.9	1,166.7	1,294.1	2,460.8
ECS Water	1.0	0.8	0.8	1.2	1.8	2.9	3.1	3.1	3.1	2.3	20.1	20.0	40.0
WATER Total	**162.2**	**174.0**	**115.8**	**128.7**	**114.5**	**245.6**	**248.9**	**117.7**	**142.4**	**145.3**	**1,595.1**	**1,743.8**	**3,339.0**

Table 16: Water supply capital expenditure forecast - $ millions (nominal)

Operational Area	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	Total 2019-2028	Total 2029-2038	20-Year Total
Water Sources	1.5	3.4	5.7	0.7	4.7	24.4	25.5	6.8	3.3	2.3	78.3	27.9	106.2
Raw Water Network	-	-	-	-	-	-	-	-	2.9	4.3	7.2	198.3	205.5
Water Treatment	34.4	19.9	10.7	16.5	34.0	122.9	127.2	8.0	8.2	27.7	409.3	454.6	864.0
Treated Water Networks	131.0	162.6	111.3	129.5	94.6	148.8	156.4	133.2	170.4	160.6	1,398.3	2,124.7	3,523.0
ECS Water	1.0	0.9	0.9	1.4	2.2	3.5	3.9	4.0	4.1	3.1	24.9	32.9	57.8
WATER Total	**167.9**	**186.8**	**128.6**	**148.1**	**135.5**	**299.5**	**313.0**	**151.9**	**188.7**	**198.0**	**1,918.1**	**2,838.4**	**4,756.5**

Table 17: Wastewater capital expenditure forecast - $ millions (real - 2017/18 base)

Operational Area	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	Total 2019-2028	Total 2029-2038	20-Year Total
Wastewater Treatment	135.8	131.6	129.7	124.7	112.6	59.8	54.9	24.6	43.8	60.4	877.9	427.6	1,305.5
Wastewater Networks	134.0	192.0	308.0	308.9	272.2	260.2	259.0	144.6	141.5	137.9	2,158.4	954.3	3,112.7
ECS Wastewater	5.2	3.2	1.3	0.8	2.3	3.6	3.9	3.9	3.9	2.8	30.8	25.0	55.8
Trade Waste	0.0	0.0	0.0	0.1	0.1	0.1	0.2	0.2	0.2	0.1	1.0	1.0	2.0
WASTEWATER TOTAL	**275.1**	**326.9**	**439.0**	**434.4**	**387.2**	**323.8**	**317.8**	**173.2**	**189.4**	**201.2**	**3,068.1**	**1,407.8**	**4,475.9**

Table 18: Wastewater capital expenditure forecast - $ millions (nominal)

Operational Area	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	Total 2019-2028	Total 2029-2038	20-Year Total
Wastewater Treatment	140.6	141.2	144.1	143.5	133.4	72.9	69.0	31.7	58.1	82.2	1,016.8	711.0	1,727.8
Wastewater Networks	138.7	206.1	342.1	355.5	322.4	317.4	325.7	186.5	187.6	187.9	2,569.9	1,583.3	4,153.1
ECS Wastewater	5.4	3.5	1.4	0.9	2.7	4.4	4.8	5.0	5.1	3.8	37.1	41.1	78.1
Trade Waste	0.0	0.0	0.0	0.1	0.1	0.2	0.2	0.2	0.2	0.2	1.2	1.6	2.9
WASTEWATER TOTAL	**284.8**	**350.8**	**487.7**	**500.0**	**458.6**	**394.9**	**399.7**	**223.4**	**251.0**	**274.1**	**3,624.9**	**2,337.0**	**5,961.9**

Table 19: Shared services capital expenditure forecast - $ millions (real - 2017/18 base)

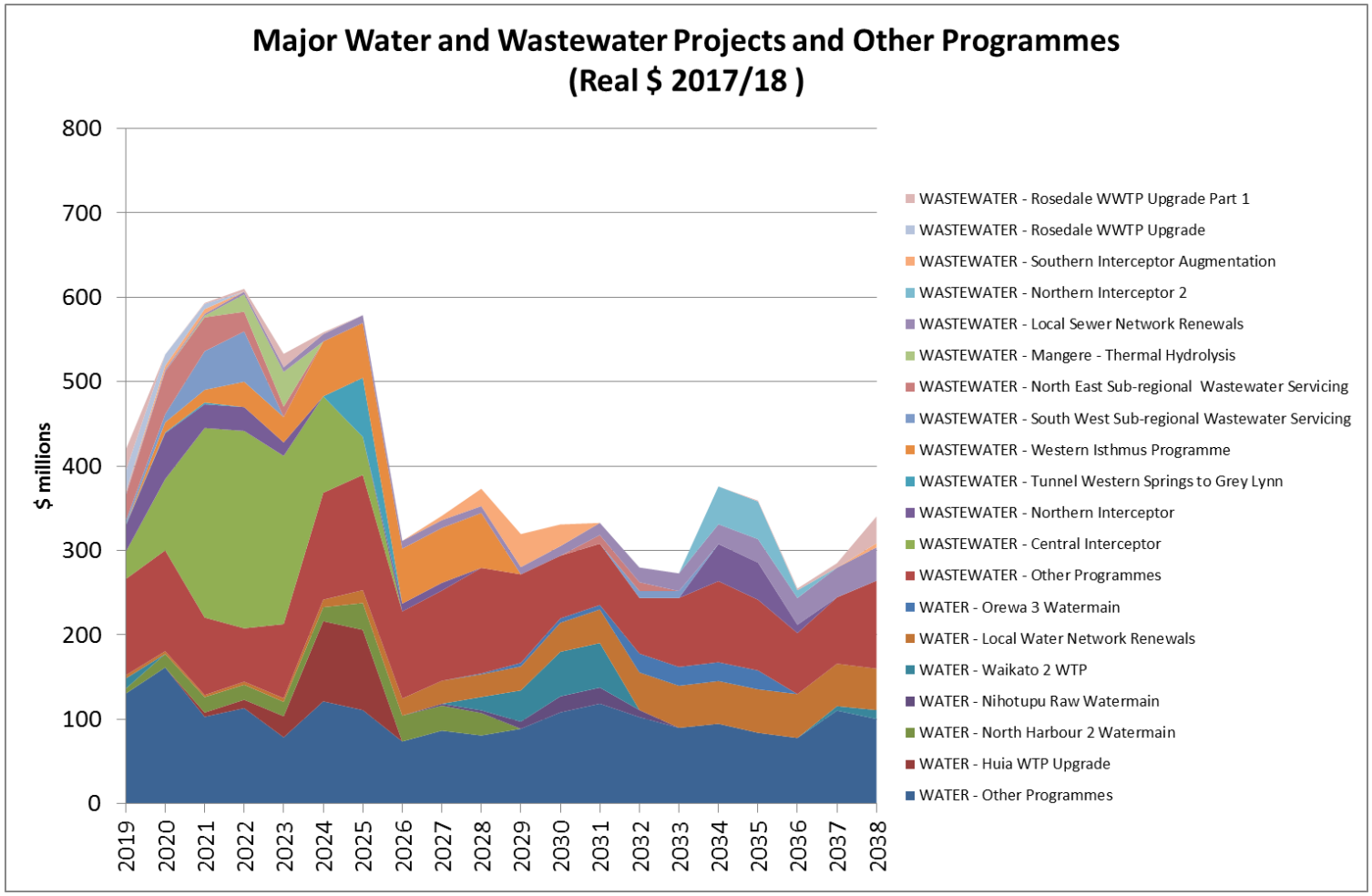
Operational Area	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	Total 2019-2028	Total 2029-2038	20-Year Total
Shared Services Maintenance	0.1	0.1	0.1	0.2	0.3	0.4	0.5	0.5	0.5	0.3	3.0	3.0	6.0
Shared Services Laboratory	0.6	0.5	0.5	0.7	1.1	1.7	1.8	1.8	1.8	1.4	12.0	12.0	24.0
Shared Services IS	33.7	11.5	5.2	5.2	6.2	6.9	8.8	8.5	7.9	5.9	99.8	56.9	156.6
Shared Services ECS	9.4	8.5	2.7	3.2	5.2	7.3	5.5	3.2	1.5	4.4	51.1	29.2	80.4
Shared Services Corporate	0.9	0.9	0.7	1.5	2.3	3.5	3.4	2.6	3.7	2.8	22.3	23.8	46.1
SHARED SERVICES TOTAL	**44.8**	**21.5**	**9.2**	**10.8**	**15.1**	**19.8**	**20.0**	**16.6**	**15.4**	**14.8**	**188.2**	**124.9**	**313.1**

Table 20: Shared services capital expenditure forecast - $ millions (nominal)

Operational Area	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	Total 2019-2028	Total 2029-2038	20-Year Total
Shared Services Maintenance	0.1	0.1	0.1	0.2	0.3	0.5	0.6	0.6	0.6	0.5	3.7	4.9	8.7
Shared Services Laboratory	0.6	0.5	0.5	0.9	1.3	2.1	2.3	2.4	2.4	1.8	14.9	19.7	34.7
Shared Services IS	34.9	12.4	5.8	6.0	7.3	8.4	11.0	10.9	10.4	8.0	115.2	93.8	209.0
Shared Services ECS	9.8	9.1	3.1	3.7	6.1	8.9	7.0	4.2	2.0	6.0	59.9	47.8	107.7
Shared Services Corporate	0.9	1.0	0.8	1.7	2.7	4.2	4.3	3.4	4.9	3.8	27.7	39.3	67.0
SHARED SERVICES TOTAL	**46.4**	**23.1**	**10.3**	**12.5**	**17.8**	**24.2**	**25.2**	**21.5**	**20.4**	**20.2**	**221.5**	**205.6**	**427.1**

Figure 32: What lies past 2028?

With the completion of the foundation projects such as Central interceptor, North Eastern and South Western sub-regional wastewater servicing projects on the wastewater side and the Huia WTP project and North Harbour 2 watermain on the water side, the annual capital investment forecast settles into a more stable pattern of around $350M per annum in real 2017/18 dollar terms.



10.3. Operational expenditure expectations

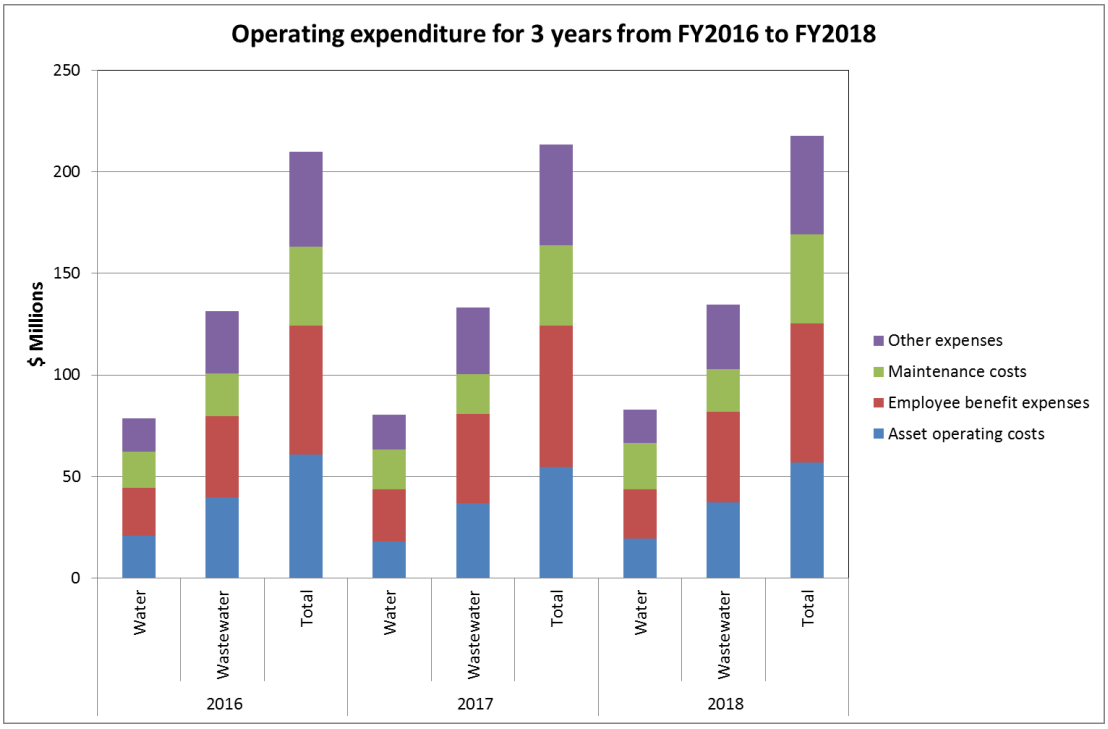
As with capital expenditure, it is helpful to provide a view of operational expenditure in the last few years as well as providing a forward view.

Table 21 and Figure 33 show the expenditure from FY 2016 to 2018

Table 21: Operational expenditure for the last 3 years

Business Area	Cost type	2016	2017	2018
Water	Asset operating costs	21.0	17.9	19.6
	Maintenance costs	17.7	19.8	22.8
	Employee benefit expenses	23.5	25.7	24.1
	Other expenses	16.3	17.0	16.5
Total Water		78.5	80.4	82.9
Wastewater	Asset operating costs	39.8	36.9	37.3
	Maintenance costs	21.0	19.9	21.2
	Employee benefit expenses	39.9	43.6	44.3
	Other expenses	30.6	32.6	31.8
Total Wastewater		131.4	133.1	134.7
Watercare	Asset operating costs	60.9	54.9	56.9
	Maintenance costs	38.8	39.6	44.0
	Employee benefit expenses	63.4	69.3	68.4
	Other expenses	46.8	49.6	48.3
Total Watercare		209.9	213.5	217.6

Figure 33: Operational expenditure over the last 3 years


Operating expenditure for 3 years from FY2016 to FY2018
$ Millions
250
200
150
100
50
0
Water
Wastewater
Total
Water
Wastewater
Total
Water
Wastewater
Total
2016
2017
2018
Other expenses
Maintenance costs
Employee benefit expenses
Asset operating costs

All forecasts exclude GST.

Table 22 : Operational expenditure 1 July 2018 to 30 June 2028, real $ (2017/18 base, millions)

Activity		2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2019-2028	2029-2038	20-year total
Water	Asset operating Costs	22.1	22.4	22.7	23.3	23.6	24.3	24.6	24.9	25.2	25.6	**238.7**	**273.9**	**512.5**
	Maintenance Costs	17.4	17.7	18.0	18.4	18.7	19.2	19.4	19.7	20.0	20.3	**188.7**	**213.0**	**401.7**
	Employee Benefit Expenses	27.2	27.6	27.9	28.2	28.6	29.1	29.3	29.6	29.9	30.3	**287.8**	**334.6**	**622.4**
	Other Expenses	13.1	13.3	13.4	13.5	13.7	13.9	14.0	14.1	14.2	14.4	**137.6**	**163.3**	**300.9**
Total Water		**79.8**	**81.0**	**82.0**	**83.4**	**84.6**	**86.4**	**87.3**	**88.3**	**89.3**	**90.6**	**852.8**	**984.8**	**1,837.6**
Wastewater	Asset operating Costs	38.2	38.9	39.4	40.0	41.0	41.7	42.6	43.2	43.7	44.4	**412.9**	**472.7**	**885.7**
	Maintenance Costs	25.3	25.7	26.0	26.3	27.0	27.4	28.0	28.3	28.6	29.1	**271.7**	**313.9**	**585.5**
	Employee Benefit Expenses	46.7	47.5	48.2	49.0	49.8	50.8	51.5	52.2	53.0	53.9	**502.7**	**563.9**	**1,066.6**
	Other Expenses	25.3	25.7	26.1	26.6	27.1	27.6	28.0	28.5	28.9	29.4	**273.2**	**303.6**	**576.8**
Total Wastewater		**135.4**	**137.8**	**139.7**	**141.9**	**144.9**	**147.6**	**150.1**	**152.2**	**154.2**	**156.8**	**1,460.5**	**1,654.1**	**3,114.6**
Watercare	Asset operating Costs	60.3	61.3	62.1	63.2	64.6	66.0	67.2	68.0	68.9	70.0	**651.6**	**746.6**	**1,398.2**
	Maintenance Costs	42.7	43.4	43.9	44.7	45.7	46.6	47.4	48.0	48.6	49.4	**460.4**	**526.9**	**987.3**
	Employee Benefit Expenses	73.9	75.1	76.1	77.2	78.5	79.9	80.8	81.9	82.9	84.2	**790.5**	**898.5**	**1,689.0**
	Other Expenses	38.4	39.0	39.5	40.1	40.8	41.5	42.0	42.6	43.1	43.8	**410.8**	**466.9**	**877.7**
Total Watercare		**215.2**	**218.9**	**221.7**	**225.4**	**229.5**	**234.0**	**237.4**	**240.5**	**243.5**	**247.3**	**2,313.4**	**2,638.9**	**4,952.3**

Table 23: Operational expenditure 1 July 2018 to 30 June 2028, nominal $ (millions)

Activity		2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2019-2028	2029-2038	20-year total
Water	Asset operating Costs	22.4	23.3	24.0	25.1	26.0	27.3	28.1	29.1	30.0	31.1	**266.5**	**394.2**	**660.7**
	Maintenance Costs	17.7	18.4	19.0	19.8	20.6	21.5	22.2	23.0	23.8	24.7	**210.7**	**306.6**	**517.3**
	Employee Benefit Expenses	27.7	28.6	29.5	30.5	31.5	32.6	33.6	34.6	35.7	36.9	**321.1**	**481.6**	**802.8**
	Other Expenses	13.4	13.8	14.2	14.6	15.1	15.6	16.0	16.5	16.9	17.5	**153.5**	**235.0**	**388.5**
Total Water		**81.2**	**84.1**	**86.7**	**90.0**	**93.2**	**97.0**	**100.0**	**103.2**	**106.4**	**110.1**	**951.9**	**1,417.5**	**2,369.3**
Wastewater	Asset operating Costs	38.9	40.3	41.7	43.1	45.1	46.8	48.8	50.4	52.1	54.0	**461.1**	**680.4**	**1,141.5**
	Maintenance Costs	25.7	26.6	27.5	28.4	29.7	30.8	32.0	33.1	34.1	35.3	**303.3**	**451.7**	**755.1**
	Employee Benefit Expenses	47.5	49.3	51.0	52.9	54.9	57.1	59.0	61.0	63.1	65.5	**561.3**	**811.6**	**1,372.8**
	Other Expenses	25.7	26.7	27.7	28.7	29.8	31.0	32.1	33.2	34.4	35.7	**305.1**	**437.0**	**742.1**
Total Wastewater		**137.7**	**143.0**	**147.8**	**153.2**	**159.5**	**165.7**	**171.9**	**177.8**	**183.7**	**190.5**	**1,630.8**	**2,380.6**	**4,011.5**
Watercare	Asset operating Costs	61.3	63.6	65.7	68.3	71.1	74.1	76.9	79.5	82.1	85.1	**727.6**	**1,074.5**	**1,802.2**
	Maintenance Costs	43.4	45.0	46.5	48.3	50.3	52.3	54.3	56.1	57.9	60.0	**514.1**	**758.3**	**1,272.4**
	Employee Benefit Expenses	75.1	77.9	80.5	83.4	86.4	89.7	92.6	95.7	98.8	102.4	**882.4**	**1,293.2**	**2,175.6**
	Other Expenses	39.1	40.5	41.8	43.3	44.9	46.6	48.1	49.7	51.3	53.2	**458.6**	**672.0**	**1,130.6**
Total Watercare		**218.9**	**227.0**	**234.5**	**243.2**	**252.6**	**262.8**	**271.9**	**280.9**	**290.2**	**300.6**	**2,582.7**	**3,798.1**	**6,380.8**


Watercare
Tapped into Auckland