Three Waters Final 2008 Strategic Plan

December 2008

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Document Contents

Auckland Three Waters Strategic Planning Programme

Final 2008 Strategic Plan

December 2008

Overview of the Strategy Development

The Three Waters Strategic Planning Programme was undertaken to tackle the big issues underpinning a region-wide approach to our region's future requirements for the provision of services in all "three waters" – drinking water, stormwater and wastewater. Each of the three waters is, of course, inextricably linked to the others.

Watercare – the region's bulk water and wastewater service provider – is pleased to have had the opportunity to lead the participating organisations through the integrated thinking required for the future.

This programme has raised some real and practical issues that must be faced by planners, policy-makers, politicians and – crucially – the general public as Auckland plans for the next 100 years.

In drinking water we need to encourage more efficient use. This is in the best interests of the environment but also may defer the need for major capital expenditure. Minimising leaks in water supply networks and encouraging consumers to use water more efficiently could have an impact on the timing of future capital projects – including the introduction of a new water source for the region.

Other options which need to be considered in this context are the substitution of rainwater in the place of A-grade drinking water for certain purposes, perhaps including toilet flushing, and the exploration of the possible use of stormwater or treated wastewater in specific industrial processes. Some of these options may appear challenging and there are practical issues to be considered. However we believe that outlining them in this report represents an important step in engaging the wider community for the next stages.

Another significant issue addressed in this report is the transfer and treatment of wastewater. The work done in this report indicates that a combination of our region's two wastewater treatment plants – in Mangere, to the south, and Rosedale, to the north – will be required for the foreseeable future. Sewer upgrades, including the construction of a new pipeline from central Auckland to Mangere, will be required. The approach taken to integrating land use planning and the management of stormwater will be critical.

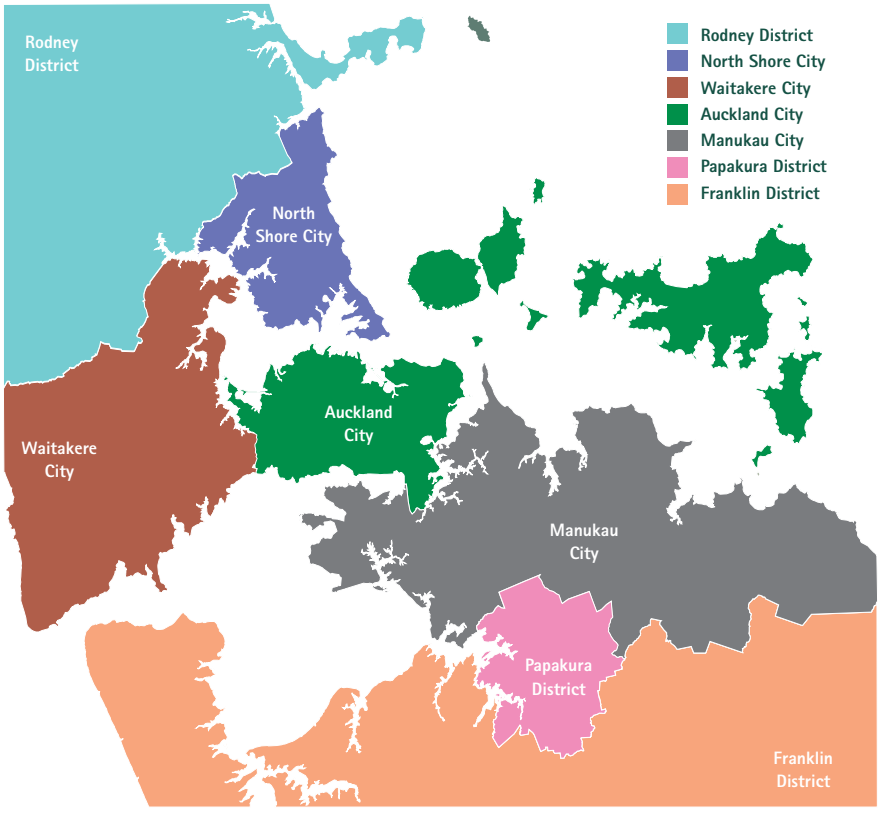
There will be considerable community and political interest in all of these issues. The increased environmental standards required by the public will be reflected in future infrastructure development.

Ultimately – of course – planning can only go so far. The next important stage of the Three Waters programme is the implementation phase, when each of the organisations with responsibility for key components of this region-wide picture picks up the challenge and delivers the results that Aucklanders need and deserve in the future.

K. M. Ford

Chief Executive

Watercare Services Limited



Our Region

Our communities demand improving environmental standards.

Future water supply, wastewater and stormwater services will reflect this.

Overview of Strategy Development and Purposes of this document

Participating Organisations

Strategic Plan development was led and co-ordinated by:

Other Participating Organisations contributing to the Auckland Region Three Waters Strategic Plan are:

The programme was established in 2004 at the request of the Watercare Shareholders Representative Group, with Watercare being charged with the role of programme facilitator.

Watercare, local network operators and councils of the Auckland region agreed in 2005 to prepare a regional three waters strategic plan.

An initial reason for the project was to investigate ways to deliver water supply, wastewater and stormwater services in the Auckland region in more integrated and efficient ways. The initial requirement was to develop a "Three Waters Vision" for the region. After publication of that Vision in June 2005, the participating organisations decided to continue to work together to prepare a Three Waters Strategic Plan to guide the delivery of wastewater, water supply and stormwater services in the region through to 2100 and beyond.

The most pressing Three Waters issue facing the region is wastewater and this is a major focus of the Three Waters Strategic Plan. In addition, the plan recognises the major benefits of reducing water demand in terms of delaying the need for new potable water sources to be developed. Stormwater management is primarily addressed locally by councils, but would benefit from more integrated regional land-use policy.

In developing this Three Waters Strategic Plan, considerable emphasis was placed on sustainability and the need to balance social, cultural, environmental and economic considerations.

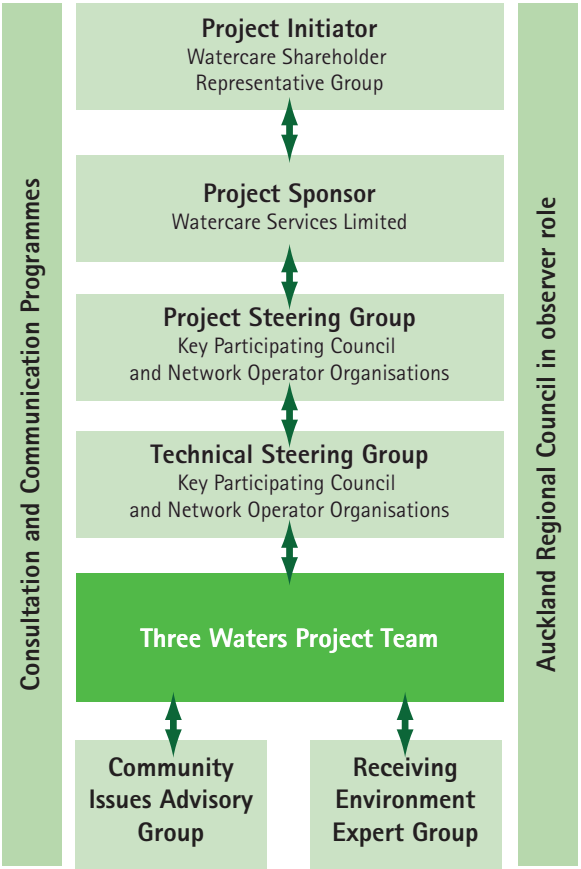
The Final 2008 Three Waters Strategic Plan:

1. Highlights the importance of water demand management.
2. Summarises key findings of more than four years of investigations undertaken collaboratively by Watercare, the councils and local network operators of the Auckland region.
3. Describes opportunities to better integrate water supply, wastewater and stormwater services and how to realise these opportunities.
4. Summarises options to address urgent wastewater issues and identify a suggested long-term strategy.
5. Describes future water supply needs and how best to address them.
6. Outlines a framework for moving forward on stormwater.

The Strategic Plan in Context

This document is one of a series of documents prepared as part of the Auckland Region Three Waters Strategic Planning Programme. Previous documents include:

Three Waters Vision	June 2005
Three Waters Issues Report	June 2006
Strategic Directions Discussion Document	December 2006
Draft for management comment	June 2007
Draft for comment by elected representatives and Board of Directors	April 2008
Final 2008 Strategic Plan	December 2008



Part A Strategic Plan Summary of Key Findings

Community and political commitment will determine the success of water efficiency and demand management measures.

Wastewater management requirements will not change as a result of reduced water usage

We require a new water source by 2026 unless we reduce water demand

The Waikato river offers the least cost future water source

A Stronger Emphasis on Water Demand Management is Proposed

It is proposed to reduce the gross per person demand for water by 15 % of 2004 levels by 2025. An additional 10 % of demand will be met by beneficially using stormwater and treated wastewater for industrial purposes and non-potable household purposes over the same period. These targets are provisional stretch targets totalling a 25% reduction in gross per person demand that will be confirmed or modified by December 2011 to take into account detailed cost benefits and public health risk assessments. These targets are likely to be achieved by a combination of some or all of the following:

- Leakage reduction programmes;
- Appropriate pricing mechanisms;
- Pressure management programmes;
- Beneficial use of treated wastewater for non-potable industrial purposes;
- Beneficial use of stormwater, using a combination of rain tanks and aquifer recharge for subsequent water supply purposes;
- Water audits of large users;
- Regional land use policy, including the promotion of sustainable urban design and low impact design methods;
- Water conservation through communication and education programmes; and
- Promotion of water efficient appliances and systems.

A regional demand projection tool is being developed to provide consistent methodologies and use of the regional drought management plan will be continued as the means of managing demand in times of serious water shortage.

Water Supply

Water supply entities in New Zealand are likely to face higher regulatory standards in relation to drinking water. Wide-ranging changes to the way we manage our water supply systems, from source to tap, are likely to be required, as a result.

A new water source for the greater Auckland area will be required by 2026, if regional water demand continues to grow in line with the latest forecasts.

The date by which a new source will be required will depend on a number of different factors, including population growth and the success of demand management measures and the beneficial use measures outlined above. If the above targets are met, it will be possible to defer expenditure of around $300 million on the next major water source upgrade for up to 20 years beyond its currently scheduled date of 2026.

Preliminary investigations to date indicate that, beyond our current water demand reduction targets, the expanded use of the Waikato River as the primary water source option will offer the next least-cost long-term solution. In this event, security of supply to North Shore City and Rodney District will be provided with a new sub-harbour pipe crossing.

Options based around a new northern water source, increased use of central Auckland aquifers, the use of rain tanks and/or treated wastewater use will continue to be considered.

In particular, a further review of northern source options will be undertaken before any commitment is made to construct a second pipeline from the Waikato River.

Wastewater

Significant upgrade work has occurred at the Mangere Wastewater Treatment Plant, which has contributed to the major improvement in the water quality of the Manukau Harbour. It is imperative that this success is built upon, through a continuing focus on the management of nitrogen and pathogen discharges to the harbour, in particular, through appropriate treatment.

The proportion of wastewater receiving full tertiary treatment will be increased to further minimise public health risk to users of the harbour. The discharge from the treatment plant will continue to be at the shoreline, generally in the same location as at present, but possibly nearer the treatment plant. Provision will be made to divert flows from parts of the contributing drainage catchment to an alternative regional wastewater treatment and disposal facility in time to ensure the nitrogen capacity of the harbour is not exceeded.

Our most immediate wastewater need is to provide trunk sewer capacity to central Auckland. This is required urgently to significantly reduce wet weather wastewater overflows that already occur and to avoid the occurrence of almost daily dry weather wastewater overflows, even in times of no or minor rainfall, by possibly as early as 2035. To meet this need, trunk sewer capacity to the Mangere Wastewater Treatment Plant will be augmented by way of a new Central Interceptor, with the final route and sizing optimised with the local network investment programmes to provide the least-cost regional solution. This will result in major regional benefits, including:

- A substantial reduction in the risk of trunk sewer breakages, which currently exists because some larger pipes cannot be entered for maintenance purposes;
- The provision of additional trunk sewer capacity to provide for growth in Auckland City, Waitakere City and longer term in Manukau City;
- A more than 70% reduction in untreated wastewater discharges to the environment from Watercare's trunk sewer network;
- The provision of on-line storage in the new trunk sewer so that, for most of the time, peak flows to the Mangere Wastewater Treatment Plant will be reduced to less than the maximum flow that can receive full tertiary treatment. This will result in public health benefits to users of the Manukau Harbour as referred to above;
- Trunk sewer flows from most of the serviced area draining to the Mangere Wastewater Treatment Plant by gravity, minimising energy use and associated costs; and
- Opportunities to substantially reduce the costs of regionally providing for growth and minimising adverse effects of wastewater overflows through optimisation with local network operators.

Based on projected regional growth, some wastewater flows will need to be diverted to other wastewater treatment facilities within the region at some time within the current planning period (up to the year 2100). It is possible that small local treatment plants will be able to meet some future needs, but there remains a need to secure a site for a second regional facility to provide certainty to the wider regional community that long-term wastewater needs can be met. A new regional facility could be required around mid way through the planning period, but could need to be operational as soon as 2027, depending on the outcomes of on-going investigations.

Extensive region-wide investigations of alternative wastewater treatment and disposal options have been

undertaken over at least the last 20 years in the Auckland region, the most recent as part of the Three Waters Strategic Planning Programme. The latest investigations used a range of assessment methods, starting with a multi-criteria analysis process to consider social, cultural and environmental issues. The investigations also considered costs over the whole planning period, but these were generally similar for all options and did not provide a basis for choosing one option over others.

In other respects, the option of using the existing Rosedale Wastewater Treatment Plant and new outfall as the second regional wastewater facility scored better than other options, using the different assessment methods and, overall, is the preferred option, based on our current understanding of future needs. A new facility in the north west of the region is also feasible but work to date has identified no clear advantages over the Rosedale option.

The Rosedale Wastewater Treatment Plant needs to be designated as a future regional facility so that appropriate planning protection can be provided to prevent such use being compromised by inappropriate land use changes. This will best be achieved by integrated planning that accommodates competing land uses, while ensuring effective and appropriate long-term community outcomes.

Prior to starting construction works required for the use of Rosedale as a regional facility, a further review of a north western option to make sure it does not offer a more appropriate solution for then current needs will be undertaken.

Stormwater Services

In general, stormwater needs to be managed locally in accordance with levels of service agreed with the local community for flood, stream and contaminant management. However, there is considerable merit in developing regionally consistent policy and infrastructure design and implementation standards for a range of issues that affect the delivery of both stormwater (and wastewater) services.

Policy Changes will be Required

As a direct outcome of the Three Waters Strategic Planning Programme, a Three Waters Policy Working Group was set up made up of representatives from all the local councils and network operators in the Auckland region, with the support of the Auckland Regional Council. The work undertaken by the Group has no official status but was intended to represent the views of experts in their respective fields of three waters management and land use planning and assist in developing the new Auckland Regional Policy Statement.

The Group outlined issues of concern, formulated desired outcomes and - where appropriate – suggested objectives, policies and methods. In broad terms, three key aspects were identified for:

- The benefits of existing and future regionally significant water infrastructure must be recognised, and provision made for its efficient establishment, operation, maintenance, upgrade and ongoing protection;
- The importance of water demand management measures and water-sensitive urban design and management principles must be recognised and promoted as part of a best practicable option framework; and
- The policy and planning framework for stormwater management must be addressed urgently, focused on a catchment-wide/city-wide approach, which highlights the importance of land use planning for managing the quantity and quality of stormwater. There must be a clear allocation of responsibility for catchment planning, with appropriate delegations of powers to allow for effective and efficient implementation that avoids duplication.

Energy Conservation

All planning for future three waters services is being undertaken to reflect the need to minimise use of and conserve energy, as far as practicable, while still meeting agreed levels of service

Cost of Delivery and Funding

All cost estimates were prepared for the purpose of comparing alternatives, not as a basis for establishing future funding requirements or the effects on rates. However, based on the work to date, the Strategic Plan proposals will not change projected Watercare costs from those set out in its current 10 year funding programme. Effects on funding after that time need further evaluation.

Governance Issues

The Three Waters Strategic Planning Programme specifically excluded any consideration of governance. The programme is being undertaken on the basis of the status quo, and in particular, that all organisations involved will continue to be responsible for those aspects of three waters management for which they are currently responsible.

This does not preclude the information being used in association with other governance structures in the future if required.

Equitable Sharing of Benefits

The joint planning and implementation of integrated solutions for the delivery of water supply, wastewater and stormwater will offer significant opportunities for efficiencies in resource use and cost savings. As part of the next stage of the Three Waters Strategic Planning Programme, these opportunities will be assessed in more detail and an equitable basis of sharing benefits recommended.

Next Steps

With the publishing of this Three Waters Strategic Plan, the Programme moves from its planning phase to its implementation phase. Achieving the desired outcomes will a require a further coordinated effort between the Participating Organisations. Effective implementation will require each party to:

- Prepare and action an implementation plan with targets for measuring performance;
- Share knowledge and support, when appropriate, for the regional achievement of performance targets; and
- Monitor and review the Strategic Plan to ensure it remains appropriate every six years.

Each of the Participating Organisations will develop their own specific Three Waters Implementation Plan outlining their actions for achieving the agreed Three Waters outcomes described in this Strategic Plan. It is important that progress against these actions is reported on at a regional level.

A combination of wastewater treatment at Mangere and Rosedale appears likely to offer the best medium to long-term solutions

Stormwater policy

No Watercare regional costs over and above its current 10 year funding plan projections are anticipated

This Strategic Plan excludes consideration of governance issues

Appropriate pricing mechanisms will be required moving forward

Satisfying urban and rural three waters needs

A 2008 snapshot and a possible future

	Urban		Rural	
	2008	Possible future	2008	Possible future
Water supply	Almost 100% bulk regional supply, treatment and distribution. Unrestricted demand.	Generally as 2008 with potential for up to 25% localised use of wastewater and stormwater as alternatives to new sources and additional demand management.	Combination of individual property and local community supply with some restrictions on demand to reflect supply availability.	Generally as 2008, with probable linkage to regional supply networks for some communities based on locality specific benefit - cost analyses.
Wastewater	Almost 100% centralised collection, treatment and disposal and very limited beneficial use.	Generally as 2008, with potential for additional beneficial use, depending on community and industry acceptability and physical feasibility.	Combination of individual and local community collect ion, treatment and disposal systems and no significant beneficial use.	Generally as 2008, with probable linkage to regional networks for some communities based on locality specific benefit - cost analyses.
Stormwater	100% local collection, treatment and disposal and no significant reuse. Main focus on flood protection and the use of bottom of catchment devices.	Generally as 2008 but potential for significant local use as alternative water source. Greater integrated catchment planning and increasing focus on stream protection and controls at source.	100% local collection, treatment and disposal with roof water used for water supply in mainly rural areas.	Likely to remain generally as 2008 but roof water use could decrease.
Wastewater solids	Biosolids beneficially used for land rehabilitation, as practicable. Remainder to landfill.	Some reliance on landfill will continue but preferred method is beneficial use for land rehabilitation and/or fertiliser substitute.	Some community systems rely on landfill. On-site treatment systems require solids disposal to urban wastewater treatment plants or rural septage disposal facilities.	Likely to remain generally as 2008 with possible trend to greater reliance on use of urban wastewater because of consenting difficulties for rural facilities.
Integrated three waters solutions	No significant integration within urban areas, however, some links in urban areas.	Integration to extent practicable to optimise efficiency and cost effectiveness.	Localised roof water use but no other significant integration.	Integration to extent practicable to optimise efficiency and cost effectiveness.
Urban – rural linkages	Limited linkages from urban to rural.	Greater reliance on rural areas for biosolids beneficial use or disposal.	Some septage to urban WWTP. Rural water supplies supplemented from urban supply during dry weather.	Generally as above, with some rural areas connected to urban areas as appropriate.

Part B General Background to the Strategy

Working in partnership with Maori

Kia pai te whakatere i te waka kei pariparia e te tai, ka morehu te kura nei

Steer with skill the canoe, lest the outgoing tide endanger the lives onboard

Important principles used in the Strategic Plan:

For Maori, linking the past, the present and the future is an important concept of life. We, too, must learn from the past in planning our future.

We must understand and exercise the principles of kaitiakitanga (guardianship) so those who follow can enjoy what we enjoy today.

We must establish the right Tikanga (protocols) that will enable us to deliver water supply, wastewater and stormwater services in an integrated and sustainable way.

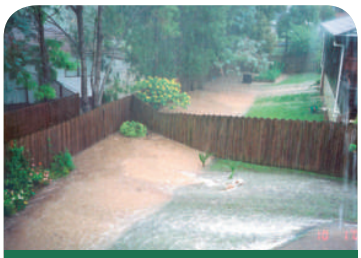
The above graph is indicative only, particularly from about 2030 onwards. Its primary purpose is to enable a best assessment of likely future infrastucture needs. Actual needs will be reviewed progressively to reflect updated information before investment decisions are made.

and three waters providers must ensure we ...

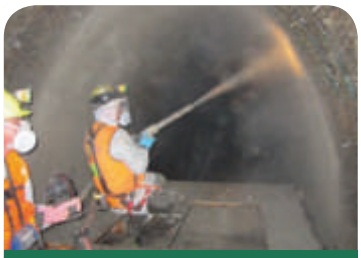
Protect our health and environment

Deliver services sustainably

Maximise efficiency through integrated delivery of three waters services



Plan for the effects of climate change



Maximise use of existing assets

Ensure flexibility to meet changing future needs

At all times during the development of the Strategic Plan, emphasis was placed on the need to balance social, cultural, environmental and economic considerations.

Why is this Three Waters Strategic Plan necessary now?

Water supply, wastewater and stormwater services will all need to:

- Serve up to 2.5 times the present population by 2100
- Satisfy changing legal requirements
- Deliver levels of service agreed with the community

Some issues require urgent attention

Planning for all issues needs to start now

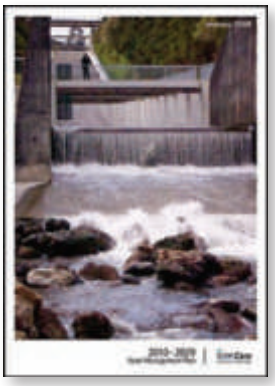
And we must look after both urban and rural communities

There is particular urgency to address key wastewater needs now...

Many household and local wastewater pipes leak and overload the networks

Some major sewers are near or at capacity in Central Auckland and some cannot be maintained because they flow full for significant periods of time

To avoid dry weather wastewater overflows that could occur almost daily in less than 30 years



Refer to Watercare Asset Management Plan 2008

For both public health and environmental reasons, it will be essential for these issues to be addressed

The Mangere Wastewater Treatment Plant will reach its flow capacity in about 2027, at projected population growth rates

Managing discharges from both the Mangere and Rosedale plants to protect the environment will continue to be very important

Limiting nitrogen and pathogen discharges into the environment, in particular, will be essential

Some Wastewater decisions are required by June 2009

Major works will be required to address these issues, including treatment plant upgrading and the duplication of major trunk sewers near the Mangere WWTP (to allow access for maintenance purposes). In the longer term, either possible relocation of the existing shoreline discharge in the Manukau Harbour or diversion of some flows away from the Mangere WWTP will be required.

Estimated capital costs for trunk components of possible complete schemes range from $3 to $4 billion over the period to 2100, excluding trunk sewer replacement and all local costs.

None of the above issues can be addressed by water demand management, low impact design, on-site wastewater treatment or local treatment plants. These options may all have a role to play, but in association with the continued use of existing infrastructure and upgrading works

Managing community demand for water to balance needs, costs and benefits

Reducing water loss and wastage and particularly leaks in pipe networks

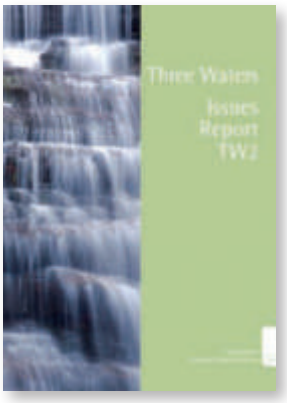
Finding ways of using stormwater safely, instead of piped supply

There are equally important water supply issues to be addressed, including...

Finding safe uses for treated wastewater instead of piped supply

Ensuring long-term security of supply for North Shore City and parts of Rodney District

Making provision to supplement rural water supplies in dry periods



Refer to Three Waters Issues Report TW2 for details

Making sure we have enough water treatment capacity to meet medium term needs

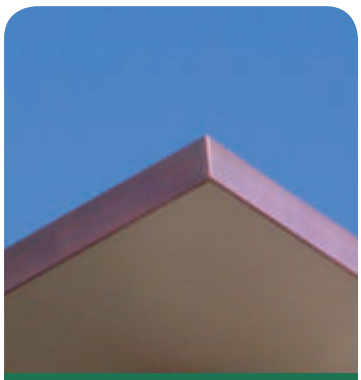
Securing sufficient water sources to meet long-term needs

And we need to look closely at whether we charge enough for water

The success of water efficiency will depend on community attitudes

Reductions in potable water use will not reduce the costs of wastewater management significantly, at least in the next 20 to 30 years. Collection pipes are designed to carry a wet weather allowance and dry weather flows are a small component of this total flow. Wastewater treatment depends mainly on contaminant loads, which are dependant on connected populations, but relatively unaffected by wastewater volume.

Regionally consistent stormwater policy will be key



To allow the prevention or control of stormwater contaminants at source

To reduce sediment discharges to the environment

To encourage stormwater use as a substitute for mains water supply

And so will a regional biosolids management plan

And for all three waters, well thought out central, regional and local government planning policies and infrastructure design standards will be essential if we are to minimise future problems

Building Act, LGA, RMA

Regional Planning

A regional Three Waters policy group has been formed to help address policy issues

National Standards

Auckland Regional Infrastructure Design Standards Manual

Towards sustainability

We will ensure sustainability by:

addressing the management of water, land and other natural resources as an integrated whole;

balancing social, cultural, environmental and economic objectives equitably;

avoiding waste, and where it cannot be avoided, minimising waste by reduction at source, reuse and/or recycling, where practicable;

minimising energy use;

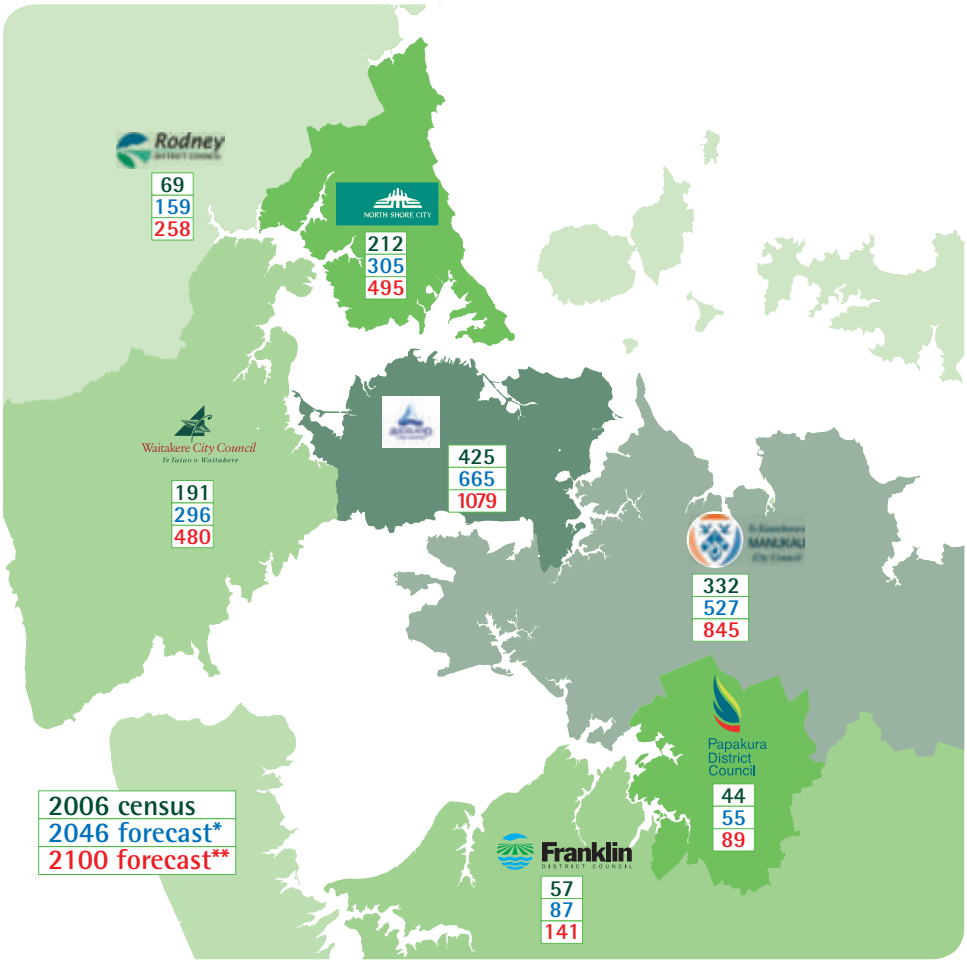
managing the requirements for new water sources by researching and implementing wastewater and stormwater reuse initiatives, where appropriate and practicable;

promoting community guardianship of natural resources that affect them;

promoting kaitiakitanga (guardianship); and

seeking solutions to immediate problems that contribute to sustainable longer-term outcomes.

Our Three Waters Vision



Key Driver No.1 - Providing for growth

Projected growth to 2100 by district

Regional growth of up to 2.5 times our present population could occur by 2100

*Population forecasts for city and district council areas in thousands. Source: Statistics New Zealand.

** Population forecast after 2050 by Shearer Consulting.

Key Driver No. 2 – Meeting wide-ranging legal requirements

Key requirements

- Aligning Three Waters Strategic Plan with Long Term Council Community Plans.
- Lobbying central government to change legislation where required.
- Ensuring consistent regional policy, aligned with outcomes of this strategy
- Providing clear guidance on important legal requirements
- Ensuring consistent interpretation and application of policies.

Local Government Act

This Act promotes the accountability of local authorities to their communities.

It provides for local authorities to play a broad role in promoting the social, economic, environmental and cultural well-being of their communities, taking a sustainable development approach.

It requires local authorities to identify all reasonably practicable options and consider the benefits and costs of each option in terms of the present and future social, economic, environmental and cultural well-being of the district or region.

Building Act

The Act sets performance standards to ensure that buildings are designed, constructed, and able to be used in ways that promote sustainable development, including:

- the efficient and sustainable use of materials in buildings; and
- the efficient use of water and water conservation in buildings.

Resource Management Act

The purpose of this Act is to promote the sustainable management of natural and physical resources.

It requires the use, development, and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural well-being and for their health and safety while:

- Sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations; and
- Safeguarding the life-supporting capacity of air, water, soil, and ecosystems; and
- Avoiding, remedying, or mitigating any adverse effects of activities on the environment.

Health Act

The underlying principles of the Act are to provide obligations and tools for city and district councils and others to ensure the protection of public health.

Key Driver No. 3 – And providing the following levels of service

We need to better inform the community

Water Supply

Present drought security design for 1:200 year drought with reservoirs drawn down to empty (equivalent to 1:50 with 25% remaining capacity).

Minimum of 24 hours storage of treated water available throughout the distribution system.

Supplies to meet New Zealand Ministry of Health Drinking Water Quality standards.

Wastewater

Ensure pipe capacity to contain dry and wet weather design flows.

Wet weather overflows from wastewater conveyance systems managed to meet resource consent conditions and customer expectations.

Optimisation of local and trunk network solutions.

Stormwater

Levels of service determined at local level by Territorial Authorities and may vary.

No regional levels of service to be addressed within Three Waters Strategy.

Habitable floor levels to be above 1:50 or 1:100 year return period storm events.

Pipes to provide capacity for between 1:5 and 1:20 year return period event.

We need to encourage:

- Better maintenance of private infrastructure to reduce leakage, in part through more stringent design standards
- Using less water.
- Making the use of treated wastewater more acceptable in particular circumstances.
- Reducing stormwater contaminants.
- Greater use of low impact design techniques.
- Improved design and construction standards / policies.
- Testing levels of service as appropriate through out the planning process.

Surface water impoundments

River sources

Groundwater resources

The environment we want to protect

Urban Lakes

Protecting the quality and values of our aquatic environment is an important regional objective and one that the three waters project will contribute towards.

To help us do that, we need to understand the environment, and how it is used.

Rural environments

Urban Streams

Rural community beaches

We have a beautiful environment we must protect for present and future generations

Developing Catchments

Urban Beaches

Receiving environments for treated wastewater

The uses of the environment we value

Urban water supply

Stock watering

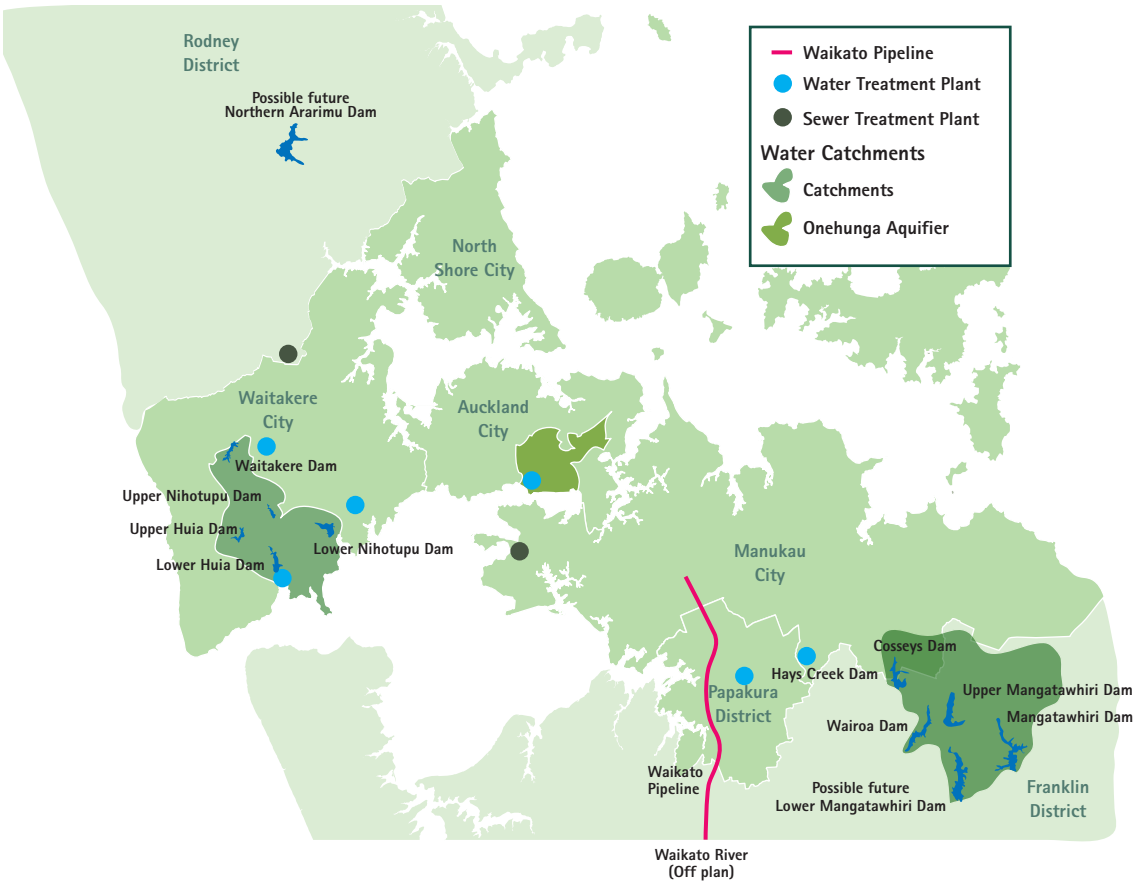
Horticulture

Water play

Treated wastewater discharges

Yachting

The environment supplies all our water



Approximately 70% of the current water supply for the Auckland region is provided by sources and treatment to the south of the main metropolitan area. There are specific places that are critical to the successful operation of the bulk water network:

- The Ardmore water treatment plant provides 60% of the water supply for the region. The Huia water treatment plant provides 25%, with the balance provided from five other facilities.
- Redoubt Road is a large treated water reservoir complex which collects and distributes all southern water.
- South to north pipelines carry the majority of regional water supplies but areas around Mangere do not have the benefit of a bulk water ring main.
- Supplies to the north of the region are carried over two road bridges.

The loss of any part of this infrastructure would have a major negative effect on Aucklanders.

Over the past 100 years the infrastructure that delivers water in the Auckland region has grown as the population has expanded. For example, the addition of large diameter water pipelines to the Watercare mains network has been a gradual process with, on average, six kilometres of pipe added every year for the past 50 years.

These assets will last for many years. The lifetime of the pipes will depend on the material they are made from and where and how they have been installed. Asset management plans record when the pipelines were installed and what they were made from. Reviewing those combinations of installation and expected lives means a forward projection of pipeline replacement or rehabilitation can be forecast.

This pattern of installation and asset life will also be recorded and reviewed for:

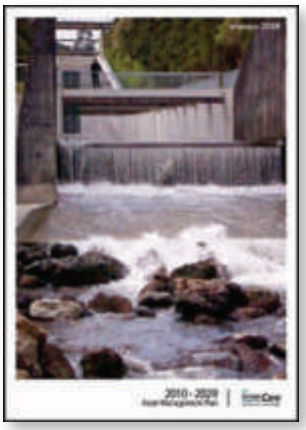
- Impounding reservoirs in the Waitakere and Hunua Ranges.
- All other asset types such as pumping stations and treatment plants.
- The local distribution systems.

Many of our existing water supply assets will need upgrading to:

- Meet more stringent New Zealand Drinking Water Standards.
- Provide for growth
- Provide greater security of supply

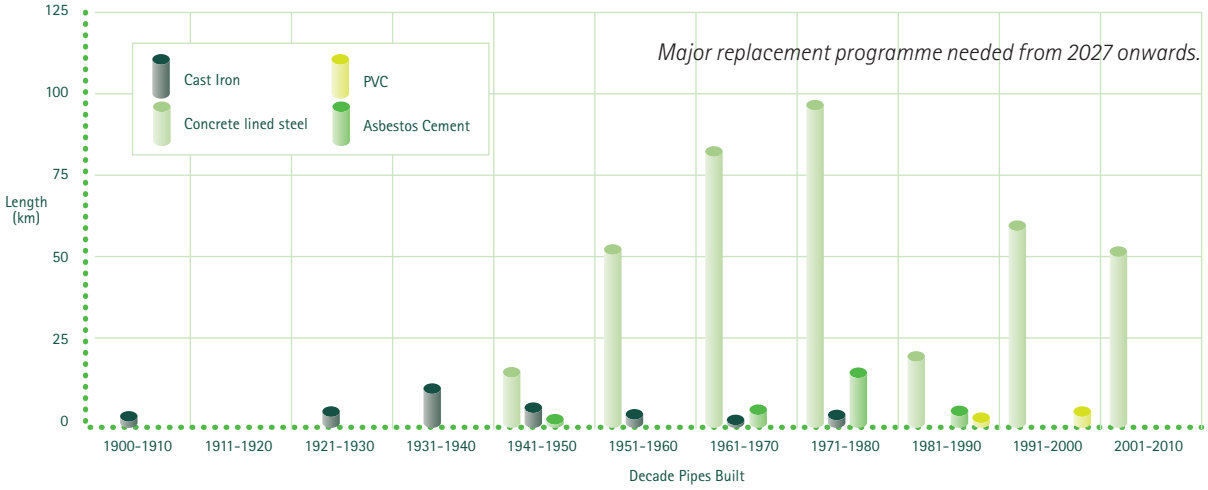
One example is the need to provide additional pipeline capacity from the Redoubt Road Reservoir to central Auckland.

Key water supply assets we need to look after and use to our advantage



Refer to Watercare Asset Management Plan 2008

Watercare trunk treated water mains' length distribution by year built



Key assets we need to look after and use to our advantage. Maintaining our current services – looking forward

Asset management plans generally look forward 20 years but this Strategic Plan has a 100 year horizon and indicates that significant investment for maintaining networks will be needed in addition to that required to meet population growth.

- Between 2027 and 2100 trunk water pipes replacement estimated at $2.4billion and trunk wastewater at 2.3billion (Watercare only)
- For trunk water pipes the replacement profile continues to increase from now through to a forecast peak in the period 2040 to 2060. At this time an estimated 110 kilometres of pipe will need to be replaced every decade.
- For Watercare's trunk wastewater network the oldest of the sewers were built immediately after the First World War. The capacity of that system has in many cases been exceeded as designers at that time looked to meet the future population forecast for the 1950s or 1960s. The lack of capacity today in that part of the system is a key driver for wastewater investment.
- The 1950s and 1960s saw expansion of the wastewater system to convey wastewater to the Mangere WWTP. Those systems are likely to require replacement in the decade 2040 to 2050 and beyond, broadly at the same time as the peak of water pipe replacement.
- The value of Watercare's trunk water and wastewater pipe systems today is $672 million (Watercare 2008 Annual Report).
- The value of North Shore's trunk wastewater pipe systems today is $50 million.
- When originally installed, many of these pipe systems would have been in less built up areas. By the middle of the 21st century the majority will be in built up urban environments. Replacement of pipe networks will present many challenges including:
  - Maintaining the levels of service while taking parts of the network out of commission;
  - Availability of pipeline materials in New Zealand;
  - Cost of works and spreading the effect on prices to customers; and.
  - Inconvenience to others when pipelines have to be excavated as many are in transport corridors.

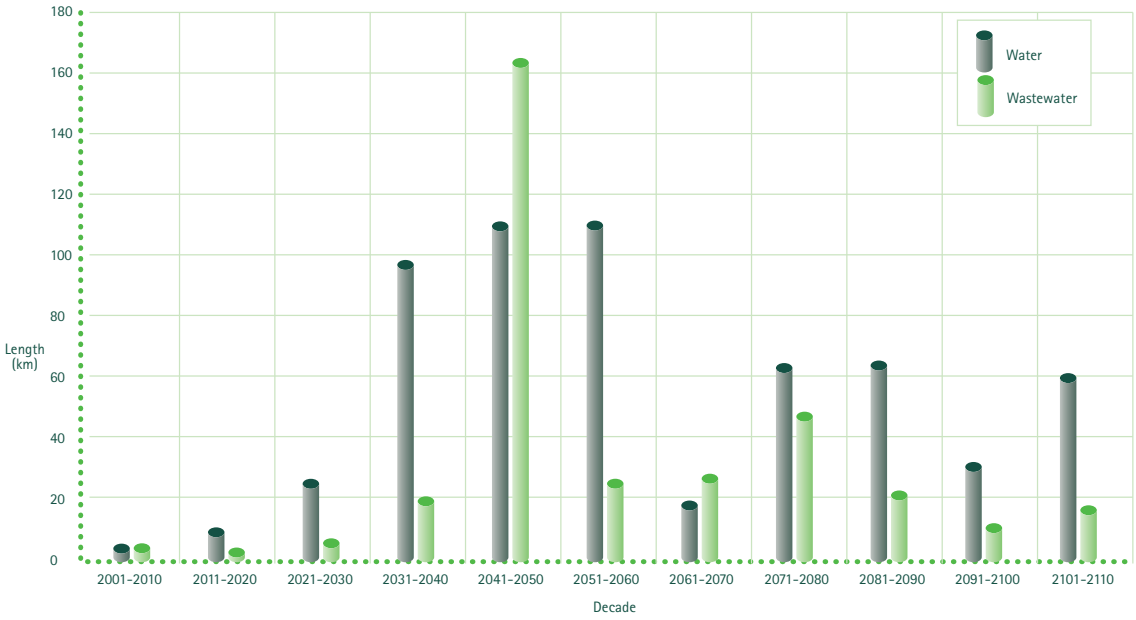
These figures exclude all local system costs.

Watercare trunk wastewater pipes replacement estimated at $2.3B between 2027 and 2100

Local water and wastewater systems will also require substantial renewal costs

Watecare Trunk Pipeline Replacement Profile

Lengths of trunk pipeline (water & wastewater) forecast for renewal in 10 year periods



Key wastewater assets requiring protection

Mangere Wastewater Treatment Plant (WWTP) in the South West of the region.

Rosedale Wastewater Treatment Plant (WWTP) in the North East of the region.

North Shore City has trunk wastewater assets that will need replacement in similar time frames.

Planning for climate change

Future climate change is considered in this 100 year strategic plan as effects could influence in particular:

- sources of water for supply;
- the behaviours of consumers; and
- the drainage networks.

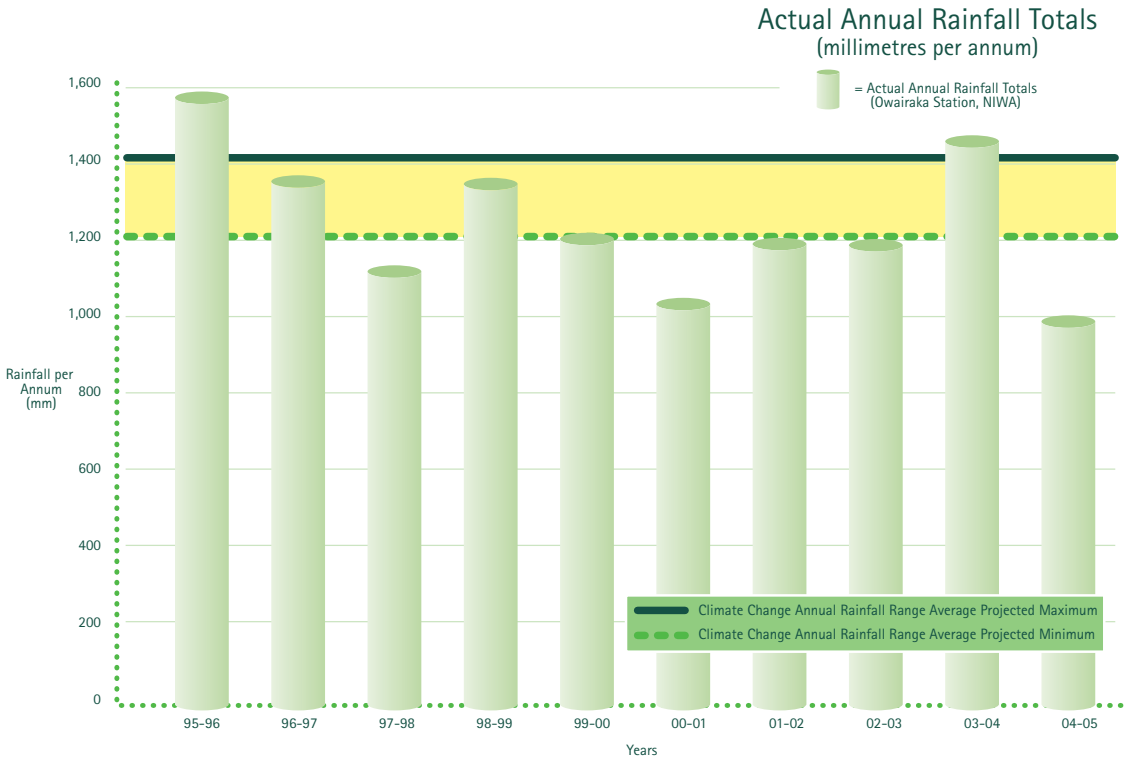
Natural variations will continue to affect the New Zealand climate in future, along with long term climate change trends. These variations, such as the El Nino and Interdecadal Pacific oscillations, may act to suppress or enhance the effects of climate change over periods of two or three decades.

Scenarios for Auckland region published by the Ministry for the Environment in 2004 suggested variations in rainfall of between -6% and +2% over the annual average precipitation.

Reviewing the past ten years of rainfall indicates that annual rainfall totals for Auckland have varied by -21% and + 25% of the average.

During this period the region has been able to meet demand despite these variations and during the most serious drought on record.

This suggests that the water sources are robust enough to cope with the suggested variations in the future climate, subject to proving additional capacity to meet future demand.



There is a strong relationship between air temperature and demand for water. The Ministry for the Environment scenario suggests annual average air temperature variation of between 0.6°C and 1.3 °C between 1990s and 2030 and 0.6 °C and 3.8 °C between 1990s and 2080s. The regional treatment and distribution facilities are designed for peak demands during the hottest part of the year.

Recorded short, sharp daily variations exceed those projected as a result of climate change and are more important than annual average temperatures. Patterns of demand will continue to be monitored to ensure appropriate plans are put in place when climate signals are clear.

Wastewater and stormwater networks will be affected by increased peak flows. Work undertaken by North Shore City Council suggests a wet weather wastewater overflow occurring once a year at present could occur twice as often in the future.

Wastewater treatment plants are built to handle the sudden increase to inflows caused by heavy rain. The potential effects of changes in rainfall intensity will be taken into account when detailed upgrading options are considered.

The most recent publication of findings by the International Panel on Climate Change provides a greater degree of certainty around the possible effects. Specific Auckland based scenarios will be considered for the effect of extreme events, recognising that short term climate is likely to be a greater driver than long term changes.

Climate change will affect all of us and we must plan for it

A regional biosolids management strategy that encourages beneficial use is required

Nationally and internationally; there is recognition that biosolids can be used beneficially rather than being sent as waste to commercial landfills. Beneficial uses include soil conditioning, land rehabilitation or use as a fertilizer. Currently, the region does not have readily available markets for the beneficial uses of biosolids.
Regionally, the two largest wastewater treatment plants at Mangere and Rosedale produce 300 tonnes per day and 30 tonnes per day of biosolids respectively.

Action to address the regional management of biosolids

Watercare has entered into an agreement with the Kelliher Charitable Trust that will see quarried parts of Puketutu Island rehabilitated with treated biosolids from the Mangere Wastewater Treatment Plant, subject to resource consent processes. Puketutu Island is in the Manukau Harbour adjacent to the Mangere Wastewater Treatment Plant.

Mangere produces a high quality biosolids product which is safe to use for soil conditioning and land rehabilitation.

Permits for the proposal will be sought from both the Auckland Regional Council and the Manukau City Council in 2008. The rehabilitation proposal includes a biosolids impoundment covering the quarry site with a void space of around 4,000,000 m^3 for biosolids. This will cater for our biosolids needs for more than 35 years.

Subject to successfully gaining permits for this sustainable use of biosolids, Puketutu Island will be ultimately used as a regional park. The regional park will be in public ownership.

Other work on beneficial uses of biosolids is also being undertaken to compliment the Puketutu Island scheme.

North Shore City council and Watercare continue to explore new opportunities, for example application to forest.

Major beneficial use of biosolids is proposed subject to Resource Consents

The Three Waters Strategic Plan is well aligned with the Auckland Sustainability Framework

Alignment with the Auckland Sustainability Framework

This Three Waters Strategic Plan is well aligned with the thinking and outcomes of the Auckland Sustainability Framework. Through its eight 'goals' and eight 'shifts' the Framework is aimed at improving the regions forward planning processes so that it can better respond to future changes and opportunities. This aim has been echoed through the Three Waters Programme over the past four years, through the regionally supported Steering Groups, regular working groups and publication of the many joint regional planning publications.

The Auckland Sustainability Framework confirms that over the Three Waters Planning Period, the Auckland region will face significant changes from global forces such as population growth and climate change.

The concept of sustainability is at the heart of the Auckland Sustainability Framework and the Three Waters Strategic Planning Programme, with both initiatives having a key focus on developing a resilient region with robust ecological systems supported by the provision of infrastructure that has flexibility built in for the future.

Part C
Integrating the delivery of Three Waters Services

Maximising efficiency by integrated delivery of three waters services

	Existing urban water supply Infrastructure	Existing urban wastewater infrastructure	Existing urban stormwater infrastructure
Where we are now			
Deciding our future needs	**Establish future needs** Levels of service (Urban and rural) Managing our water demand Wastewater use Stormwater use	**Establish future Needs** Levels of service (Urban and rural) Flow reduction opportunities Beneficial use Potential	**Establish future Needs** Local solutions for flood control and stream management Regional approach to contaminant control at source Beneficial use policy
Identifying our options	**Investigate Options** Demand reduction New sources Regional infrastructure needs Policy	**Investigate Options** On site solutions/ local treatment Regional infrastructure needs Community and discharge locations Policy	**Investigate Options** Focussed on policy Sediment control Contaminant control Beneficial use Design standards
Evaluating Options	Optimisation, Scenario Analysis, Multi Criteria Analysis		
Implementing	Mix of solutions to best meet needs – appropriate design standards, low impact design, on site and local solutions and regional infrastructure		

Integrated policy, design and delivery

We have choices - the community must decide what it is willing to accept

In the short term, an immediately available option for integrating three waters delivery is the use of rainwater collected on site as a source of non-potable water. This can be used in both greenfield development sites and in brownfield development sites, particularly as redevelopment occurs. The cost of using rainwater is higher than many alternatives but may still be an option of choice for some members of the community. Its use can have other benefits in relation to stormwater management.

Low impact design, control of contaminants at source and local use of treated wastewater as a source of non potable water should be encouraged within a consistent regional policy framework. This needs to be developed cooperatively by regional and local councils and network operators to take into account overall costs and benefits. This work is currently underway.

Use of treated wastewater for industrial purposes is viable and the extent of use will depend on relative costs compared to the cost of potable water.

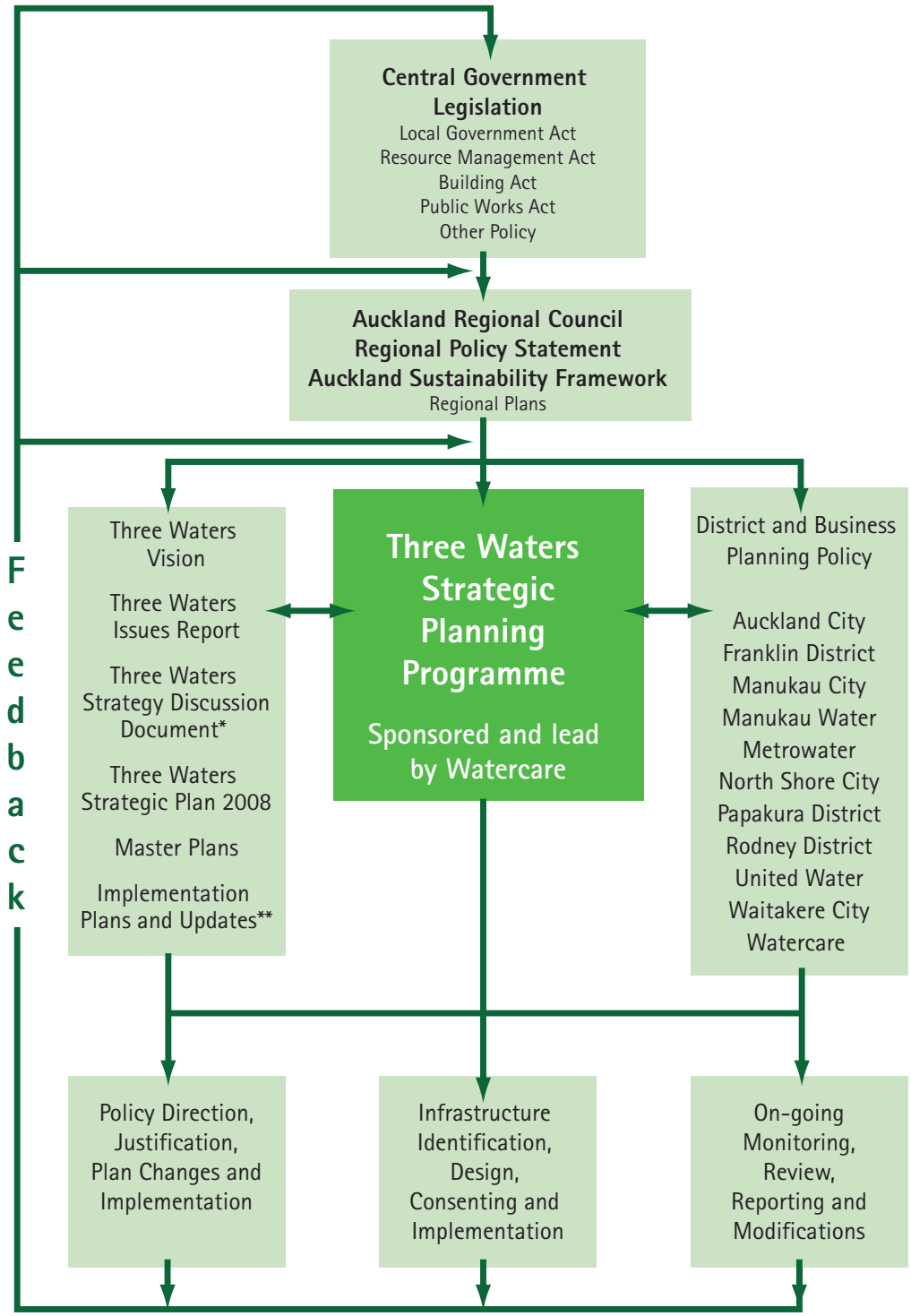
Use of treated wastewater as a direct substitute for potable water is technically feasible. This will require consultation and strong community and Ministry of Health support. Direct use of treated wastewater for drinking is not included as a part of the current Strategic Plan.

Worldwide trends include:

- Integration with community outcomes.
- Restoring the water cycle.
- Protecting and enhancing ecosystems.
- Recycle, reduce and reuse.

The Auckland community must decide which of the above it is willing to accept.

Water demand management must be actively promoted, if we are to defer the need for new water sources.



Within an integrated statutory and planning framework

Many organisations have a role to play in delivering Three Waters Services

* Produced as a draft discussion document with no formal feedback request.
** Work already commenced.

Water demand management will be a critical requirement for the successful delivery of efficient three waters services. This is discussed in Part E.

Integrated planning in a broader context

The delivery of three waters services is inextricably linked to land use planning, which is undertaken by regional and district councils and, consequently, is outside the control of network operators. The Three Waters Strategic Planning Programme is being undertaken to reflect:

- Current land use and development areas as defined in regional and district planning documents, in particular, the Regional Growth Strategy;
- Possible areas outside the current Metropolitan Urban Limits that could be developed in the future; and
- Projected population growth to 2100 that will affect future land use patterns.

The Three Waters Strategic Plan was prepared to service the needs of the community in accordance with known requirements and to respond to changing future needs, not to constrain growth by limiting access to three waters services.

The methods and actions that will be taken to ensure integrated delivery of three waters services are described in the following chart.

Integrated, coordinated actions are required on an on-going basis

Three Waters Strategic Planning Programme

Goal	Method	Joint action by Watercare and Local Network Operators
Providing for Growth	Regional Strategic Planning	Participate in Regional Sustainability Framework Process
Meeting Regulatory Requirements	National Policy Development	Lobby Central Government on Matters Relating to Three Waters
	Regional Policy Development	Participate in Regional Policy and Plan Processes Relating to Three Waters
	District Plan Policy Development	Contribute to District Plan Policy Development Relating to Three Waters
Agreeing Levels of Service	Local Government Act Processes	Provide Input to Long Term Council Community Plans
	Consumer Liaison Programmes	Customer Surveys and Consultation Programmes
Delivery of Integrated Three Waters Services	Seamless Efficient Delivery of Services	Joint Planning of Trunk and Local Networks
	Regional Consistency	Development of Regional Infrastructure Design Standards Manuals
	Linked Provision of Services	Potable Water Substitution by Stormwater and Treated Wastewater to Appropriate Extent
	Sustainable Delivery of Services	Balanced Consideration of Social, Cultural, Environmental and Economic Well-beings
	Optimised Maintenanace and Operating Programes	Development of Regional Infrastructure Manuals
	Three Waters Strategic Plan	Development of Regional Implementation Plans

Part D
Wastewater

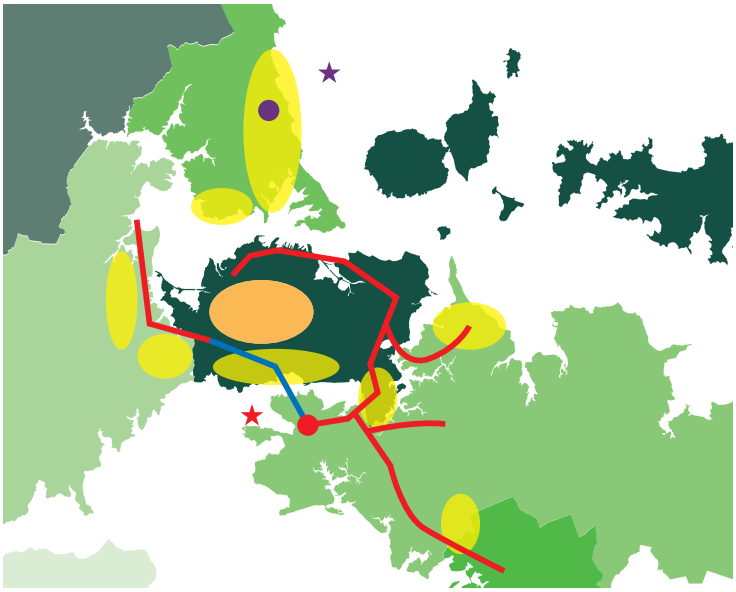
Wastewater - our current situation

The Mangere Wastewater Treatment Plant is a state of the art facility which treats flows from Auckland City, Manukau City, Papakura District and Waitakere City

The Rosedale Wastewater Treatment Plant is a state of the art facility which treats flows from North Shore City

Wastewater Treatment and Discharge Facilities

- Existing North Eastern (Rosedale) WWTP
- 2010 long sea outfall discharge from Rosedale WWTP
- Existing South Western (Mangere) WWTP
- Existing Shoreline discharge from Mangere WWTP



Indicative Wastewater Network Issues

- Existing combined sewer area, area with main wastewater wet weather overflows and area with dry and wet weather capacity constraints
- Existing areas of known higher and/or moderate infiltration and inflow
- Watercare trunk sewers with capacity constraints in the short to medium term
- Critical Watercare trunk sewers which cannot be accessed for maintenance purposes

Many wastewater issues need to be addressed now and in the future.

Central Auckland area where wastewater capacity upgrades are needed most and which are furthest from existing treatment plants

Like many of our large trunk sewers, the Hobson Bay pipeline is nearing the end of its life and is being replaced to provide more capacity

Average projected daily wastewater flows as m^3/d* (indicative)

* Based on 300 litres per person per day, which includes allowances for domestic, industrial and commercial use and groundwater and surface water inflow.

City or District	2006	2016	2046	2076	2100
Auckland	120,000	150,000	200,000	270,000	325,000
Manukau	90,000	115,000	150,000	210,000	255,000
North Shore	60,000	75,000	90,000	120,000	150,000
Papakura	12,000	15,000	20,000	25,000	30,000
Waitakere	55,000	70,000	90,000	120,000	150,000

Wastewater – some facts and figures – present and future

Main Watercare trunk sewer capacity

Sewer Name	Areas Served	Issue	Action Required
Western Interceptor	WCC and 4000ha of ACC and parts of MCC	Capacity upgrade required before 2050	Concourse storage required in Waitakere City by 2012
Manukau Siphon	As above	Inaccessible for maintenance	Requires duplication to allow access (priority)
Hillsborough Tunnel	Central Auckland	Inaccessible for maintenance	Requires duplication to allow access (priority)
Orakei Main Sewer	Central Auckland	At wet weather capacity**	Capacity augmentation
Eastern Interceptor	Central Auckland, MCC	At wet weather capacity**	Capacity upgrade, including new Hobson Bay Tunnel (under construction)
Southern Interceptor	MCC, Papakura District	Upper section requires duplication by 2015**	Duplication
South Western Interceptor	As above	Middle section requires duplication by 2030**	Possible Duplication

(Note : This does not include North Shore trunk sewer constraints or local network constraints).

Existing wastewater treatment plant capacities m^3/d

WWTP	Current Average Daily Flow	Treatment Capacity		Disposal Capacity	
		Currently Consented	Maximum Possible	Maximum at Existing Location	Maximum at Alternative Location in General Locality
Mangere	300,000	390,000	>750,000***	450,000, subject to confirmation	>600,000* Papakura Channel) > 750,000 (South Tasman Sea)
Rosedale	65,000*	90,000*	> 450,000***	>450,000, subject to confirmation	Not assessed

Existing treatment plants have potential to treat much greater populations than at present

* As meaning above ** Upgrades required to meet regional overflow targets *** Some upgrading would be required.

Wastewater – Learning from the past

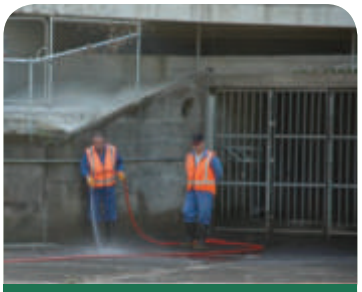
Some ways of dealing with waste that were successful in the past can no longer be used in Auckland urban areas because of their effects on public health and the environment....




It is no longer acceptable to the people of Auckland to have:

Sanctioned discharges of untreated or poorly treated wastewater to water

Unlimited wastewater overflows

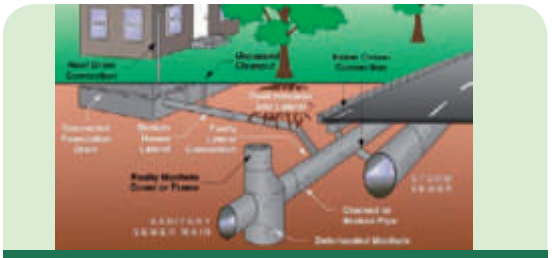


Unpleasant odours from any part of wastewater systems

Simple, local problems can have major cumulative effects

Practical experience shows:

Gulley traps can allow large volumes of stormwater into wastewater networks



Private household sewers are a major source of excess flows into public sewers and it is not practicable to provide a water-tight system

If flows in pipes get too low, like during the 1994 drought, problems with solids settling occurs

It is not possible to prevent all overflows occurring

Question	Answer	Influencing factors	Approach used in Three Waters Planning
What effect will water demand management have on future wastewater management needs?	No significant effect for the foreseeable future, but could in future if alternative household wastewater systems used, such as vacuum systems or grinder pumps. Care required to avoid insufficient flow to keep solids moving along pipes.	Demand management could reduce dry weather wastewater flows. These have no significant effect on pipe sizes (designed for peak wet weather flows) or treatment plant size (design mainly affected by load from number of people served not dry weather flow).	Water demand management will be promoted for water supply reasons, not wastewater. This can be reviewed depending on levels of water savings achieved in the future
Will on-site wastewater systems be used to avoid or reduce the need for major infrastructure upgrading in existing urban areas?	On-site systems will not form a significant part of the solution for existing urban areas. Major upgrades are required to address existing issues. Any use of on-site systems in existing urban areas would have negligible, if any, effects on trunk wastewater upgrading requirements.	On site systems are not suitable for use in most parts of urban Auckland because of high population density, low permeability soils and risks to public health and the environment.	Use of on-site systems will be facilitated for use in appropriate circumstances in greenfield developments.
Will local wastewater treatment systems be used to avoid or reduce the need for major infrastructure upgrading in existing urban areas?	Local wastewater treatment systems will not form a significant part of the solution for existing urban areas. They are generally unsuitable for use in major urban areas, except where safe use or disposal methods exist.	Safe disposal methods do not generally exist in most parts of urban Auckland, as most soils are low permeability and discharge to streams would require high-cost treatment that would not represent the Best Practicable Option. Where a defined use for treated wastewater exists, local plants can be built later but this will not change initial upgrading needs.	Once a preferred regional solution has been agreed, a sensitivity analysis will be undertaken to assess if local treatment could reduce longer-term infrastructure capacity needs. This will include testing options of greater numbers of treatment plants.
Is it intended to use treated wastewater for non-drinking purposes?	Limited quantities of treated wastewater are currently used for non-drinking purposes at the Mangere and Rosedale Treatment Plants. Uses for industrial purposes and irrigation have been investigated in the past but costs and other factors prevented such use. Safe use for irrigation and other purposes will continue to be investigated and promoted, as appropriate.	Community acceptability, the protection of health and safety and economics will be the main factors that influence the extent of future use of treated wastewater. The cost of using treated wastewater has historically been greater than using piped water. As long as that remains the case, it will be a major barrier to its use.	The potential to use up to 5,000 m^3/d for industrial cooling water has been identified as part of the three waters programme and is being pursued. Other opportunities will be investigated at least every five years.
Is it intended to use treated wastewater for drinking?	Not at present, but it remains an option for the future.	The same factors as above will influence decisions. It is not expected to be the community's first choice while alternative water sources can be developed, particularly at lower cost.	Does not form part of current strategy.
How will greenfield developments be serviced for wastewater?	It is expected that areas within the existing Metropolitan Urban Limit will be connected to the existing wastewater systems. Each development outside the existing MUL will be considered on its merits. Any one or more of on-site systems, satellite plants with local use or disposal and connection to the main urban wastewater system will be considered.	Regardless of which solution is used in any particular case, either inside or outside the MUL, it will be important for long term sustainability that the use of appropriate design standards are enforced.	New policies to ensure the influencing factors listed left are properly addressed will be pursued.
How can existing public and private drainage systems be better utilised to deal with future growth	Key to better utilisation of the drainage systems will be using the capacity of that drainage system as it was originally intended - specifically this means reducing stormwater inflows.	Infiltration/inflow control can reduce the levels of flows required to be conveyed by the drainage system. Also possible use of low pressure or vacuum systems could reduce wastewater demands.	Due to the variability of results and cost of reducing inflow and infiltration, it has only been considered at a high level at this time (will be considered in more detail later). As the specific city implementation plans are developed, greater certainty can be placed on the results of inflow/infiltration improvements and assessed through an opitimsation process.

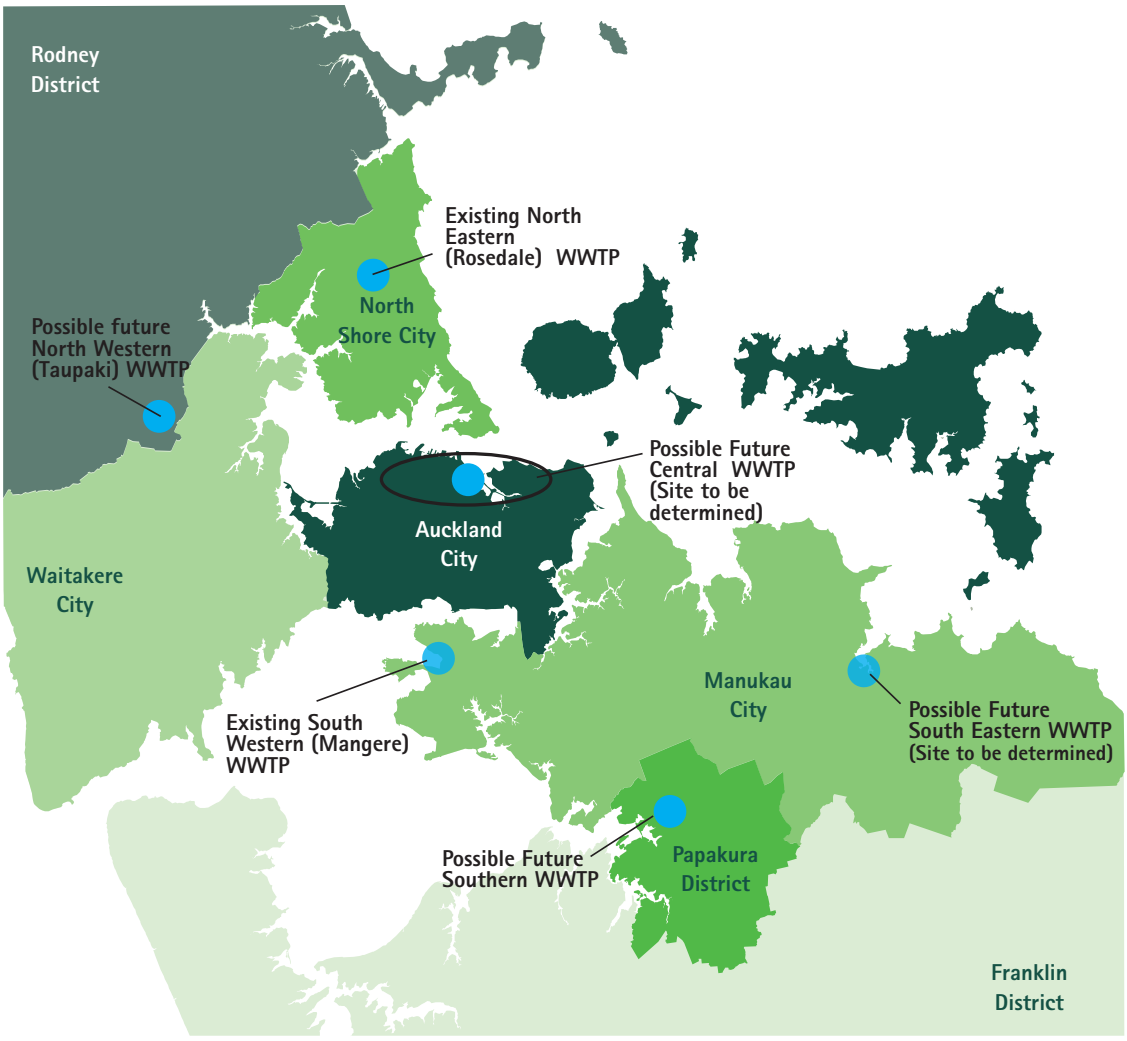
Wastewater – questions and answers for the future

- flexibility of solutions will be key

Future Regional Wastewater Options

Any future option must include treatment facilities and a safe means of using or discharging treated wastewater back to the environment. Six potentially suitable regional treatment plant sites were identified, including the currently unused site at Drury.

Any future South Eastern or Southern Wastewater Treatment Plant is not expected to be required until the second half of the planning period, so was not evaluated in detail.



It is almost certain that continued discharge of treated wastewater to water will be required for the foreseeable future

More than 99% of treated wastewater is currently discharged direct to the environment. Unless there is a major financial or other interventions to bring about change, this figure is unlikely to drop below 95% within the first half of the 100-year planning period.

In 2006 , Three Waters Report 24 - Interim Trunk Wastewater Master Plan - Concept Development and Initial Assesment was completed. This report identified a wide range of options for addressing the region's trunk wastewater issues for the next 50 years. Through this process a number of concept solutions was assessed. Options which included a significant component of flow under gravity to a treatment plant were shown as more preferable compared to pumped options.

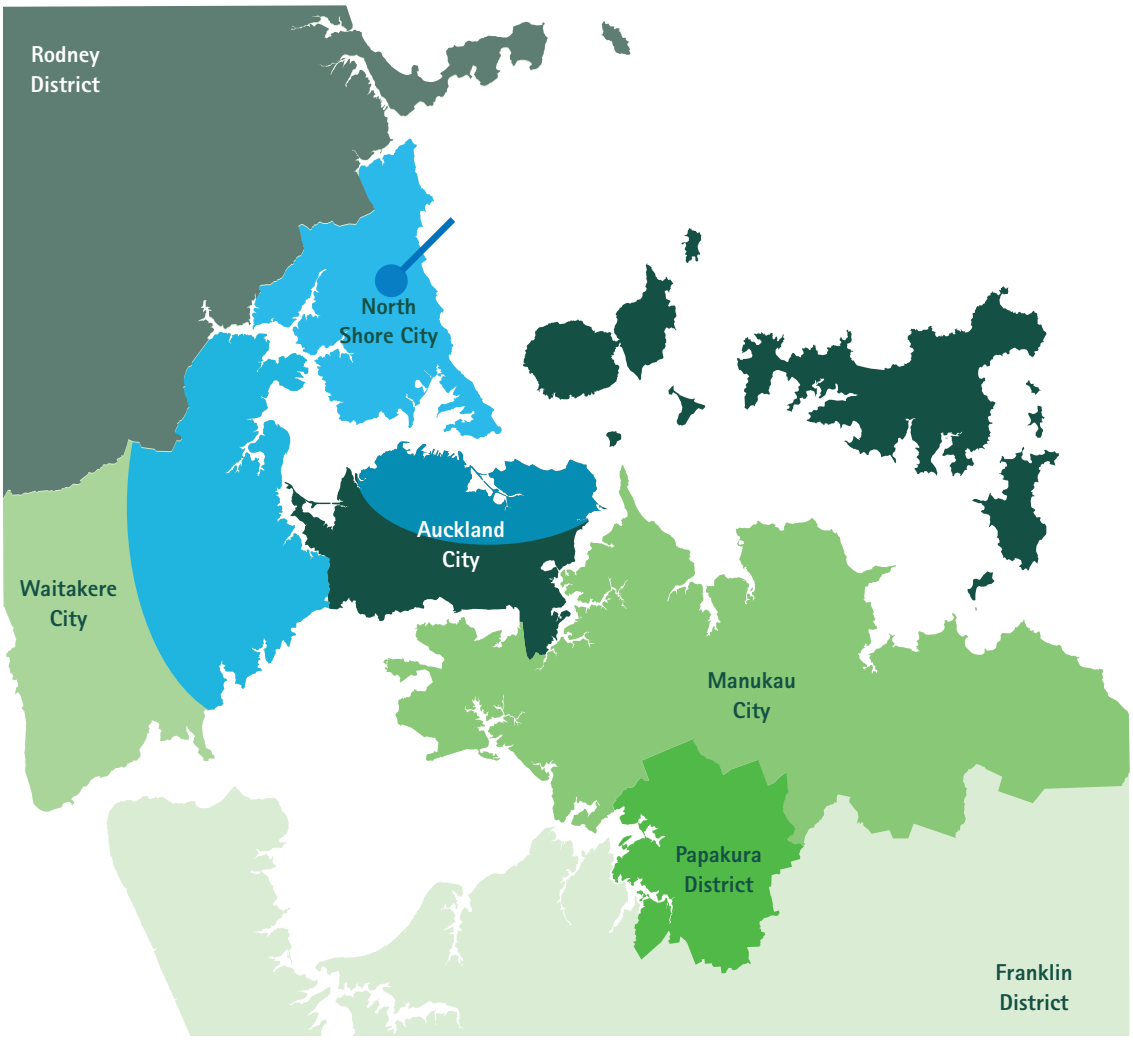
Other relevant reports include:

TW 38 - Distributed Wastewater Treatment Plants.

TW 40 - Evaluation of complete wastewater collection, treatment and use/disposal options.

TW 46 - Complete Wastewater Options

Possible Future North Eastern Regional Wastewater Treatment Plant Concept

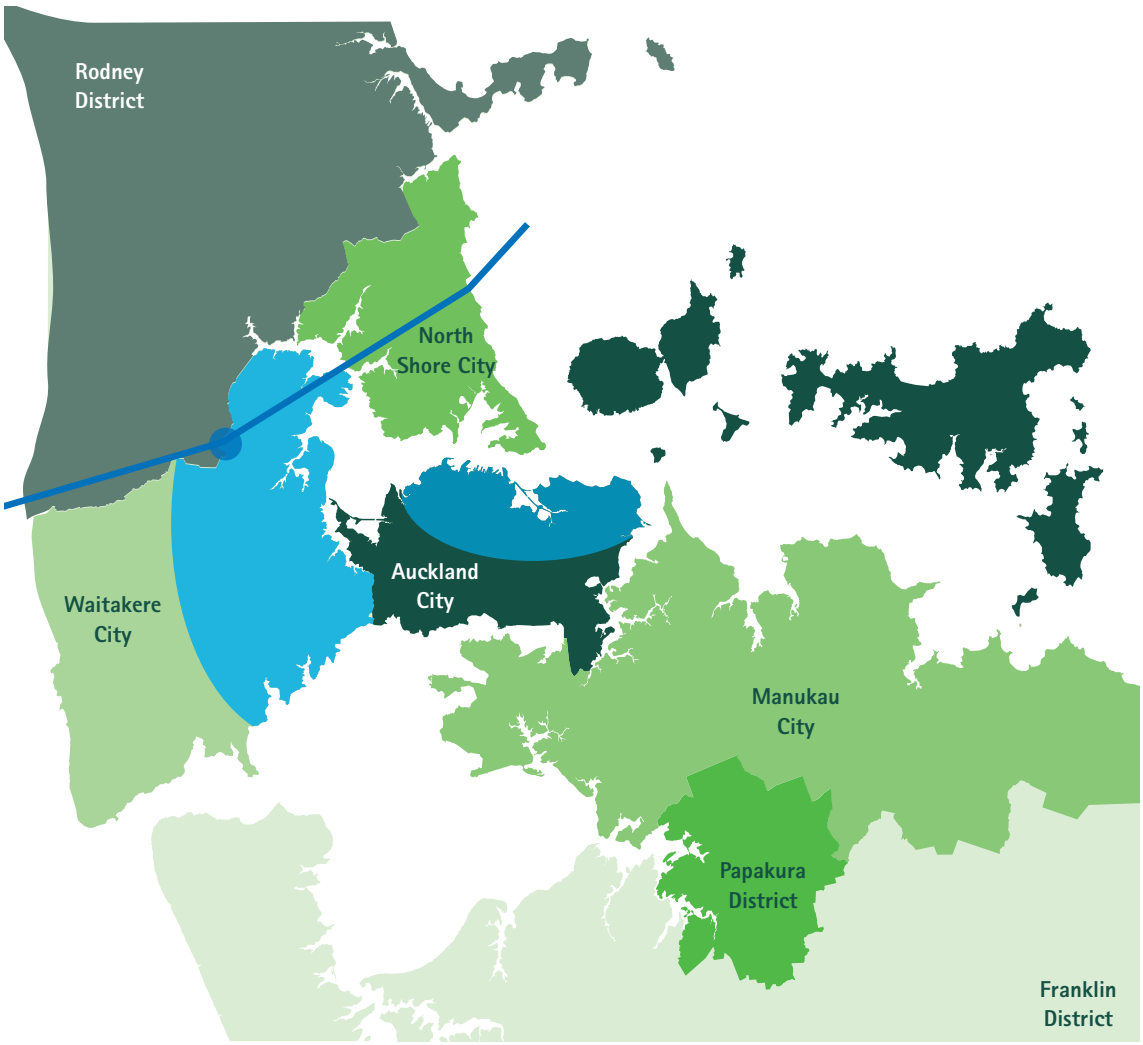


Areas which could be served shown in blue.

	Treatment Plant	Discharge
Current Status	Existing.	New 2.8 km outfall due for completion by December 2010.
Legal Owner	North Shore City Council.	
Consent Status	Designated site.	6 m^3/s authorised to 2030 (based on North Shore population of 300,000 people).
Potentially available capacity (Average daily flow in m^3/d)	More than 450,000.	More than 450,000.
Potential equivalent population served	1,500,000	1,500,000
Possible catchment areas served	North Shore City, Waitakere City and parts of central Auckland.	
Technical feasibility	No issues of particular concern apparent from preliminary investigations.	Will be existing by time regional facility established but could require some upgrading for longer-term regional use.

An existing WWTP with potential for expansion

Possible Future North Western Regional Wastewater Treatment Plant Concept

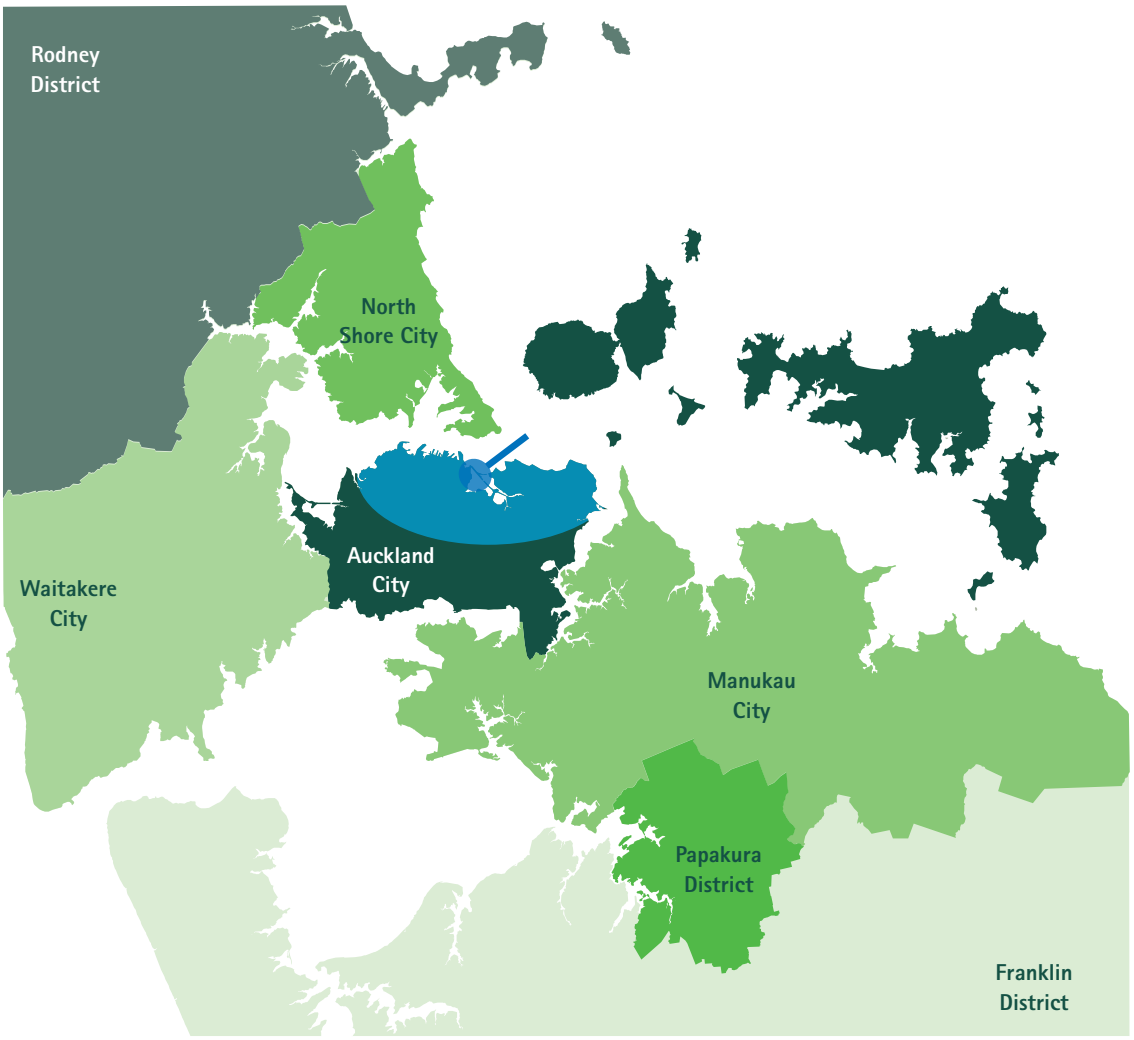


Areas which could be served shown in blue.

A possible future WWTP site at a site owned by Watercare (other sites could also be suitable)

	Treatment Plant	Discharge – East	Discharge – West
Current Status	Greenfields site.	New 2.8 km tunnel and outfall due for completion by December 2010.	Concept.
Legal Owner	Watercare.	North Shore City.	Not yet existing.
Consent Status	Land zoned rural.	6 m^3/s authorised to 2030.	No consents applied for.
Potentially available capacity (Average daily flow in m^3/d)	More than 300,000.	More than 450,000.	More than 300,000.
Potential equivalent population served	1,000,000	1,500,000	1,000,000
Possible catchment areas served	Waitakere City and parts of central Auckland.	North Shore City, Waitakere City and parts of central Auckland.	Waitakere City and parts of central Auckland.
Technical feasibility	No issues of particular concern apparent, based on preliminary investigations.	Will be existing by time regional facility established.	High energy coast will require careful engineering, but feasible.

Possible Future Central Regional Wastewater Treatment Plant Concept

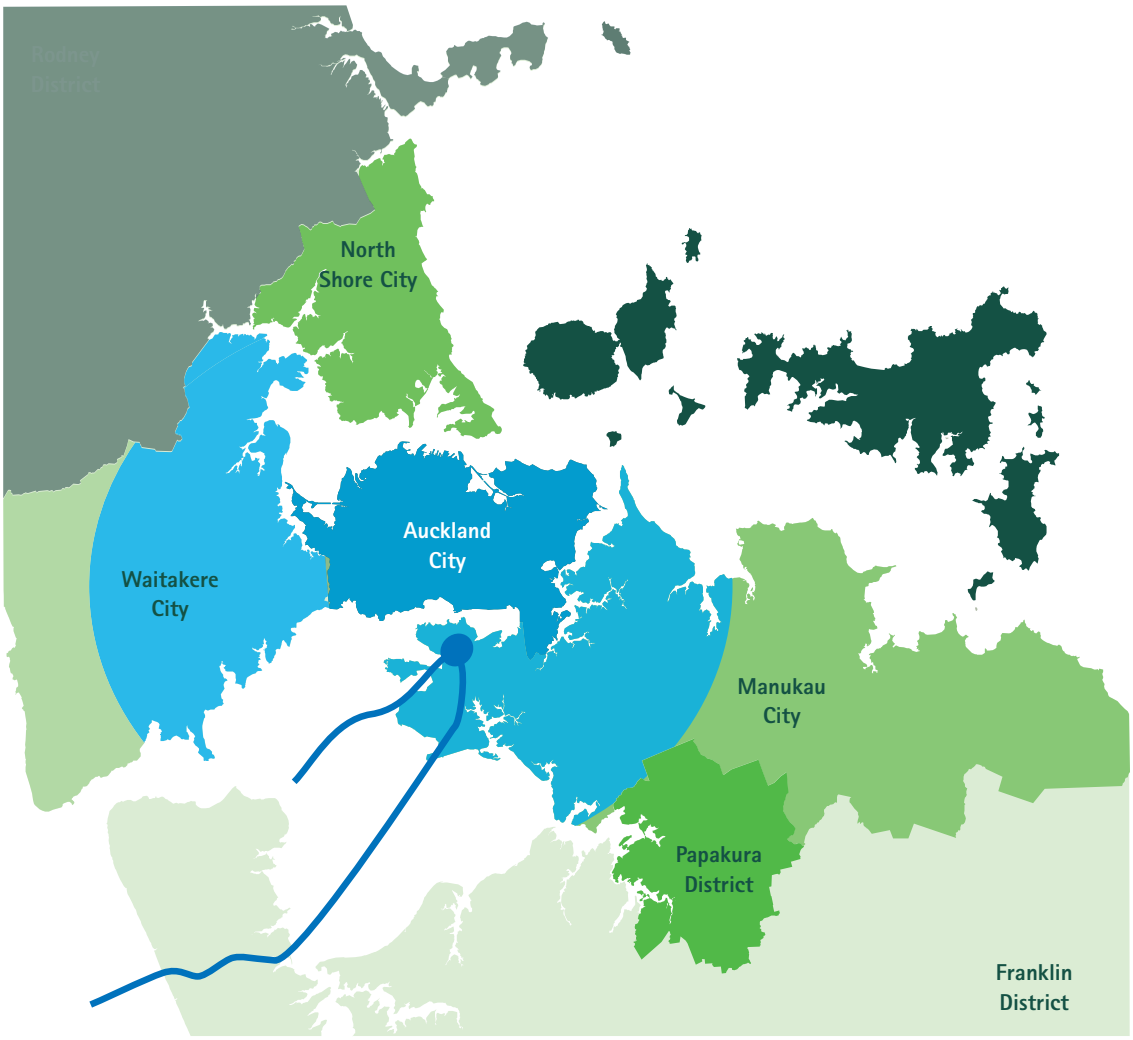


Areas which could be served shown in blue.

	Treatment Plant	Discharge
Current Status	No suitable site yet identified.	Concept only.
Legal Owner	Not yet existing.	
Consent Status	No consents applied for.	No consents applied for.
Potentially available capacity (Average daily flow in m^3/d)	Around 150,000 subject to confirmation.	Around 150,000 subject to confirmation.
Equivalent population served	500,000	500,000
Possible catchment areas served	Parts of central Auckland.	
Technical feasibility	Highly complex treatment plant with underground construction.	Up to 5 km long land based storage tunnel in CBD and 2 km outfall, but expected to be feasible.

A possible theoretical future WWTP site for which no actual site has yet been identified

Possible Future South Western Regional Wastewater Treatment Plant Concept



Areas which could be served shown in blue.

An existing WWTP site with potential for expansion

	Treatment Plant	Shoreline Discharge	Papakura Channel	Tasman Sea South
Current Status	Existing.	Existing.	Concept.	Concept.
Legal Owner	Watercare.	Watercare.	Not yet existing.	Not yet existing.
Consent Status	Designated site.	25 m^3/s authorised to 2032.	No consents applied for.	No consents applied for.
Potentially available capacity (Average daily flow in m^3/d)	More than 750,000.	Around 500,000 but subject to confirmation.	Expected to be more than 600,000 but subject to confirmation.	More than 750,000.
Equivalent population served	2,500,000	1,500,000 Possibly more	2,000,000	2,500,000
Possible catchment areas served	All areas of MUL, excluding North Shore city.	Manukau City, Papakura District and parts of Auckland City.	Manukau City, Papakura District and Auckland City.	All areas of MUL, excluding North Shore City.
Technical feasibility	No issues of particular concern apparent except nitrogen removal and pathogen removal under some peak flow conditions.	Existing.	Feasible but involves work in sensitive marine environment.	40km long pipeline. Work in sensitive marine environment and high energy coast will require careful engineering, but feasible.

Choosing between options

Two sets of decisions need to be made:

- How do we address the immediate need to provide additional sewer capacity to serve central Auckland?
- Where do we treat and discharge treated wastewater in the future?

In making these decisions, there are a number of important outcomes we want to achieve:

- To maximise gravity flow of wastewater from where it is generated to the treatment plant as far as possible, to reduce energy use.
- To maximise the use of investment in existing plants, to defer the need for further expenditure on new plants for as long as possible.
- To retain as much flexibility as possible for the future.
- To minimise risks of delay as a result of land acquisition and resource consent requirements.
- To minimise existing risks associated with major trunk sewers that are inaccessible for maintenance purposes.
- To ensure solutions are technically feasible and have an appropriate balance of social, cultural, environmental and economic well-beings.

The initial decision needs to be based on a pragmatic assessment of all key factors. The second decision, relating to longer term strategic directions for wastewater, needs to be based on a comprehensive assessment of options and the use of multi criteria assessment techniques.

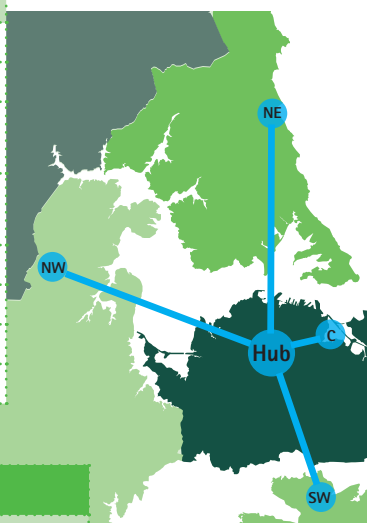
Choosing where wastewater goes initially - Factors to be considered

North West

For
Site owned by Watercare
Against
Plant does not exist
No consents
Could add 10 Years before start
Major pumping (unless existing site changed)
Extra peak flow treatment
Difficult tunnel construction
Larger outfall
Cost > $2,000 per person served

North East

For
Existing consented site
Potential long term capacity for 1.5 million people
Cost < $1,500 per person served
Against
Major pumping
Peak flow treatment restrictions
Peak flow discharge restrictions
New consent required if out of district sewage included, possible variation only
Deep tunnel construction
Competing land use interests



South West

For
Existing consented site
Flow okay to 2027
Load okay to 2046 at shoreline with extra hydraulic and nitrogen removal capacity
Peak flow capacity
Maximises gravity flows
Maximises benefits of existing investment
Maintains maximum flexibility
Major reduction of risks associated with maintaining existing trunk sewers
Cost around $1,000 per person served
Against
Consent variation needed
Need to relocate outfall by 2027 or later or divert flow to another plant
Tidal discharge

Central

For
Close to location to which wastewater can gravitate
Against
No site identified
Site may not exist
No discharge location identified
No consents
Serious peak flow restrictions
Biosolids restrictions
Could take 15 years before start
Cost > $3,500 per person served

Key requirements

Maximise

- gravity flow
- current investment
- flexibility
- sustainability

Minimise

- cost
- risk

Providing maximum flexibility to meet changing circumstances

Neither a Central nor a North Western WWTP offer feasible short term options to address the region's immediate needs for the reasons given on the previous page. In particular, neither has an identified discharge location, no site for a Central WWTP is easily identifiable and none of the treatment plant or discharge locations has resource consents.

Of the remaining two options, use of the existing South Western (Mangere) WWTP up to it's consented discharge load capacity has substantial advantages in terms of meeting the desired outcomes listed on the previous page and is also the least cost option by a substantial margin. Therefore, continued use of the South Western Plant as the main regional WWTP in the 15 to 20 year time horizon is proposed, providing the advantages described below.

Proposed concept:

- Duplicate the Manukau Siphon and Hillsborough Tunnel to allow access for maintenance purposes
- Extend central interceptor to central Auckland
- Maximise gravity flow to South Western WWTP to reduce energy requirements
- Collect more than 70% of Watercare's wet weather overflows
- Provide "Hub" at limit of gravity flow area to pump flows from lower areas to start of gravity line.
- Continue using South Western WWTP up to nitrogen and pathogen load limits set out in resource consent conditions for existing discharge location to maximise benefits of existing investment.
- Retain flexibility to change discharge location or divert some flows from the Hub to a different WWTP.

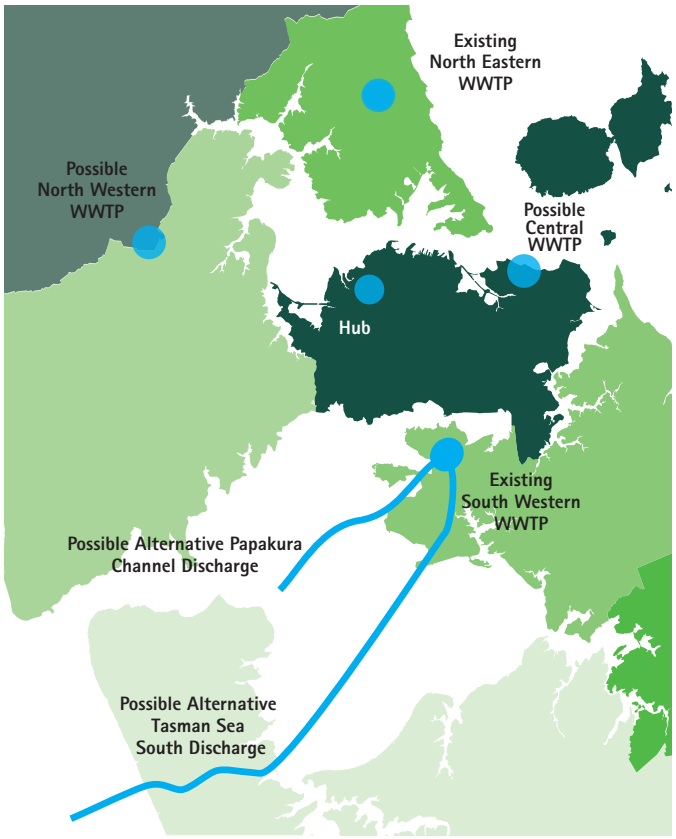
PS 25 = Major Existing Pumping Station

First decision:

South Western Plant will continue as the main regional facility for the next 15 to 20 years

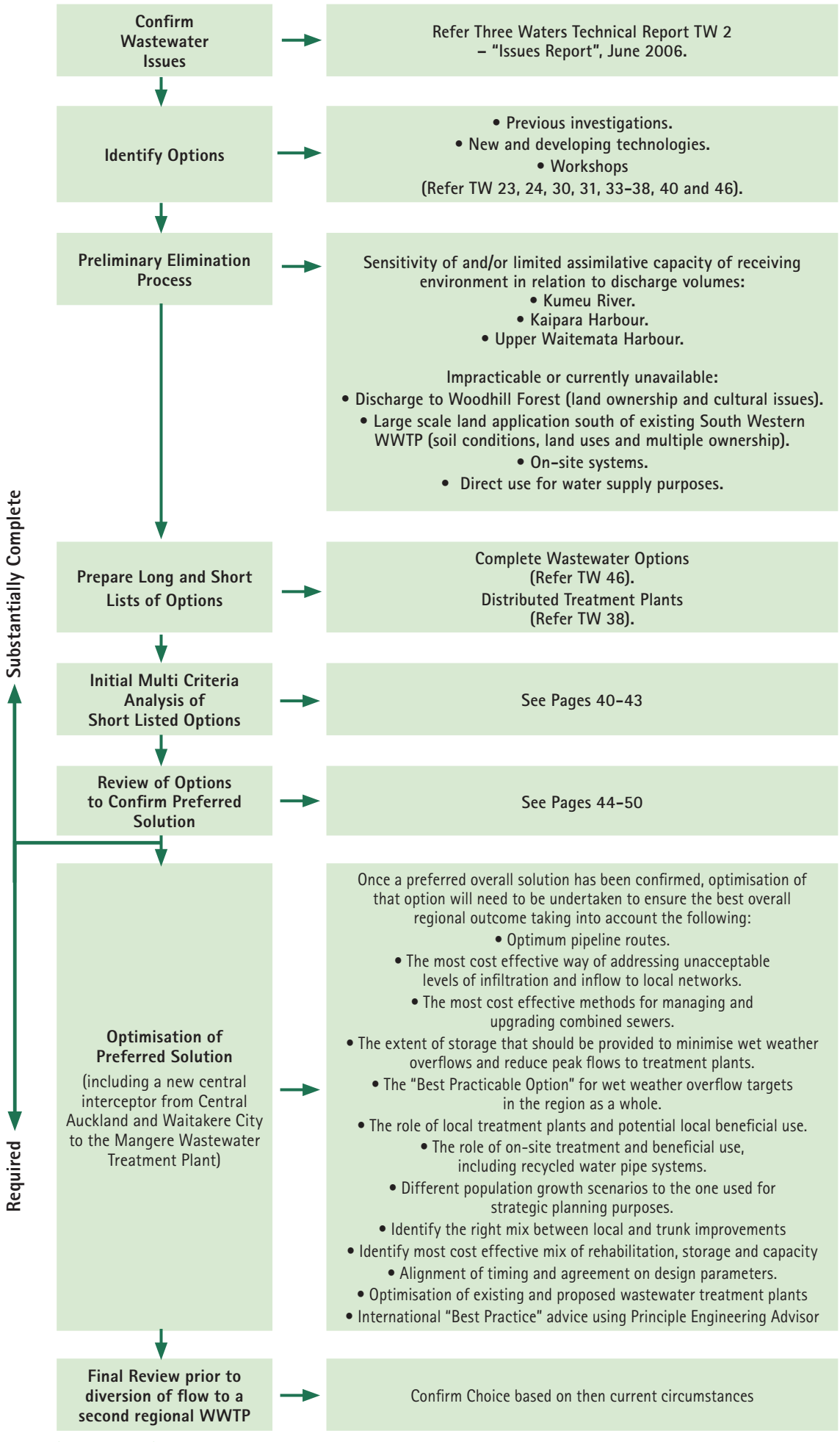
Flexibility will exist to:

- Improve treatment plant efficiency at the South Western WWTP.
- Relocate discharge to the Papakura Channel.
- Relocate discharge to the Tasman Sea South.
- Reduce flows to the South Western WWTP by using "distributed" wastewater treatment at local level.
- Divert flows from up to one million people to the North Eastern WWTP.
- Divert flows from up to one million people to the North Western WWTP.
- Divert flows from up to 500,000 people to a Central WWTP.
- Beneficially use the high quality treated wastewater.



Hub = Possible Future Major Pumping Station

The following process was and continues to be followed to identify a preferred long-term solution.



Assessment of longer term wastewater options for areas within the Metropolitan Urban Limit

Detailed list of Three Waters technical reports included on back inside cover

Major optimisation of the preferred solutions will be required

Preliminary assessment of longer term wastewater options for areas within the Metropolitan

A robust, comprehensive multi criteria options evaluation process was used

The following analysis methodology was used to compare options:

Four specialist groups were established to analyse 14 short-listed options on the basis of social, cultural and environmental well-beings and legal, technical, risk and timing issues. Each group finalised the goals the group would use to score options and then scored each option against each goal as described below.

A separate process was used to consider economic well-being. In this process, detailed estimates were prepared by the Project Team and internally and externally peer reviewed. Covec Group prepared Net Present Value analyses based on the peer reviewed estimates. All options were scored against the economic goals by the Project Team and the process peer reviewed by Price Waterhouse Coopers.

As a further part of the overall process, two expert groups provided specialist input on wastewater treatment and the effect of treated wastewater discharges on receiving environments for each option (refer TW33).

The following scoring system was used consistently by all groups as the basis for assessing the extent to which each option contributes to the achievement of a goal:

+4	Very good
+3	Good
+2	Moderately good
+1	Slightly good
0	Neutral
-1	Slightly poor
-2	Moderately poor
-3	Poor
-4	Very poor

Ranking of options was undertaken from 1 to 14 using a consistent range of methods for all well-beings, including ranking of:

a) Total positive scores for each individual treatment plant.
b) Total negative scores for each individual treatment plant.
c) Total net scores for each individual treatment plant.
d) Total positive scores for each individual treated wastewater discharge.
e) Total negative scores for each individual treated wastewater discharge.
f) Total net scores for each individual treated wastewater discharge.
g) Total positive scores for all treatment plants in combination.
h) Total negative scores for all treatment plants in combination.
i) Total net scores for all treatment plants in combination.
j) Total positive scores for all treated wastewater discharges in combination.
k) Total negative scores for all treated wastewater discharges in combination.
l) Total net scores for all treated wastewater discharges in combination.
m) Total positive scores for all treatment plants and treated wastewater discharges in combination.
n) Total negative scores for all treatment plants and treated wastewater discharges in combination.
o) Total net scores for all treatment plants and treated wastewater discharges in combination.

Grading of options was undertaken for each ranking a) to o) generally using the following system:

- Ranking 1 to 3 "Good" Grade
- Ranking >3 to 6 "Moderately Good" Grade
- Ranking >6 to 9 "Neutral" Grade
- Ranking >9 to 12 "Moderately Poor" Grade
- Ranking >12 "Poor" Grade

An alternative grading method was used as a check where appropriate. This involved five equal score bands. An overall grading was allocated for each option for each of the four well-beings and legal, technical, risk and timing issues. This used the best fit average grade from the individual grades and other appropriate considerations as set out in Three Waters Technical Report TW 40 – "Options Evaluation Process".

This approach allows balanced consideration of:

- Local and regional interests;
- Positive and negative features;
- Multiple components in a way that minimises the likelihood of bias and any individual component unduly influencing the outcome disproportionately.

Trunk sewers were not considered to any significant extent in the analysis as the main new trunk sewer works are common to all options. Any additional overall effects will be short term and limited in extent, compared to the effects of discharges, in particular.

Weighting

Individual criteria were given at a weighting of 2 and 3 while keeping other criteria at a weighting of 1. This did not result in any significant changes in relative preference between options.

Short Listed Options

Option	North Eastern WWTP			North Western WWTP			Central WWTP			South Western WWTP		
	Areas Served	People Served	Discharge Location	Areas Served	People Served	Discharge Location	Areas Served	People Served	Discharge Location	Areas Served	People Served	Discharge Location
B2	NSCC	0.5 million	New East Coast Long Outfall	Not used			Not used			As existing	2.5 million	Tasman Sea South
C2 **C1**	NSCC WCC	1.0 million	As above	Not used			Not used			As existing, less WCC	2.0 million	Papakura Channel Tasman Sea South
E	NSCC WCC Part ACC	1.5 million	As above	Not used			Not used			As existing, less WCC & part ACC	1.5 million	Existing Shoreline
F2 **F1**	NSCC	0.5 million	As above	WCC	0.5 million	Tasman Sea North	Not used			As existing, less WCC	2.0 million	Papakura Channel Tasman Sea South
G2 **G1**	NSCC	0.5 million	As above	WCC	0.5 million	New East Coast Outfall	Not used			As existing, less WCC	2.0 million	Papakura Channel Tasman Sea South
H	NSCC	0.5 million	As above	WCC Part ACC	1.0 million	Tasman Sea North	Not used			As existing, less WCC & parts ACC	1.5 million	Existing Shoreline
I	NSCC	0.5 million	As above	WCC Part ACC	1.0 million	New east Coast Outfall	Not used			As existing, less WCC & parts ACC	1.5 million	Existing Shoreline
J1	NSCC	0.5 million	As above	Not used			Part ACC	0.5 million	New Waitemata Harbour outfall	As existing, less parts ACC	2.0 million	Papakura Channel
K	NSCC	0.5 million	As above	WCC	0.5 million	Tasman Sea North	Part ACC	0.5 million	New Waitemata Harbour outfall	As existing, less WCC & parts ACC	1.5 million	Existing Shoreline

Notes:

- Any option with a letter only indicates the discharge location for the South Western WWTP is the existing shoreline discharge to the Manukau Harbour.
- Any option with the number 1 after a letter indicates the discharge location for the South Western WWTP is a relocated discharge to the Manukau Harbour in the Papakura Channel.
- Any option with the number 2 after a letter indicates the discharge location for the South Western WWTP is a relocated Tasman Sea South discharge.

Option A is generally similar to Option B, but duplicates existing trunk sewers instead of a new central interceptor. Option A was eliminated on the grounds of cost and practical considerations.

Option D is generally similar to Option C, except nitrogen and microbiological discharge loads would be up to twice current consent loads. It was not evaluated in detail in the strategic planning process but can be reconsidered later if required.

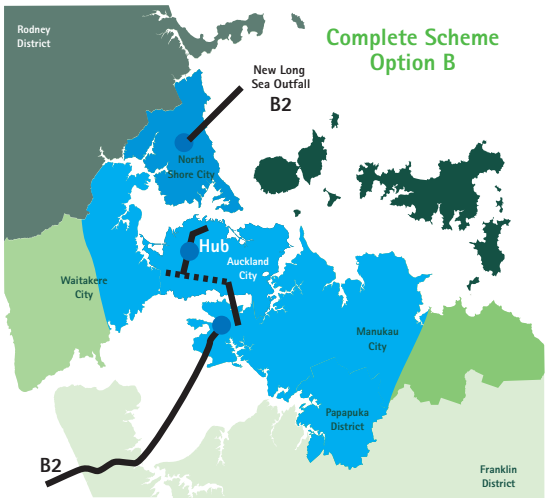
All options except Option D are based on meeting existing discharge nitrogen and microbiological consent loads from the North Eastern WWTP.

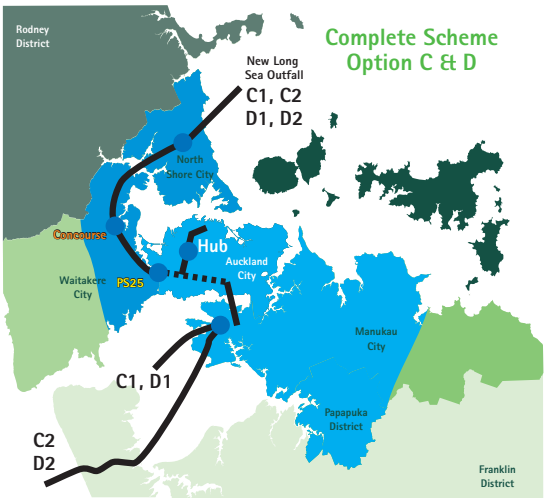
All discharges from the South Western WWTP at the existing shoreline discharge will meet nitrogen load limits as existing resource consent conditions or as otherwise needed to maintain harbour water quality.

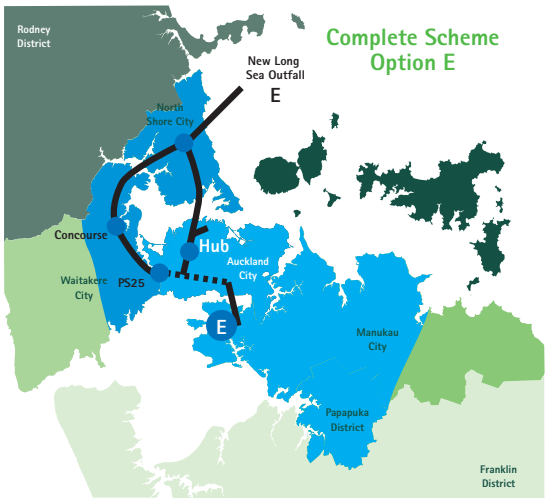
Stringent pathogen treatment will be continued for any discharges from the South Western WWTP at the existing shoreline discharge or any relocated discharge to the Papakura Channel.

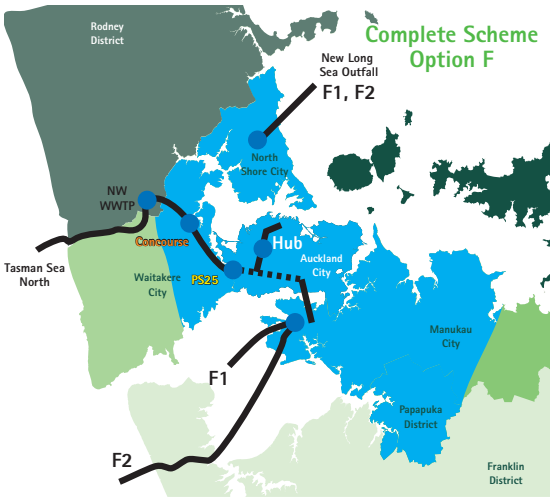
A wide range of short listed options was evaluated

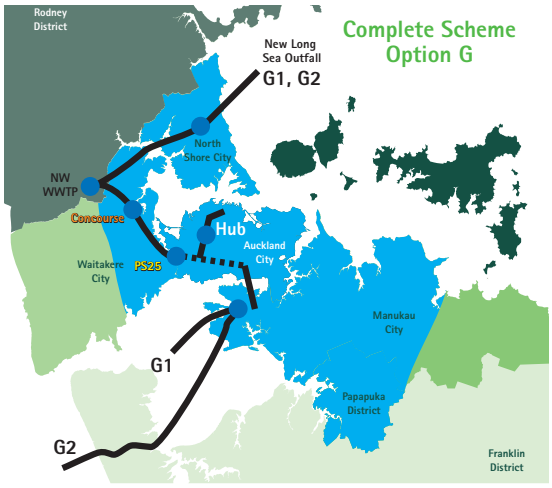
Evaluated Scheme Options B to K

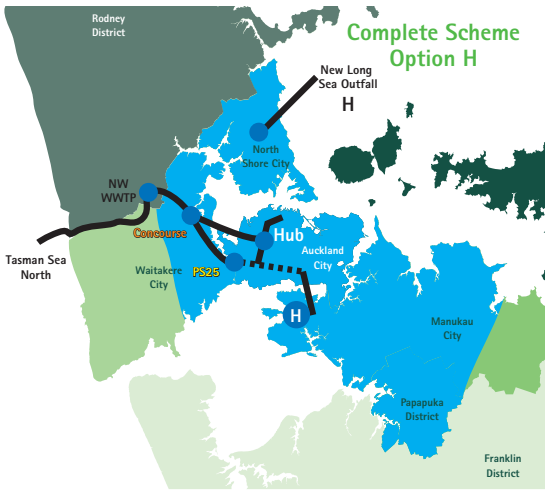






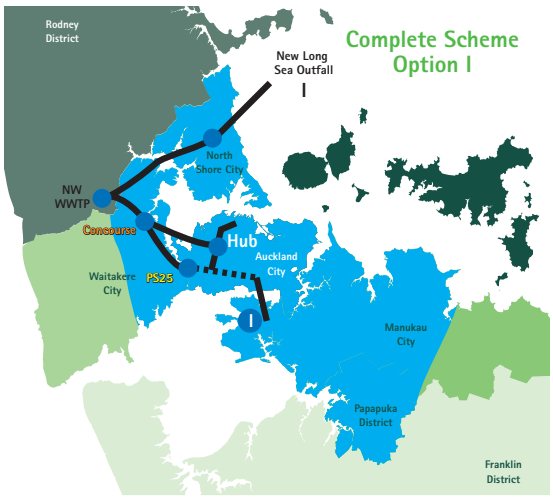


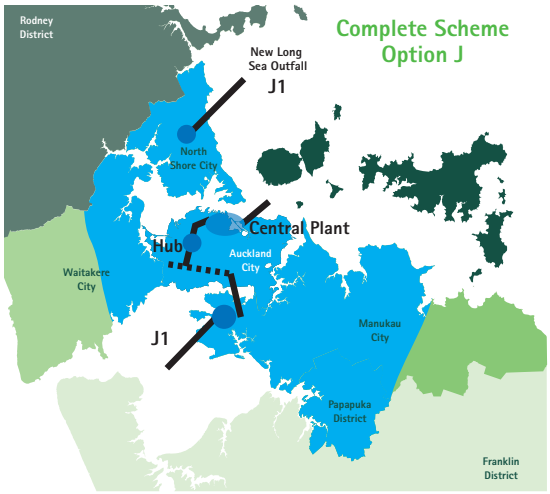


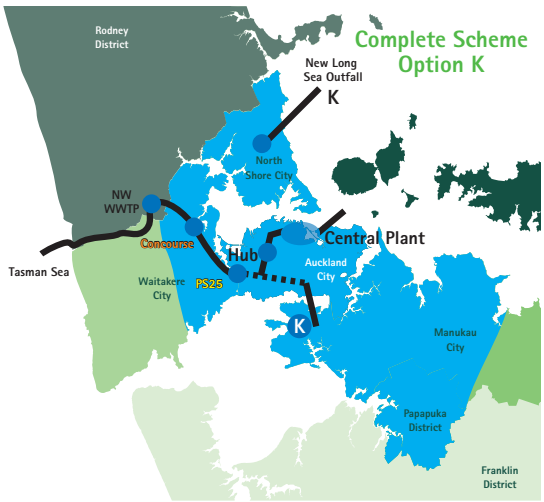


KEY

- ——— – Indicates pipes/routes
- PS25 – Pumping Station
- Concourse – Waitakere Facility







Goals Relating to Social Well-Being

- To protect public health and safety.
- To manage the three waters acitivity so that the use, development, and protection of land can occur in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural wellbeing.
- To enhance lifestyle, amenity and recreation opportunities.
- To equitably distribute benefits and dis-benefits between existing communities across the region.
- To equitably distribute benefits and dis-benefits between present and future generations.
- To gain community acceptance.

Goals Relating to Cultural Well-Being

- To maintain and enhance the mauri of water.
- To protect taonga and wahi tapu.
- To protect ancestral lands and water.
- To protect and enhance the four well-beings of tangata.

Goals Relating to Environmental Well-Being

- To minimise adverse effects on surface water.
- To minimise adverse effects on groundwater.
- To minimise adverse effects on terrestrial ecology.
- To minimise adverse effects on land and soil.
- To minimise adverse effects on rare or sensitive environments.
- To minimise adverse effects of construction.
- To minimise effects on different habitats and receiving environments.
- To minimise use of energy and chemicals.
- To maximise environmental benefits.

Goals Relating to Economic Well-Being

- To minimise capital costs.
- To minimise operating costs.
- To minimise whole of life costs.
- To minimise funding gaps between project costs and revenue currently projected to be available.
- To be affordable to the community.
- To be within the community's willingness to pay.

Goals Relating to Legal, Technical, Risk and Timing Issues

- Ability to obtain and comply with resource consents.
- Ease of construction.
- Technical feasibility and ease of operation.
- Flexibility and ability to meet changing circumstances and community needs.
- Potential for new technologies to contribute to the future delivery of a three waters service.
- Extent of integration with other regional initiatives.
- Ability to acquire necessary land access rights.
- Time for implementation.
- Risk due to climate change.
- Extent to which significant existing risks reduced.
- Numbers of parties involved in decision making.

Basis of multi criteria used to Assess Options

Options were evaluated to satisfy Local Government Act four well-being requirements

Local solutions will be used where appropriate

Indicative total estimated capital cost of options	$M to 2100
B2	3476
C1	3463
C2	3511
D1	3403
D2	3451
E	3404
F1	3484
F2	3532
G1	3520
G2	3568
H	3318
I	3445
J1	3617
K	3867

The assessment of longer-term wastewater options within the Metropolitan Urban Limit , based on the multi-criteria analysis process summarised on previous pages, enabled the following preliminary conclusions to be drawn:

- Estimated whole of life costs for all options were within 15% of the average and hence were all within the bounds of estimating accuracy. Consequently, whole of life costs could not be used as a reliable basis for differentiating between options.
- When options were compared on the basis of scores from the specialist social, cultural and environmental groups, Options E, I and K were broadly comparable, followed somewhat further back by Options B2, C2, G1, G2, H, and I. This was confirmed by the numerical scores in the table, where G (Good) = 1, MG (Moderately Good) = 2, N (Neutral) = 3, MP (Moderately Poor) = 4 and P (Poor) = 5
- Most options were broadly comparable on legal, technical, risk and timing grounds, as all options assessed were technically feasible, and the cost estimates provided for differences.
- If ability to proceed without undue delay were to become important, Option E would have advantages over other options. Option E would also leave greatest flexibility for the future as it would build on existing plants and leave all other future opportunities open.

Overall, Option E was considered to be the preferred option from the multi-criteria analysis but before making final recommendations for strategic plan purposes, further consideration was given to individual components of complete schemes and other factors as set out below.

Proposed Role of the Mangere WWTP as Part of the Future Regional Wastewater Strategy

Continued use of the Mangere WWTP as the primary regional wastewater treatment facility is the most practicable solution in the medium term for the following reasons:

- It was planned and designed for the purpose;
- The Mangere WWTP has existing resource consents to allow treatment of flows under average dry weather conditions from at least another 300,000 people using existing treatment methods;
- The Mangere WWTP has the existing ability to treat substantially greater volumes of wet weather flows than the other major existing WWTP at Rosedale;
- The quality of the Manukau Harbour has improved substantially as a result of the major investments made in Mangere WWTP upgrades in the last 10 years;
- There is no other facility currently available to accept regional flows; and
- Its continued use in the medium term optimises the benefits from historical investments and avoids the need for substantial expenditure on additional treatment capacity at an alternative site.

Medium to Longer-Term Upgrading of the Mangere WWTP as Part of the Future Regional Wastewater Strategy

Decisions on the optimum load that can be treated at the Mangere WWTP and future upgrading needs will be determined under the Resource Management Act. Such decisions will be based on the effects of the treatment plant and associated discharges on the environment. Expert opinion indicates that the two issues that will be of greatest influence in future decision making are the protection of public health and the effects of nitrogen on the Manukau Harbour.

With the flow balancing effects of the proposed central interceptor described below and Project Hobson, a substantial increase in the WWTP's ability to treat peak flows will occur. This will result in improved protection of the public health of harbour users and public health considerations are unlikely to be a constraining factor in the future. This leaves the effects of nitrogen as the primary limiting factor on Mangere WWTP capacity.

Work to date by an expert group of scientists suggests that a total nitrogen load to the harbour of three tonnes a day in summer, or possibly less could be needed to maintain or enhance harbour water quality. The actual acceptable load is likely to be influenced by changes in harbour water quality resulting from improved stormwater discharge quality, climate change and naturally occurring changes in ecology. For internal planning purposes, the implications of having to meet a total nitrogen load of two tonnes a day in summer by 2050 is under investigation. This compares to nitrogen discharges of around 15 tonnes a day prior to the upgrade.

With enhanced biological treatment to remove nitrogen, it is estimated that the required load could be met with the connected population through to 2050 and possibly 2070. Programmes are being developed to refine both the acceptable nitrogen load to the harbour and the level of nitrogen removal that can be achieved by treatment at the Mangere WWTP.

If beneficial use of treated wastewater can be successfully introduced in the region on a significant scale, a larger load will be able to be treated without increasing the quantity of nitrogen to be discharged to the harbour.

Potential to Extend the Capacity of the Mangere WWTP by Relocating the Existing Shoreline Discharge Location for Treated Wastewater to the Papakura Channel or to the Tasman Sea

Expert advice suggests that a greater population could be served by the Mangere WWTP if the existing shoreline discharge was relocated. Broadly speaking, an additional 500,000 people, potentially (compared to the existing discharge location), could be treated with the discharge relocated to the Papakura Channel. In excess of 2.5 million people could be treated if the discharge were relocated to the Tasman Sea.

The Tasman Sea option was selected as the preferred option in the regional wastewater study completed by the ARA in 1989. The proposal resulted in such a high level of community opposition that the decision was overturned in favour of a treatment plant discharging high quality

Overall grades from the multi criteria analysis for each option are shown below for social, cultural and environmental criteria

	Option	B2	C1	C2	D1	D2	E	F1	F2	G1	G2	H	I	J1	K
Achievement of Goals	Social	N	MP	MP	MP	MP	N*	N	N	MG	N	N	N	MG	MG
	Cultural	MG	MG	MG	MP	N	G	MP	MP	MG	MG	MG	G	N	MG
	Environmental	MG	N	MG	MP	MG	MG	N	MG	N	MG	MG	MG	MP	MG
Indicative equivalent scores		7	9	8	12	9	5 to 7*	10	9	7	7	7	6	9	6

* Could vary from moderately good to moderately poor, depending on whether a wider region perspective or a more local perspective is taken.

The lower the score, the better the option.

treated wastewater at the current shoreline discharge.
The Tasman Sea option was reconsidered as part of the Three Waters Strategic Planning Programme. It would result in improved water quality in the Manukau Harbour but considered inappropriate and/or impracticable for the following reasons:

- The solution would require the construction of a tunnel approximately four metres in diameter and 40 kilometres long, mainly below the sea, with major construction risks and cost uncertainties;
- The asset would be difficult to maintain;
- The construction cost, broadly in the order of one billion dollars, could not be staged and would result in a major drain on scarce community funds;
- The expenditure would need to be deferred as long as possible to minimise effects on other regionally significant priority projects. There would be a strong likelihood that short to medium term investments in high quality treatment to allow continued shoreline discharge from the Mangere WWTP would be wasted once the new discharge was commissioned;
- To be economically feasible, the discharge would be of a generally lower quality than any other discharge options considered in the overall investigation programme and likely to be strongly opposed by iwi and some other members of the community for that reason;
- The commitment to such major capital expenditure and the lower quality treated effluent would compromise the likelihood that beneficial use of treated wastewater would be seriously pursued;

The Papakura Channel option was also investigated in the past, but never seriously promoted. The discharge would affect a relatively pristine part of the Manukau Harbour used for shellfish gathering. Actual effects of nutrients in the discharge would be difficult to predict with certainty, which would represent a high level of risk.
Based on current knowledge, both options would involve an unacceptably high risk of future problems. Neither is consistent with the philosophy of encouraging maximum beneficial use of treated wastewater. Both would affect environments currently unaffected to any significant extent by wastewater discharges. There is no economic justification for pursuing either option over and above other options.
For these reasons, neither option is considered to offer an acceptable means of deferring the need to identify and ultimately use a second regional wastewater treatment plant.

Expected Timeframe Before Capacity of Mangere WWTP is reached

The time by which the capacity of the Mangere WWTP is reached will be determined by the conditions of existing and any future resource consents granted.
The average daily flow limits of the existing resource consents will be reached in or about 2027 at currently projected population growth rates. While it is anticipated that, based on the effective management of effects on the environment, new consents will be able to be obtained for increased flow (but at the same or lower nitrogen discharge load), this cannot be guaranteed.
The range of timeframes by which the capacity of the Mangere WWTP could be reached is:

a) 2027, if no extension of the existing consent limits can be obtained;
b) Between 2050 and 2070, if new consents can be obtained and new technologies can reduce nitrogen loads sufficiently.

Time will be required to obtain consents for any alternative regional wastewater treatment facility. A decision on a second regional wastewater treatment plant could be required no later than 2015 and possibly sooner.

Outcomes of Preliminary four well-being Multi Criteria Analysis Process

South Western WWTP will continue as the main regional facility until it's capacity is reached

Ensure short term decisions are consistent with long term aspirations.

Need for Second Regional Wastewater Treatment Plant as Part of the Future Regional Wastewater Strategy

One of the purposes of the Three Waters Strategic Plan is to set out a long-term strategy for managing wastewater in the Auckland region in an integrated way with the management of water supply and stormwater. Identifying the site or sites at which wastewater treatment will be undertaken is one of the fundamental starting points for developing any such wastewater strategy.

Important reasons for early identification of the sites at which treatment will take place in the long-term are:

- To provide certainty that future regional wastewater needs can be met in an effective, efficient and well planned way that will optimise the use of available funds;
- To avoid the acquisition or holding of land for future wastewater treatment purposes that will not ultimately be used for that purpose;
- To avoid uncertainty for communities living near sites that have been identified as possible regional facilities but will not ultimately be used for wastewater treatment purposes;
- To ensure that land use planning in the general locality of future regional facilities recognises and provides for the relevant activities at the site and minimises the potential for conflict to result from inappropriate adjacent land uses (This need to take into account possible competing land use issues) ; and
- To provide certainty for wastewater planners so that all works undertaken in the short and medium term are compatible with long-term objectives, so as to minimise inappropriate solutions and wasted expenditure.

Trunk Sewer Upgrading Needs as Part of the Future Regional Wastewater Strategy

Additional trunk sewer capacity is required to provide for growth in central Auckland, Waitakere City and longer-term in Manukau City. The initial investigations of trunk sewer options undertaken as part of the TWSPP and associated investigations were wide ranging. They included consideration of duplicating the existing trunk sewers from central Auckland to the Mangere WWTP and new trunk sewers from central Auckland via new routes to the Mangere WWTP, the Rosedale WWTP and possible new treatment plants in central, west and south Auckland, along with storage solutions.

South Auckland treatment plant options were subsequently excluded from the current Strategic Plan as there is no certainty on future development trends and population to be served. A preliminary assessment of initial options to take flows from central Auckland to the Managere WWTP, Rosedale WWTP and possible sites in central and west Auckland was undertaken as part of Report TW 40. This showed that continued use of the Mangere WWTP is the only realistically practicable option in the short to medium term.

Duplication of the existing Orakei main sewer and Eastern Interceptor was compared against a partially new route to the Mangere WWTP, as summarised in the following table.

Short Term:

The Hillsbourough Tunnel and Manukau Siphon need to be duplicated

	Duplication of Orakei Main Sewer, Eastern Interceptor, Manukau Siphon, Hillsborough Tunnel and other sewers to provide same level of service as Central Interceptor	Construction of new Central Interceptor, incorporating second Manukau Siphon and Hillsborough Tunnel
Total length of pipes	50 kilometres	22 kilometres
Indicative capital cost	$1,100 million	$700million to $800 million
Construction considerations	Route follows route of existing pipes in built up area, with associated difficulties in avoiding existing services, requiring combination of open cut and tunnelling with major potential for traffic and other community disruption	Tunnel construction for whole length with no significant difficulties in avoiding existing services or potential for traffic and other community disruption
Timing of benefits	Requirement to complete majority of works before benefits of reduced overflow potential realised, likely to be after 2026	Staged development possible with main benefits achieved before 2020

When considering options to provide the required future trunk sewer capacity, the following factors need to be taken into account:

- The Manukau Siphon and the Hillsborough Tunnel - two major components of the existing western interceptor trunk sewer - will require duplication in the medium term. The existing 50-year old pipes cannot be inspected or maintained and there is an increasing likelihood of failure as the pipes further age;
- The new Hillsborough Tunnel can be constructed as a storage tunnel with relative ease;
- By providing additional trunk sewers from the end of any new Hillsborough Tunnel to Pumping Station 25 (St George), which serves Waitakere City, and to a location near Western Springs or Chamberlain Park, the major trunk sewer upgrading requirements can be met;
- This solution will require less investment by an estimated $300 million to $400 million dollars and, in combination with the above will have the following additional benefits:
- All flows in the trunk sewer will be transferred to the Mangere WWTP by gravity, avoiding the need to use energy for pumping;
- The volume of Watercare's wet weather overflows will reduce by more than 70%;

- Storage in the new tunnel will allow peak flows to be balanced out so that perhaps 99.5% of all flows to the Mangere WWTP will receive full treatment, with public health benefits to users of the Manukau Harbour (actual percentage subject to detailed checking);
- The storage facilities may allow a lower cost solution for addressing issues associated with some combined sewers owned and managed by Auckland City/ Metrowater.

The trunk sewer augmentation programme described above is currently known as the central interceptor. It will provide advantages to all of the main urban councils, as follows:

Auckland City

Provides for short-term growth needs, reduces wet weather wastewater overflows, allows flexibility for addressing combined sewer separation and improves water quality in Waitemata and Manukau harbours.

Manukau City

Provides for medium-term growth needs and improves water quality in Manukau Harbour, in particular, with no more than minor change in effects at the Mangere WWTP.

Waitakere City

Contributes to short and medium-term growth needs and improves water quality in Manukau Harbour, in particular.

North Shore City

Delays need to use Rosedale or other regional facility.

Selection of the Recommended Second Regional WWTP

In the intervening time since the main options evaluation process was undertaken, it has been possible to refine overall directions as outlined above. The choice of the second future regional WWTP can now come down to a straight comparison between Rosedale (NE), a site in west Auckland (NW), and a possible site in central Auckland (Central).

Three different methods were used to undertake this comparison, as follows:

- Comparison of the three treatment plant and discharge options based on scores from the original evaluation – social, cultural, environmental and legal, technical, risk and timing, but using a smaller group of criteria;
- Listing a series of questions relevant to the suitability of options for treatment and disposal and scoring each of the three options under consideration against the questions; and
- A generic overview of relevant factors.

Each is considered in turn below.

Comparison of Options Based on Original Scores

This is summarised for a reduced list of criteria in the following table. The figures in brackets represent populations served of 0.5, 1 and 1.5 million people.

Basis of Comparison of options	Order of Scoring from Best to Worst (1 to 5)				
	1	2	3	4	5
Social criteria only	NE (1)/Central (Equal)		NW (0.5)	NE (1.5)	NW (1)
Cultural criteria only	NE (1)	NE (1.5)	Central	NW (().5)/NW (1) (Equal)	
Environmental criteria only	NW (1.0)	NW (0.5)	NE (1)	NE (1.5)	Central
Combined social, cultural and environmental criteria	NE (1)	NE (1.5)	Central	NW (0.5)	NW (1.0)
Combined social, cultural and environmental criteria, where social is weighted three times more important than cultural and environmental	NE (1)	Central	NE (1.5)	NW (0.5)	NW (1.0)
Combined social, cultural and environmental criteria, where cultural is weighted three times more important than social and environmental	NE (1)	NE (1.5)	Central	NW (0.5)	NW (1.0)
Combined social, cultural and environmental criteria, where environmental is weighted three times more important than social and cultural	NE (1)	NE (1.5)	Central	NW (().5)/NW (1) (Equal))	
Legal, technical (Note timing excluded in the reduced criteria as not critical)	NE (1)	NE (1.5)	NW (0.5)	NW (1.0)	Central

The table shows that the use of the North East WWTP scores better than other options overall, based on consideration of social, cultural and environmental criteria only, even when scores are weighted. Economic criteria are not sufficiently different between options to alter the positions.

An evaluation based on legal and technical criteria also identifies the North East WWTP as the preferred option.

Short to Medium Term:

Additional trunk sewer capacity is required for Auckland and Waitakere growth

Long Term:

The North Eastern WWTP will have capacity to treat other regional wastewater out to 2100

Comparison of Options Based on Key Questions

A list of key questions is set out in the following table . The questions are related to how treatment and discharge facilities might be accommodated in different locations. Each of the three options of a north east, north west and central facilities is then scored against the questions from 1 to 5. 1 is the most positive in terms of suitability and 5 is the least favoured.

It can be seen that the North East WWTP scores best with a score of 17, the North West WWTP comes second with a score of 23 and the Central WWTP third with a score of 34. The scores for the North West and Central plants are potentially optimistic, meaning the gap between them and the North East WWTP could potentially be greater.

Evaluation of Options Based on Suitability in Terms of Pertinent Questions

	Existing Rosedale WWTP		New North Western WWTP		New Central WWTP	
Question	Answer	Score	Answer	Score	Answer	Score
Does a site for wastewater treatment exist with the required land area, and if not, is there a high likelihood that a site can be found	Yes	1	Yes	1	No. Because of the intensely developed urban area within which the site would be located, low likelihood of finding a site	5
Is use of the site for wastewater treatment purposes consistent with Regional and District Plan provisions or could it be made compatible without undue difficulty	Yes, but will need joint planning to ensure compatability between competing land uses.	1	The site is not zoned for the purpose at present but on a broad initial assessment its use for wastewater treatment purposes could be compatible with adjacent land uses	2	There is unlikely to be any area in the locality where the treatment plant could be sited that could accommodate the plant without major land use planning issues	4
Can the use of the site for the proposed extension or implementation of wastewater treatment facilities be undertaken without unacceptable effects on the environment	Yes, with appropriate covering of tanks, noise control and landscaping. There are many plants all round the world where effects are managed to protect adjacent land uses	1	As Rosedale	1	Generally as Rosedale, but significant construction effects likely	2
Does the site have reliable services available (including roads, power supply, water supply, communications) or can reliable services be provided with relative ease	Yes, being in a fully serviced area	1	Many services would have to be provided in a rural environment. Reliable power supply would be more difficult to ensure compared to urban areas	2	Yes, being in a fully serviced area	1
Is the site desirable in terms of minimising energy costs for getting wastewater to and from the sites	Less than ideal because of 45 metre elevation of site above sea level	3	Least attractive of sites because of site elevation of 55 to 60 metres above sea level. An alternative site could be used	3	Best of three sites with relatively low energy required to pump flows to and from site, but not ideal	2
Can peak wastewater flows be handled with relative ease if the site is used as a regional plant	Some limitations, but generally yes, with flow balancing capacity available in ponds (even with reduced area) and provided appropriate flow balancing provided in network	2	Generally as Rosedale but may require construction of flow balancing pond prior to discharge to minimise size of outfall pipe	2	Less suited to peak flow treatment because membrane plant that would be used would not handle peak flows economically	3
Can biosolids be managed with relative ease	Yes, generally as at present, but off-site use and/or disposal can be an issue	2	As Rosedale	2	Unlikely to be room for on-site biosolids treatment of any kind, requiring facilities elsewhere	4
Does a method of effluent disposal exist with sufficient capacity to meet future needs without undue effects on the environment and/or the community, and if not, is there a high likelihood that a discharge location can be found and consented	Yes, with appropriate treatment. Low potential for undue effects on the environment and/or the community. Some augmentation of the proposed new outfall could be required	2	There is no existing discharge. Options do exist with low potential for undue effects on the environment and/ or the community. As the discharge would affect environment and community not currently affected, somewhat less favourable than Rosedale in terms of overall effects	3	Generally as North Western WWTP	3

Question	Existing Rosedale WWTP		New North Western WWTP		New Central WWTP	
	Answer	Score	Answer	Score	Answer	Score
Can use of the site be staged in a way that avoids major upfront expenditure	Not entirely, but easiest to stage and minimise upfront costs of all options. Main upfront costs over and above sunk costs would be the pipeline to the plant and additional treatment capacity for say 100,000 people	2	Much less opportunity for staged development and expenditure than Rosedale. In addition to the pipeline to the plant, initial site development costs, servicing and support infrastructure costs and, in particular the cost of the discharge system would need to be added at a minimum likely additional initial cost compared to Rosedale of around $173 million	3	Generally as North Western WWTP but with a minimum likely additional initial cost compared to Rosedale of around $334 million	4
Taking an overall balanced view of the effects of the option on local communities, how do the different options compare?	Broadly speaking, the option would not affect any communities that are not affected by the current situation and existing effects would not be significantly changed by the option	1	As well as the communities affected by the existing Rosedale facility, communities which are not currently affected, at both the new treatment plant and discharge sites, would be affected to some extent, albeit to a limited extent	2	Generally as North Western WWTP but with potentially greater construction effects in addition	2
Taking an overall balanced view of overall project risks, how do the different options compare?	Lowest risk option as facility is already consented for the intended purpose, treatment plant site conditions are known and relatively straight forward and there will be no significant risks associated with a new discharge	1	Somewhat higher risk because of lack of consents and significantly higher risks associated with a new ocean outfall	2	Significantly higher risks because of the lack of an obvious site, lack of consents, major underground construction for the treatment plant and risks associated with a new outfall	4

Other questions could also be asked, including which option would allow maximum flexibility to respond to changes in need for wastewater services. A seperate investigation again showed the Rosedale option would allow greater flexibilty.

The North Eastern WWTP will have capacity to treat other regional wastewater out to 2100

The North Eastern WWTP is the prefered second regional wastewater facility based on currently available information

Generic Overview of Options

This overview is based on comparing options to provide additional wastewater treatment capacity for 500,000 people and possibly up to 1,000,000. In reality, a figure at the lower end of the scale is more likely if treated wastewater reuse is actively pursued and new technologies over the next 30 to 40 years allow increased efficiency in removing nitrogen from wastewater.

At a very high level, the choice will be influenced by:

- Whether facilities can be developed without undue effects on communities and the environment;
- Which option involves least risk;
- Which option offers most flexibility to deal with future change; and
- Which option is most easily affordable, assuming all meet generally equivalent performance standards.

By using a very simple direct comparison of the three options using scores allocated by independent groups of experts, the North Eastern WWTP is preferred on almost every count.

In terms of the questions listed in the table overleaf, the North Eastern option is once again preferred on all counts individually and overall, and the Central WWTP is least favoured by a substantial margin.

With specific regard to the central plant, the following need to be considered:

- There is no existing land-based site for a treatment plant and no real expectation that one will emerge in the future;
- While reclamation is theoretically feasible, experience in New Zealand has shown it to be almost impossible to get consented;
- A central treatment plant would be membrane based and poorly equipped to deal with peak flows economically;
- Biosolids would require off-site treatment with considerable complications and additional cost;
- Any treatment plant development would require coordination with many different organisations, which makes a successful outcome less likely;
- Any central treatment plant would be very high cost and would place additional pressure on available funds; and
- Obtaining consents for both the treatment plant and discharge could be impossible.

While there are sound reasons for wanting to pursue a central treatment plant, the factors against such an option being realistic are likely to be insurmountable. They are certainly sufficient to make any reliance on a successful outcome imprudent to say the least and of too high risk to be taken further at the present time.

Overall, in a straight comparison between north east and north west options, the north eastern option is favoured for the following reasons:

- No significant increase in effects, if any, compared to existing consented limits;
- Minimises effects on communities overall;
- Best addresses cultural issues, of the options available;
- Maximises benefit of existing resources and investment at Rosedale and the associated outfall;
- Will provide financial benefits to North Shore ratepayers;
- Will extend the expenditure profile more than any other option in terms of time, with benefits to all regional ratepayers;
- Requires less energy to pump wastewater to the treatment plant unless a new north west site is chosen;
- Lower overall construction risk.

In a fully regional context, which is the premise of the TWSPP, there do not appear to be any compelling reasons for not using Rosedale as a second regional facility, provided appropriate controls are put in place. Accordingly, this Strategic Plan proposes that Rosedale is the second regional wastewater facility.

This final choice will need confirmation prior to physical construction works being undertaken. It will be important to secure the Rosedale WWTP for future regional purposes by land use designations to avoid use of the land for other purposes.

The central interceptor concept includes:

Duplication of Manukau Siphon and Hillsborough Tunnel.

Mitigation of 70% of trunk wastewater discharges to Waitemata Harbour.

Network capacity augmentation for growth in Auckland City, Waitakere City and longer term Manukau City.

Opportunity to be jointly optimised with the sewer separation programme and also mitigate nearby local network operator discharges.

Online storage sufficient to balance peak flows to the Mangere WWTP, significantly reducing bypass events.

A flow transfer station (hub) to divert flows longer term enabling flow sharing between regional WWTPs.

Part E
Water Supply

Water supply - our current Auckland situation

Water delivered to households and businesses through a piped supply comes from one of three main sources

- surface water stored behind dams;
- groundwater; and
- river water.

Watercare, the region's bulk provider of water services, manages those sources, providing a source water drought security of 1:200 years (based on draining the reservoirs to empty) or 1:50 with 25% remaining available.

Auckland has moderate consumption by comparison to other cities in New Zealand and world wide. On average, Aucklanders consumes less water than Americans and Australians but often more than those living in some European cities. This lower level of consumption in Europe probably reflects the longer term water efficiency policies in place in those countries and the price of water.

Forecasts made in this strategic plan for Auckland's future water needs are based on today's average demand of around 300 litres per person (combined domestic and industrial use and leakage). That means that Auckland currently needs an average of 370,000m^3/d (or around 150 Olympic sized swimming pools) to be put into supply every day.

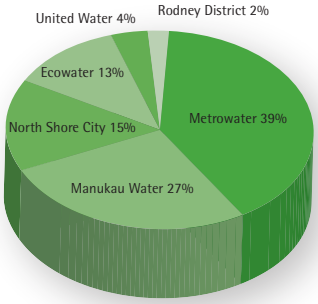
If this level of water use continues, future average needs could be more than 630,000 m^3/d by 2050. This would require almost two more Waikato treatment plants. By 2100, we could need more than 900,000m^3/d or at least another three Waikato treatment plants.

The first increase in new water sources to meet our current average demand is forecast for 2026.

Water demand increases on the hottest days of summer. Water systems in Auckland are designed to provide almost half as much again during the summer over the average annual demand. There is sufficient source water available to meet this seasonal increase until 2026. However, additional water treatment facilities are forecast to be needed by 2010.

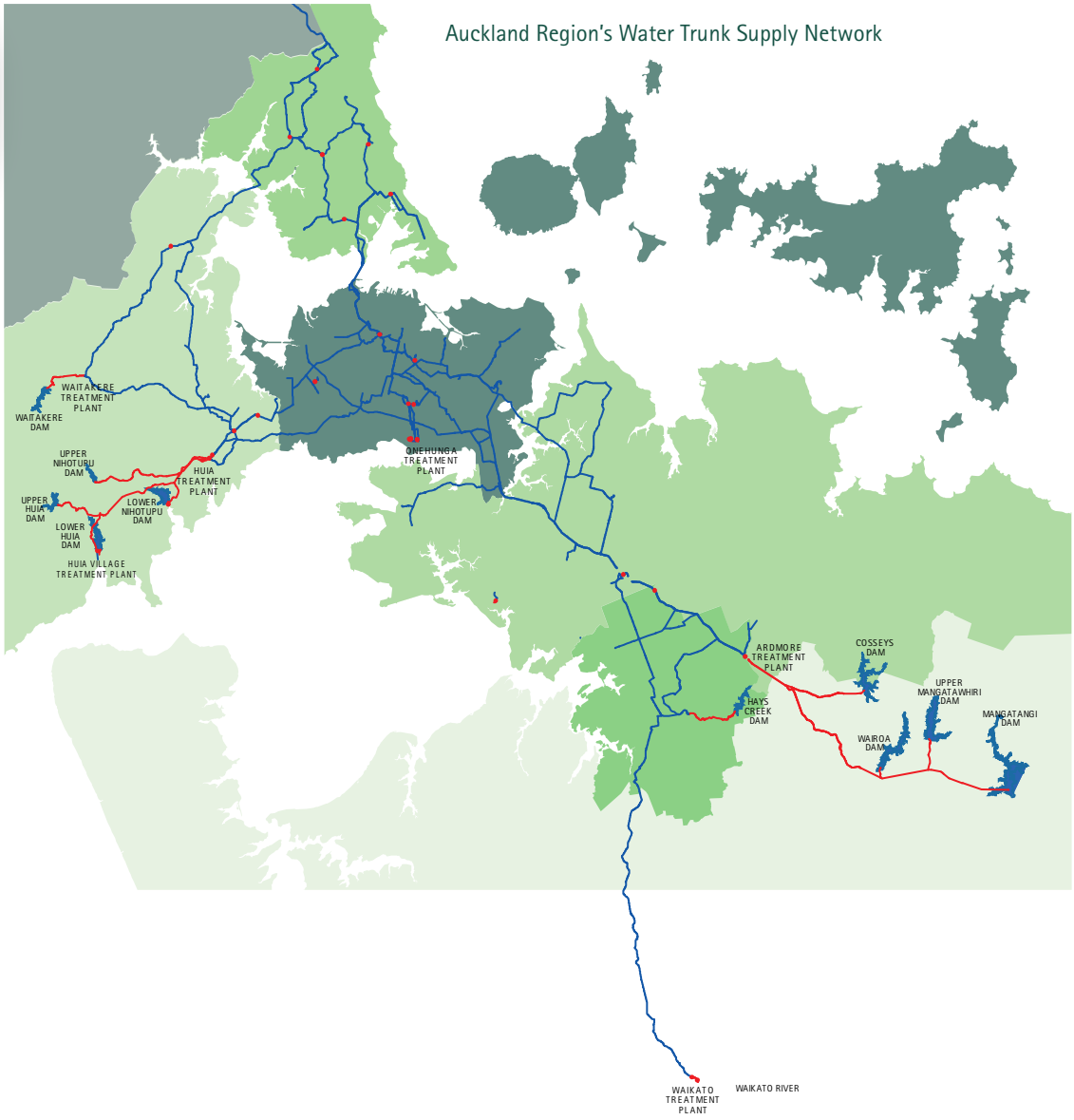
There are opportunities to reduce consumption in Auckland and, as a result, the need for new water sources. This will require the use of water efficiency and water demand management methods, subject to cost effectiveness and community acceptability.

This strategic plan proposes a substantial reduction in daily water use per person to delay the need for new water services.



Current regional water use as a percentage of the total

Auckland Region's Water Trunk Supply Network



Water consumption in litres per person per day

Local Authority Area	Average personal use	Total use
Rodney District	180	250
Papakura District	190	330
Auckland City	185	355
Manukau City	190	305
North Shore City	200	260
Waitakere City	165	233

How we use water in litres per person per day

(Where * means no surveyed data specifically for Auckland exists)

	Indicative use in litres
Drinking, kitchen and washing*	25
Washing*	110
Toilets and other household use*	35
Garden watering*	15
Industrial and commercial use	80
water such as fire-fighting	24
System losses	15
Total	305

Our overall community water supply position

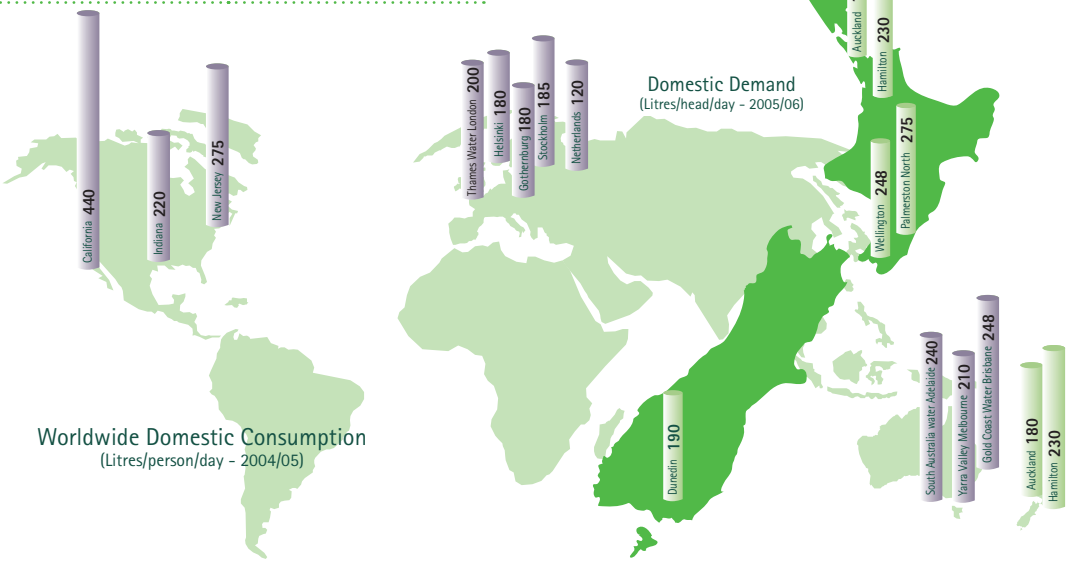
	Volume (1000m³/d)	Year capacity exceeded
2008 Average daily use	375	2026
Total treatment capacity available	570	
Average volume of treated water available	395	
2008 Peak daily use	495	2010
Peak volume of treated water available	570	

Based on 2008 forecast.

Water sources currently used for urban supply

Source	Daily volume in cubic metres
Lake	95,000,000 m³ (Total available)
River	150,000 m³/d (Currently allowed in resource consents)
Groundwater	21,000 m³/d
Roof water	Unknown but small <2,000 m³/d
Treated wastewater	> 60,000* (Including recycle streams)

** Source 2004 Audit of Recycled Water at Mangere WWTP.*



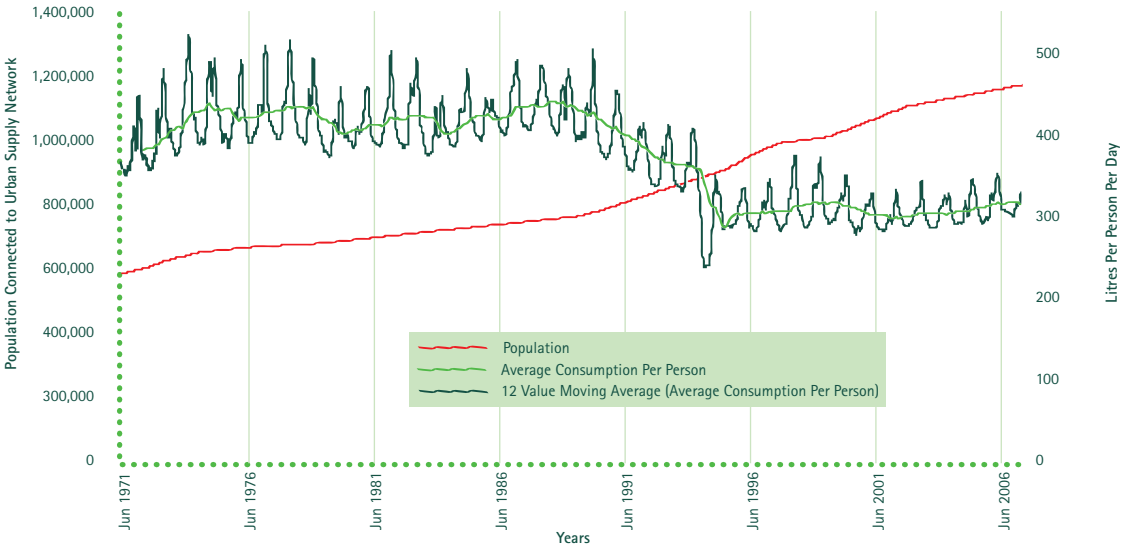
Auckland Region - our current water supply situation

Urban Domestic Water Use in New Zealand

Water supply – Learning from the past

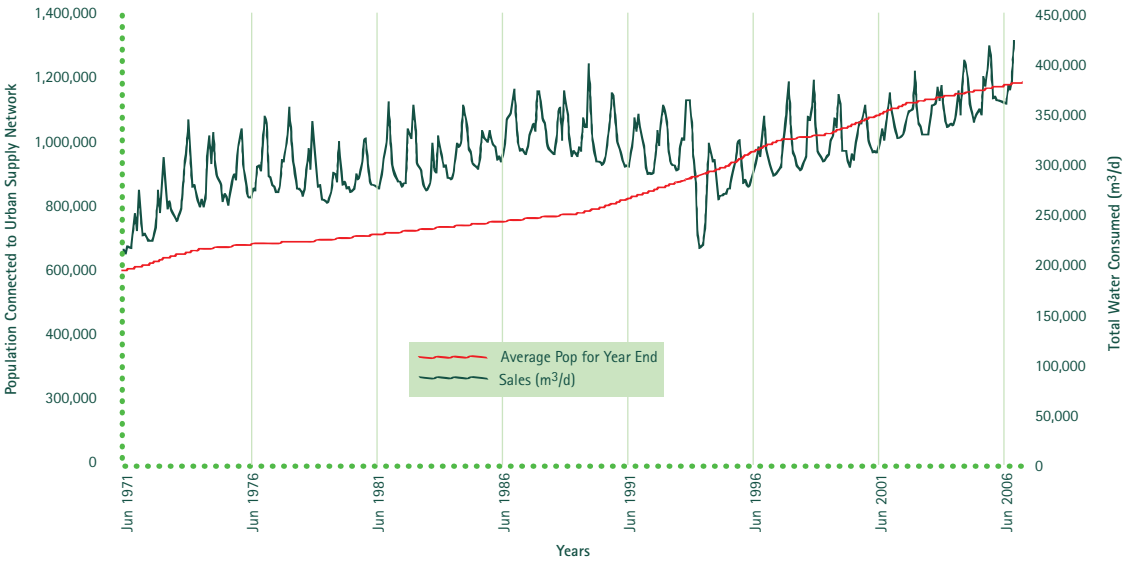
Water consumption dropped in the late 1980s and early 1990s even though population continued to grow. This occurred as a result of drought, the relocation of meat works and other manufacturing industry out of the water service area and universal water metering. Since then our overall consumption expressed as volume per person has been stable.

Population and Average Gross Consumption Per Person Per Day



Growth in population over recent years has seen a proportional increase in the total water consumed.

Population Growth and Total Water Consumed



The Auckland region has an excellent network of dams in the Hunua and Waitakere Ranges.

Large pipe systems bring water to the urban area with around 80% of the volume moved under gravity. This is very efficient and climate friendly.

Local distribution pipe work moves the water to households and businesses. All pipe work everywhere in the world leaks to some extent. Maintaining pipe networks at the minimum economic level of leakage is a desired outcome for all responsible network operators.

Levels of leakage are discussed in many ways, often as percentages. This term should be avoided as climatic factors can distort comparisons between years and organisations. One of the better methods is to work out both:

- The quantities that are lost over the total length of pipe in the system - the more pipes there are the harder it can be to find and fix leaks and;
- The quantities lost over the number of properties supplied - the greater the number of connections to properties, the higher the leakage is likely to be as experience shows that losses occur at joints. Therefore the higher the number of joints the higher the leakage can be expected to be.

Using these measures to compare Auckland with others around the world indicates that Auckland has a better leakage record than many cities.

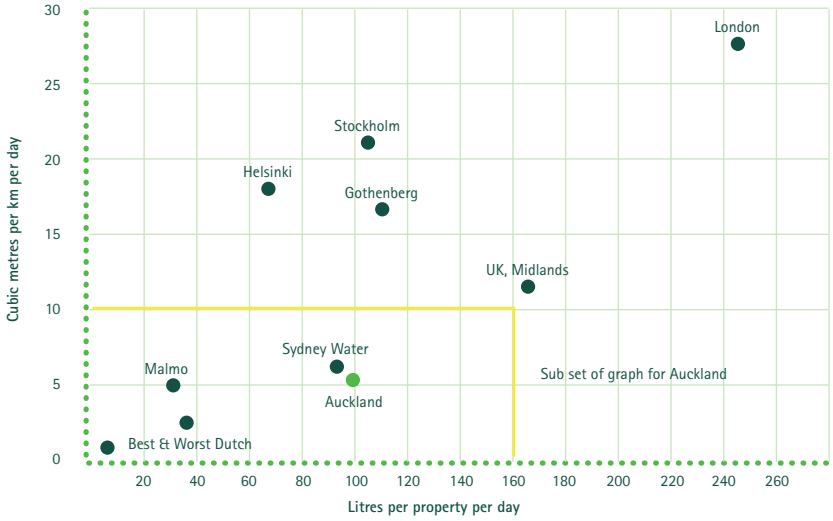
On average around 40,000 m^3/d of water is lost through leakage around Auckland. The price of this lost water is approximately 13 cents per property per day.

Finding and fixing leaks can be a very effective way of saving water although there will be a time when the cost of doing so is greater than the cost of developing a new source.

Water supply losses are estimated at around 40,000 cubic meters per day

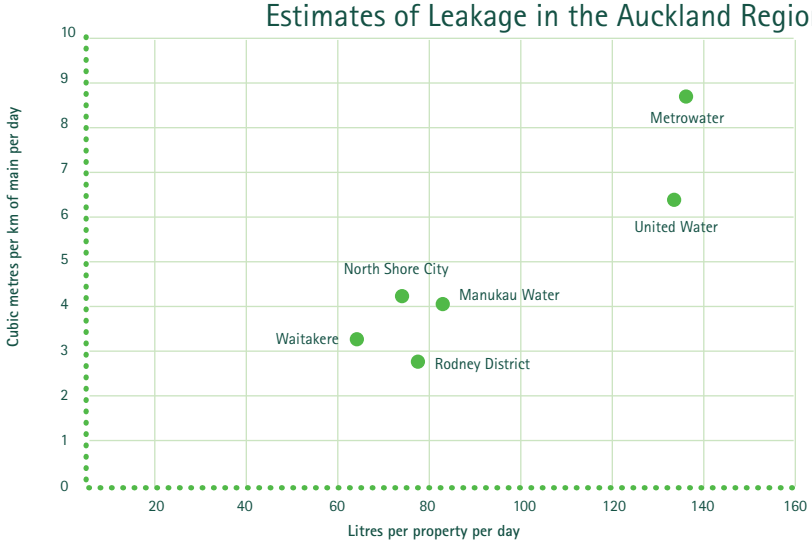
Auckland has a better leakage record than many cities

Estimates of Leakage Internationally



(Worldwide Information from: Security of Supply, Leakage and Water Efficiency – 2005-06 Ofwat, UK)

Estimates of Leakage in the Auckland Region



(Auckland Information from: Auckland Water Industry Annual Performance Review – 2005-06)

(Note: Watercare losses not shown as overall leakage is low. Trunk network has few direct connections and a relatively short networks have large diameter mains).

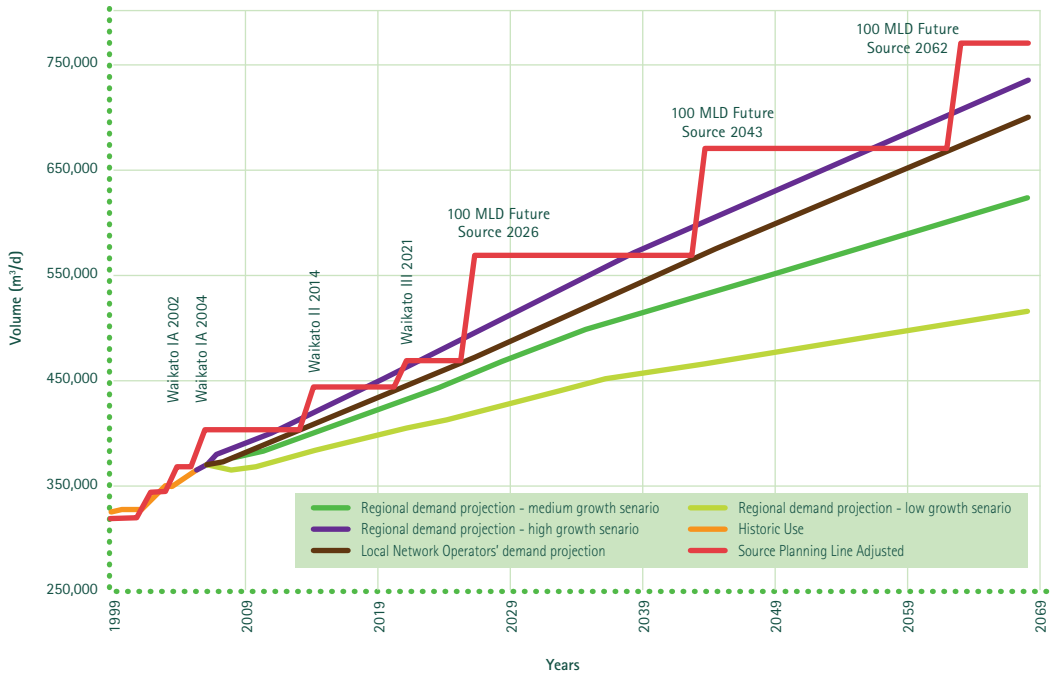
Water Supply for the Future Demand Forecast

A forecast of future demand for water is prepared every year looking ahead for at least 50 years. This identifies when new sources of water will be required. The forecast identified the need for a new source in 2026.

There are a number of ways to respond to this

- Build new resources to ensure supplies are available, requiring capital investment and many years of planning to ensure consents can be gained and sources can be developed.
- Reduce the demand for water that will be required, spending money on techniques that use water efficiently.
- Using both of the methods outlined above.

Water Demand Projection



Water management – supply and demand - the tools available

We can manage demand by using some or all of the following options:

- Changing the behaviour of water users.
- Continuing with efficient practices and operations.
- Seeking alternative sources.

Reduce demand by changing behaviour

- Promote efficient water using devices.
- Educate consumers about the implications of their use and assist with information about that use.
- Provide incentives to reduce consumption, such as the use of pricing mechanisms that change behaviour.
- Undertake audits of household, schools and industrial water use.

Implement efficiency measures

Manage losses from the pipe system by seeking out and repairing leaks and managing the pressure of the water so that losses are minimised.

Impose restrictions

Limit non-essential use, particularly household outdoor use and targeted industrial use, for short periods in times of drought.

Use or recycle stormwater and treated wastewater

Treat and recycle water that has been used and substitute potable water use with other sources such as stormwater collected in rain tanks, grey water, groundwater for external use and/or treated wastewater.

Manage excess water

Capture water not needed immediately and store it, for example, by returning it to aquifers for re abstraction at a different location and timing.

Add additional water supply sources

Augment existing supplies with new sources within the region and/or import water from outside the region.

Each of the water efficiency and demand management options are valid mechanisms for managing water but each requires an appropriate level of investment to achieve the benefits. Experience also indicates that it is easy to over-estimate benefits and under-estimate the costs and the time taken to realise the benefits of implementing the options. Some options should be "business as usual" for the water industry (like leak control), while others will need to be applied in specific local circumstances. All may be valid in particular circumstances and their application should be regularly reviewed, especially as some can have important additional benefits for other parts of the water cycle.

Auckland Water Management Plan 2004

- our agreed way forward

The Auckland Water Management Plan "From the Sky to the Sea", published in 2004, set out an approach to water efficiency that the region would take. The objective was to reduce per capita water demand by 5% over 20 years.

The Auckland Water Management Plan (AWMP) "established a comprehensive and unified approach to managing the existing and future water needs of the Auckland region in a sustainable, wise and efficient manner". The plan set out a number of actions to be implemented by local network operators.

The review of those action plans identified in the AWMP was carried out in late 2006. This demonstrated that some have been more successful than others.

Experience around the world suggests that when there isn't a drought, achieving such savings can be difficult and so far that has proven to be the case in Auckland.

Since 2004, consumption has increased – the 2008 target was to reduce average consumption of water to 294 litres per head per day, whereas the actual consumption in 2008 was 297 litres per head per day which was set as the 2005 target. In addition, the trend line shows increasing rather than falling consumption.

Changing behaviour requires renewed effort to enable water efficiency to be effective. This Three Waters Strategic Plan anticipates 15% reduction in per capita consumption by 2025 will be achieved, which will partly compensate for an increase in population. Implementing these changes will require commitment to a range of actions and the Strategic Plan anticipates an additional 10% reduction in overall water demand through the beneficial use of stormwater and treated wastewater over the same period. This will give a total of a 25% savings in demand.

The next two pages of this document outline a series of questions that apply in 2008, and the likely answers. The options that have been specifically considered for the Strategic Plan are laid out in the additional two tables as:

- Opportunities to reduce demand;
- Opportunities to improve supplies.

Water supply – 2008 questions and answers for the future

Question	Answer	Influencing factors	Approach used in Three Waters Planning
What role will water efficiency and demand management play in future three waters management?	Because the single largest driver for more water is population growth, water demand management or efficiency could defer the need for a new water source by 10 to 15 years.	Water efficiency and demand management will depend on the community's willingness to save water.	Local network operators and Councils to advise Watercare of savings they can achieve and commit to, as failure to meet agreed targets will lead to water shortages.
Can significant reductions in water use be made by reducing system losses?	Reducing the losses from pipes can be cheaper than developing a new source of water, but needs local investigations by each local network operator. There is a minimum economic level of leakage.	The cost of finding and fixing leaks and the value of water paid for by customers but not used.	The long term water demand forecast assumes that all LNOs will achieve the current best practice in the region.
What role will the use of stormwater as a substitute for mains water play in future three waters management?	Two options exist – households using tank water to replace piped water for non drinking purposes. At a city scale, storm water can be recharged into the ground for later abstraction.	Depends on economics - All new households could be required to install a rain tank when the house is built. This is encouraged by some but not all contacts. Collection, treatment and supply of stormwater for non potable uses may be used on a development scale. Generally only supported for no potable purposes by Health Department.	The long term water demand forecast assumes that district plans will be changed and that a proportion of new houses will have rain tanks. No allowance has been made for retrofitting. Overall it is envisaged that stormwater and treated wastewater will meet 10% of required water supply needs by 2025.
What role will the beneficial use of treated wastewater as a substitute for mains water play in future three waters management?	Beneficial reuse of treated wastewater is unlikely to be acceptable on a large scale in Auckland. The principle areas of opportunity are industrial uses and irrigation of sporting facilities. This is seasonal and uneconomic at the present time.	Social acceptability is a key influencing factor, with few in the community accepting direct re use as a viable option at present. If it costs more to treat and supply wastewater when compared to drinking water the proposition will be unattractive.	The long term water demand forecast assumes that some re use will occur but in only a limited number of industrial applications in the short to medium term future.
Can we use treated wastewater for drinking?	Technically yes, but few places in the world do. Namibia is probably the only example of this occurring over a sustained period.	Social and cultural influences make this unattractive at the present time.	No allowance made in the water demand forecast for the use of treated wastewater as a substitute for drinking water purposes, but possible medium to long term future.
What effect would increasing the price of water use of pricing / tariffs have on water use?	Evidence from around the world suggests that as the price of water increases so the demand falls. Sophisticated tariffs have been developed that try to recover the cost of water provision, especially where there is a significant seasonal influence.	Most households pay for water based on the quantity that they use. The use of a seasonal price could influence the behaviour of customers when water is in highest demand in the summer. Any prices would need to ensure that all health and well-being needs could be met. Forms of differential pricing may have potential to be used as an efficiency tool, according to overseas experience.	Price has been used as a factor in the long term scenario, but indirectly , based on all LNOs introducing charges for wastewater disposal. Evidence in Auckland does suggest that a reduction in water use does occur when wastewater charges are introduced.

Water supply – 2008 questions and answers for the future

Question	Answer	Influencing factors	Approach used in Three Waters Planning
How will Watercare plan to ensure enough water is available when there is uncertainty about what savings can be made?	Watercare will continue to carry out long term planning revising demand forecasts on an annual basis, looking ahead at least 20 years. This gives sufficient time for planning and investment.	The biggest single influence of water demand at this time is the growth of Auckland's population. Average use per head is fairly stable but the number of people in the region continues to grow.	The water demand forecast makes different assumptions about the success of water efficiency measures. This provides upper and lower boundary estimates of what might happen, enabling a debate about how much effort the community wants to make.
Where will the next main source of water be?	There are a number of possibilities, ranging from expanding the Waikato source, to new reservoirs or river abstractions from the north of Auckland, or increasing the abstraction of groundwater.	Making savings on demand would mean that a new source isn't needed for many years Unless these savings are realised, a new source will be required by 2026.	Two options are being considered - a northern supply source and associated trunk mains and an augmented southern supply source and associated trunk mains.
How will Watercare ensure long-term security of supply for North Shore City and Rodney District	Watercare will maintain its focus on the risks presented by pipes supplying the north that have to use the two major bridges in the region.	Developing a source or major storage to the north of the Waitamata Harbour will provide increased security. Providing additional supply pipes under harbour is proposed.	Depends on the source chosen (see above), but if the Waikato River continues to be extracted, a new water main under the Waitemata harbour will be provided.
When will the next source of water be developed?	If behaviour doesn't change forecasts suggest around 2026.	Making savings on demand would mean that a new source could be deferred possibly by up to twenty years.	A new source will be required by 2026 unless effective demand management measures are in place.
When will treated water capacity be upgraded?	Forecasts for water demand at the hottest time of the year determine how soon new treatment will be required. At present 2010 is the expected date.	The summer weather has a very big influence on peak demand. Because that is out of Watercare's control, investment may need to be made to ensure that appropriate supplies are maintained. Demand management around that peak demand could put off the need for investment.	The long term water demand forecast works on the forecast average need for water accepting that short duration, seasonal needs are important Pipe networks are usually designed with those needs in mind.
What effect will changes have in New Zealand's drinking water standards have?	There are proposed changes to New Zealand's Drinking Water Standards expected to come into effect in 2008/09. The proposed changes could require substantial investment in order to ensure compliance.	Raw water sources, treatment technology, pipeline materials and residence time of water in pipelines all have an influence on water quality.	A specialist investigation is being undertaken as a part of the Three Waters programme to accurately determine the magnitude of the effects proposed drinking water standards will have on the Auckland region.

Water supply – quantifying opportunities to reduce demand

Option	Method	Potential Savings	Certainty of Implementation
Reduce demand	Price Mechanisms.	Potential savings of around 2,000m^3/d, assuming all LNOs introduce volumetric wastewater charging by 2012 resulting in a 2.4% reduction across the region.	Volumetric wastewater charges are now in place for two of the six local network operators receiving a water supply from Watercare. A number of the remaining LNOs are reviewing whether charges could and should be applied. This strategic plan assumes six years will be required before the change in policy is implemented.
	Target Outdoor Discretionary Use.	Rodney District Council targeted 2004/05 summer campaign effectively reduced water demand below supply available.	Five of the six LNOs do not ask for customers to make savings during summers periods. This policy is likely to stay in place. Therefore, no water savings are included in this strategy. These types of restrictions are only valid for managing summer peaks.
	Water Audits – Commercial and Industrial.	Savings depend on industries targeted. Savings of 2,000m^3/d, have been assumed.	Audits are a positive opportunity to work with large users as savings in water are likely to save cost of the water bill. Many cities around the world have found that industry can make a greater proportion of savings than individual households.
Restrictions and Regulation	Changes to bylaws and Building Codes, requiring water efficient devices to be installed in new buildings.	To date the main change of relevance has been the addition of rain tanks for storm water attenuation.	There is some conflict between tanks for storing rain and those for slowing down roof water runoff. The certainty of implementation is low but the scenario assumes up to 80,000m^3/d can be saved by 2100 by the use of roofwater.
	Garden Watering Restrictions.	Restrictions do influence peak demand, but likely savings have not been quantified for Auckland. Increased development density over time is likely to reduce the demand for garden watering.	No change to current policy so no savings allowed.

Option	Method	Potential New Water	Certainty of Implementation
Increase Supplies	New Sources – Groundwater.	The Onehunga aquifer has an estimated 60,000 m^3/d of water available for potential supply. Only half this is used at present. A further 30,000 m^3/d is potentially available as a future source for urban water supply, some of which is already used privately. The Western Springs aquifier and Three Kings Quarry also have potential.	Increasing a source that already provides water can be expected to be an easier and cheaper option than developing one from new. Quantifying the amount of water available (yield) is not precise, so the actual additional quantity available is somewhat uncertain.
	New Sources – Surface Water.	These vary depending on the location and source chosen but range from 20,000 to 150,000 m^3/d. Auckland City Stonefields development being pursued.	There is enough water available from sources such as the Waikato River and other sources to meet the future needs of Auckland through to 2100 and beyond, in association with prudent demand management.
	Substitution – recycle/ reuse wastewater and stormwater.	Wastewater treatment and beneficial reuse is limited at present to existing wastewater treatment plants. There are no plans for direct reuse of treated wastewater for household uses, but there are opportunities for industrial reuse where the recycled water could replace drinking water.	Investigations have shown that there are industries that could use recycled water. They are limited in number and volume today but could increase in the future. This strategy takes a long view and assumes use could increase from around 5000 m^3/d in 2015 to perhaps 20,000 m^3/d by around 2025.
	Substitution – rain water tanks.	Rain tanks can be included in all new houses that are built so the benefits will be gradual over time. No assessment of the potential for retro fitting tanks in existing properties has been made as the costs are likely to be very high ($15,000-20,000 per property).	Without some form of district plan that enforces the rate of installation of rain water tanks the benefit cannot be guaranteed. This places a significant risk on the source provider. A regional investigation will be undertaken to confirm regional role of the rainwater tanks in the future.
Managing Excess Water	Aquifer recharge.	Storm water recharged and stored in the Central Auckland Isthmus could provide addition water in the city For this strategy up to 20,000 m^3/d has been allowed, although it could be more.	Recharge of the aquifer is possible although the urban nature of the city could keep volumes below the maximum calculated.

Water supply – qualifying opportunities to improve supply

Review of current status of "Sky to the Sea" Programme

Key

- ✓ Watercare
- ✓ Metrowater
- ✓ North Shore City Council
- ✓ United Water
- ✓ Waitakere
- ✓ Manukau Water
- ✓ Rodney District Council
- ✓ Franklin
- ✓ Auckland City

Progress to 2008

Water Demand Management			
Management Option	**Implementation Tools**	**Commentary**	**Auckland Water Industry Response**
Water Metering	• Quarterly meter billing for residential • Monthly meter billing for high water uses	Provides for better accountability and enables leaks to be more quickly detected by customers.	✓ ✓ ✓ ✓ (some areas only). ✓
Water Accounting and Loss Control	• Telemetry systems • Field surveys and repairs • Water audits • Water meters • Hydrant permits	Enables better tracking of Non Revenue Water loss to enable greater controls. All LNOs and Watercare have leakage management programmes in place. Some programmes are more proactive than others.	✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓
Water Pricing	• Sliding tariffs • Wastewater charging • Stormwater charging	Wastewater charging now used by 3 LNOs (through CCOs). Legal clarity required for the other LNOs to implement wastewater charging under the LGA. There are specific issues that need to be considered for high water users. Staggered rates also available.	✓ ✓ ✓ ✓ ✓ Note: other LNOs considering wastewater charging, but waiting for legal clarity in relation to LGA requirements.
Water Efficient Landscaping/ Outdoor Use	• Education and promotion • Regulation and restrictions (e.g. hose pipe restrictions) • Subsidies (e.g. rain tanks)	Domestic outdoor water use can be very inefficient and educational campaigns may be effective in raising awareness. Hose pipe restrictions over summer are used by other cities in NZ (e.g. Hamilton).	Rain tank subsidies ✓ ✓ ✓ ✓ ✓ Note: all LNOs have information on websites in relation to efficient outdoor water use.
Water Use Audits	• Mandatory audits for high water use industries • Residential water audits on request, or as part of programme	Water use audits can identify inefficiencies and ways to improve practices.	✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓
Pressure Management	• Pressure zone management	All LNOs and Watercare have in place pressure management programmes. Some programmes are more proactive than others.	✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓
Wastewater and Stormwater Reuse	• Subsidies or rebates (e.g. retrofitting rain tanks) • Regulation (e.g. required by resource consent) • Best practice	Potential examples include: • Industrial (e.g. cooling water or general reuse) • Agriculture (irrigation) • Non potable residential • Groundwater recharge	✓ ✓ ✓ ✓ ✓ ✓

Water Demand Management			
Management Option	**Implementation Tools**	**Commentary**	**Auckland Water Industry Response**
Information and Education	• Media (television, newspapers, websites) • Billboards • Pamphlets • Household water audits	Recent examples include: • WCC 2006/07 "Water Wiseup" campaign targeting schools and high water users. • RDC 2006/07 "Every Drop Counts" campaign targeting households	✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓
Promotion of Water Efficient Technologies	• Subsidies and rebates • Water Efficiency Labelling (WEL) • Free water efficient devices (e.g. gizmos) • Retrofitting	Current examples include: • Rebates offered by NSCC, RDC and WCC for retrofit of rain tanks for non potable water use • WEL will be introduced in 2007, and be mandatory for all appliances by 2008. • Free gizmos (or similar) provided by all councils	✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓
Regulation and Restrictions	• Regulation • Bylaws • NZ Building Code	Changes to Building Code could be made to make water efficient devices mandatory in new developments. Some councils require new developments to install rain tanks or greywater reuse of wastewater or stormwater as part of resource consent conditions.	✓ ✓ ✓ ✓ ✓
Best Practice	Proactive measures led by water utilities, government and large industry.	Examples include: • Development of water efficiency plans voluntarily by industries • Voluntary water audits • Stormwater reuse for irrigation of parks, toilet blocks etc	✓ ✓ ✓ ✓ ✓
Supply Augmentation	Feasibility study required to identify potential new water supply sources, and evaluation process to identify optimum source.	Supply augmentation is a long term strategy that will eventually be required for the Auckland Regions growing population and associated demand. Most effective if coupled with other water demand management initiatives, as this can delay when additional supply required.	✓ ✓

Key

- ✓ Watercare
- ✓ Metrowater
- ✓ North Shore City Council
- ✓ United Water
- ✓ Waitakere
- ✓ Manukau Water
- ✓ Rodney District Council
- ✓ Franklin
- ✓ Auckland City

Options for new sources – north or south?

Investigations have shown that there are potential new sources of water to both the north and south of Auckland. Each brings different attributes to future water source management.

	Northern	Southern
Social	• Maintains security of supply for northern parts of the urban area by reducing dependence on harbour bridge crossings.	• Adaptation of network to mitigate risk associated with bridge crossings through alternative infrastructure.
Cultural	• Potential concern about developing abstractions and impoundments for inter catchment transfers.	• Increase of Waikato River abstraction could be of concern.
Environmental	• Commitment to major construction ahead of need "just in case". • Increases the cost of pumping due to distance. • New pipeline route to be found.	• Incremental design allows expansion as demand increases "just in time" • Builds on existing consents and knowledge of environmental impact. • Pipeline corridor already developed. • High energy usage.
Economic	• Higher cost option. • May require reworking of recent investment for Orewa.	• Least whole of life cost option. • Increasing energy costs are of concern.

Options for northern or southern source and network development

Potential Future Sources to the North of Auckland

Watercare undertook a comprehensive investigation of alternative regional water sources in 1995. As part of this 2008 Strategic Planning Programme a high level review of the more favourable options from the 1995 study was undertaken to update the costs of supplying water from each. No work has been undertaken to determine if the sources are still available as land use and ownership may have changed over the past 12 years.

Expanding the Waikato source

Growth in the region's demand for water will initially be met by increasing the amount of water taken from the Waikato River to the consented maximum of 150,000 m^3/d. The river has substantial capacity to provide additional water for the Auckland region, if required in the future. An advantage of this option is that, unlike a dam, the source can be expanded in stages as demand arises. This has been proven to be very capital cost effective with the current Waikato plant and means that costs can also be staged.

The Waikato Source

Membrane treatment technology

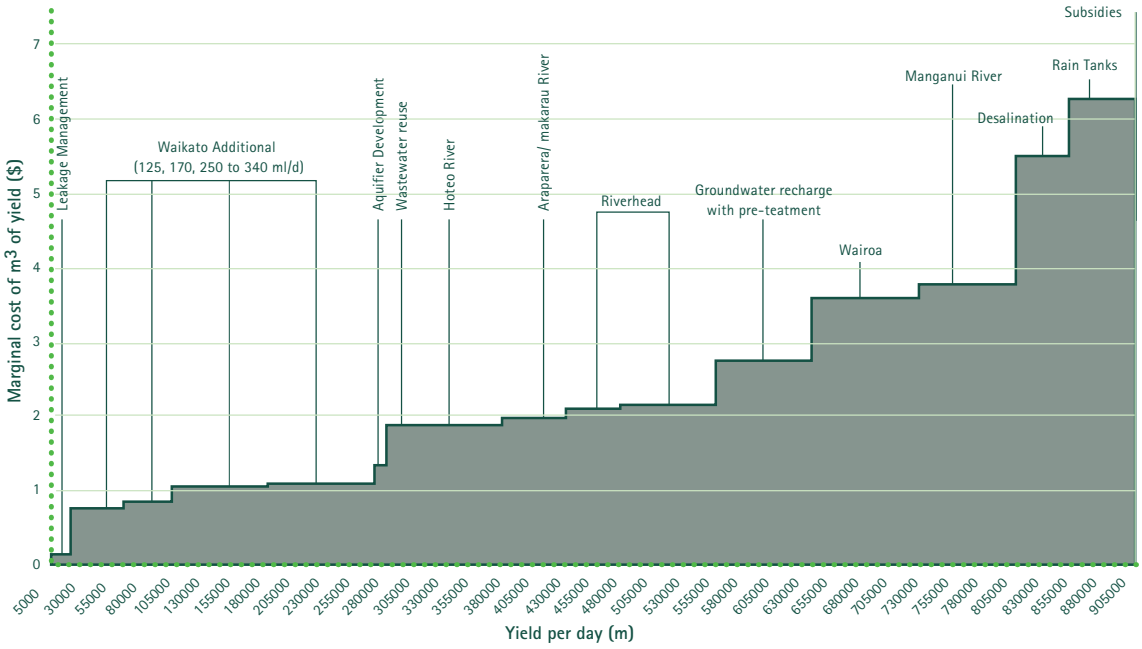
Future water supply options - comparative costs

Developing different and new water sources and methods of saving water can be compared to understand which are the most sustainable and cost effective options. Each of the major options that contribute to either the supply or demand side of the balance has a cost associated with it.

Comparing the net present values provides an indication of the most cost effective of those options.

This graph shows that staged development of the Waikato source is a more cost effective solution than developing other sources to the North of Auckland.

Cost curve showing increasing marginal cost of achieving each successive m^3 of water

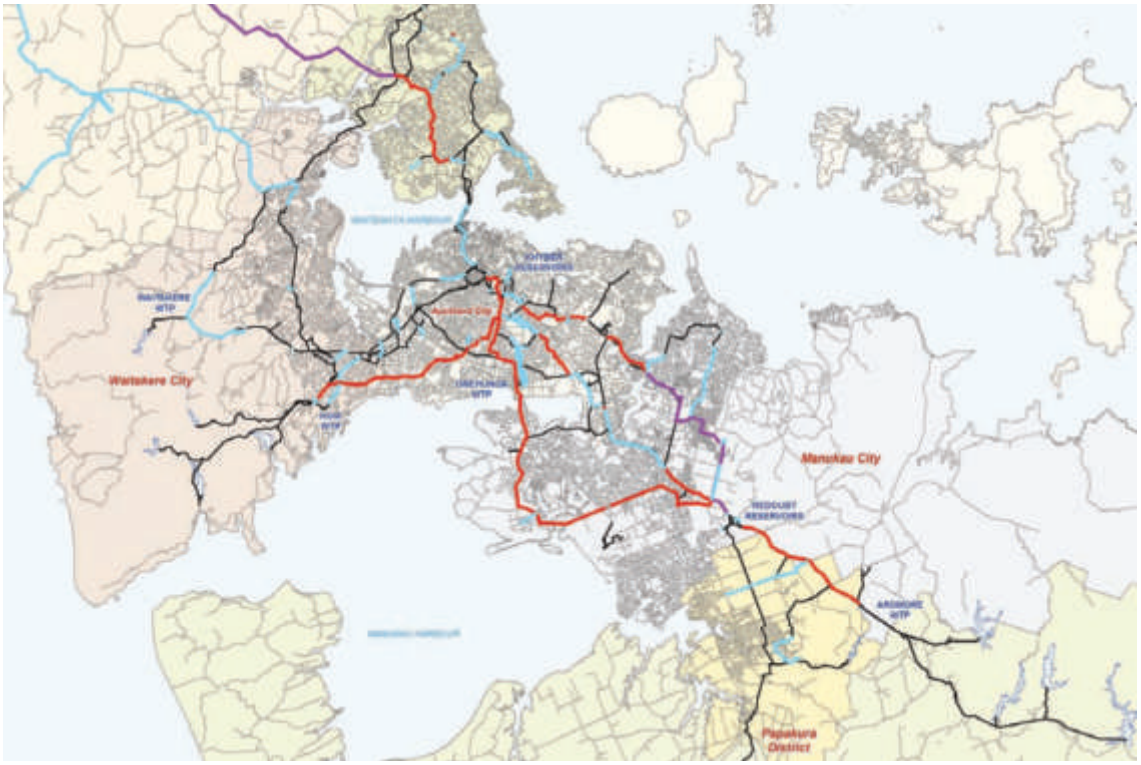


Network Management is very cost effective

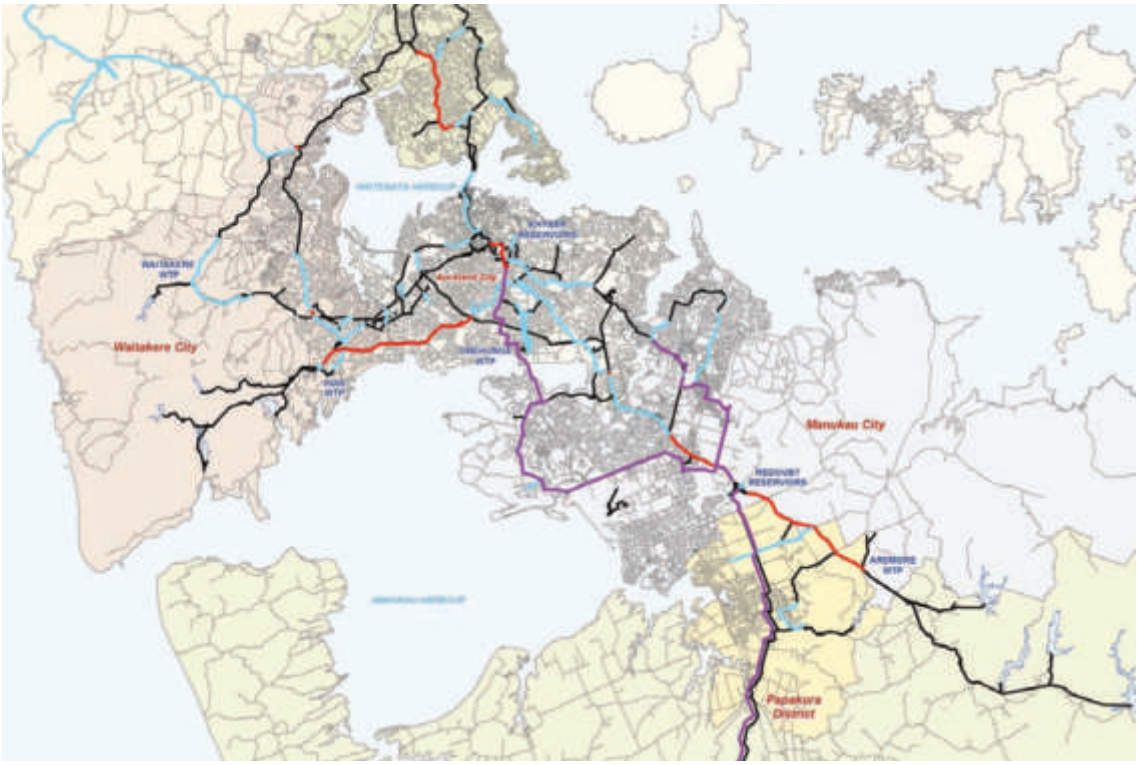
Waikato expansion offers a cost effective future supply

Both northern and southern sources would require an additional network of pipes to deliver water to Auckland. A comparison between sources and the associated networks constructed for 2057 indicates that the southern option would cost less. Both options offer the same level of service. Subsidies to encourage purchase of water efficient appliances would have a greater cost than $7 per m^3. Energy requirements and reliability of electricity supplies will be critical considerations in any final decisions.

Northern and Southern Network requirements



Northern Network Map



Southern Network Map

Option	2057 Network Costs	2057 Source Development Cost	Total
Southern Source	$560m	$200m	**$760m**
Northern Sources	$507m	$450m	**$957m**

Network and source total costs

From a cost point of view, a southern source is clearly preferred. Prior to making a final choice a further review of northern sources will be undertaken.

Developing a 2008 Long Term Water Efficiency Scenario

The assumptions listed below were used to develop a proposed water demand strategy.

The effectiveness of any strategy will depend almost entirely on the willingness and commitment of councils and local network operators and the regional community to make the strategy work.

The broad assumptions are:

- Rain Tanks on all new domestic properties will be installed with a projected saving of up to 80,000 m^3/d by 2100.
- Beneficial wastewater use for industrial purposes will start at 5,000 m^3/d from 2015 and increase to 20,000 m^3/d by 2025.
- Universal wastewater charging will be in place by 2015 and result in a saving of approximately 6,000 m^3/d in water use.
- Pressure and leakage management will result in savings of around15,000 m^3/d by 2045. This will require leakage rates to be maintained at 60 litres per connection.
- Additional groundwater recharge and/or use will increase from current levels by 1,000 m^3/d in 2015, rising to 15,000 m^3/d by 2025.
- Water audits of schools, industry and domestic use will result in savings of 20,000 m^3/d from 2015.
- The use of water efficient devices will reduce water demand by 500 m^3/d by 2015 and by 23,000 m^3/d by 2100.
- Overall targets are:
  - 15% reductions in per capita demand by 2025
  - 10% of supply provided by beneficial use of stormwater and treated wastewater by 2025.

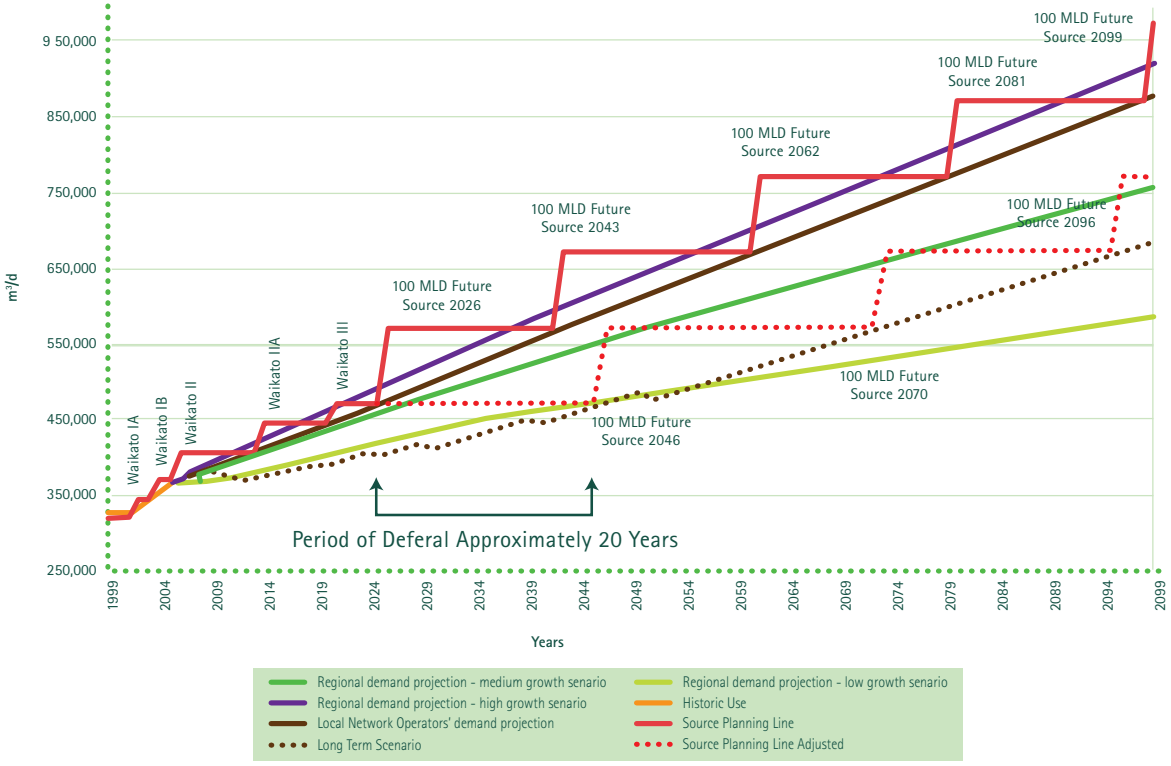
If the above components of the efficiency scenario are fully implemented, the effects on the future water demand forecast for the Auckland region would be to defer the next major regional water source by around 20 years.

Comprehensive cost benefit analysis will be required to confirm the most appropriate savings target.

Future Supply-Demand Efficiency impacts

The following graph outlines the effect meeting targets on water source requirements. It should be noted that the strategy outlined is only one of many options for reducing demand. All decisions will need to be subjected to cost/benefit and public consultations processes.

Auckland Region Water Demand Projection Showing the Effects Water Efficiency Can Have On Future Water Source Requirements



All elements of the strategy will require investment, just as the development of a new source would. Reviewing the possible costs indicates the strategy will be more expensive than the development of the next Waikato source. However, this efficiency cost would have the benefit of putting off the development by up to 20 years. It is also consistent with an overall philosophy of "reduce, recycle and reuse.

Waitakere Dam

Lower Nihotupu Dam Spillway

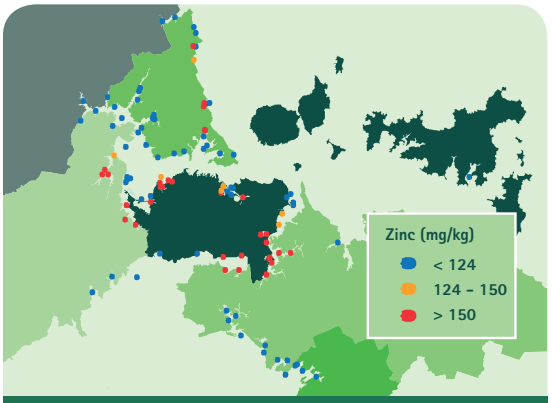
Part F
Stormwater

Stormwater – our current situation

Stormwater is formed when rain falls on hard surfaces and is shed directly from those surfaces, such as roofs, roads and low permeability soils.

It generally remains as stormwater for a relatively short time while it finds its way into an existing water body such as a stream, a lake, an estuary or the sea.
Without controls, stormwater can cause serious harm to the environment, by:

Washing silt from land development and building sites into streams, estuaries and the sea



Transporting a wide range of contaminants like zinc into the environment, resulting in accumulation in sediments

Damaging areas within overland flow paths and resulting in flooding of houses, industrial and commercial premises and land

Causing erosion of stream banks at times of high flow, adding to the amount of sediment discharged downstream and adversely affecting stream ecology

Maintenance of stream banks is also an ongoing concern of a number of councils. On the other hand, because it originates from rainfall and is formed in large quantities in urban areas, where there are large numbers of people, stormwater can be used as a local water source. However, unless it is treated, it is only suitable for non drinking purposes such as toilet flushing, clothes washing or garden watering.

Regional Stormwater Action Plan

In 2004, the Boston Consulting Group undertook a review of regional stormwater management which became the Regional Stormwater Action Plan. The plan identified additional effort was required in the areas of:

- Integrated Catchment Management planning;
- Controlling contaminants at source;
- Regional communication and community education;
- Local authority capacity building; and
- Alternative sources of funding.

These issues remain relevant and while progress has been made, future solutions will continue to require regionally coordinated efforts in these areas.

Stormwater management options and responsibilities

Different stormwater management opportunities exist in new development (greenfield areas), compared to largely developed urban (brownfield) areas.

In greenfield areas, options exist to manage stormwater to substantially reduce its adverse effects, provided the necessary regulatory policy direction is in place and enforced. Ad hoc development of urban areas over many years without effective stormwater policy in place means that serious stormwater effects are occurring in parts of the urban area and mitigation options are constrained by existing development.

In greenfield areas, options include:

Water friendly urban design

Rain gardens

Wetlands

Capture and use

In brownfield areas, options include:

Local solutions to mitigate overland flow and flooding

Upgrading existing stormwater treatment devices

Stream protection works

Retrofitting storage tanks

Stormwater regulation and responsibilities

Activity	Responsible Party	Method	Issues
Setting national policy direction	Central Government	Statute	Resource Management Act – Avoid, remedy or mitigate effects of stormwater, National Coastal Policy Statement
			Building Act/Code – Control on certain building materials, rules relating to gully traps, rules relating to building in flood plains (Controls on contaminants from cars)
			Local Government Act – Control of nuisance arising from stormwater, agree levels of service with affected communities
			Health Act – Protection of public health
Setting regional policy direction	Auckland Regional Council	Regional Plan: Air, Land and Water under RMA	Flood management Stream management Effects of stormwater contaminants Adoption of the Best Practicable Option
		Regional Plan: Coastal under RMA	Effects of discharges Structures in the Coastal Marine Area
		Regional Plan: Sediment Control under RMA	Control of sediment from subdivisions, specifically, and from small sites as permitted activities
Approving works in accordance with regional policy	Auckland Regional Council	Resource consents under RMA, and taking into account harbour models, fate and effect of contaminants, etc	Defines rules for construction, operation, maintenance and monitoring
Setting land use policy	City and District Councils	District Plans under RMA and giving effect to the Regional Policy Statement	Development locations and densities Impermeable area rules Flood management controls Building close to streams
Setting infrastructure design standards	City and District Councils and network operators	Infrastructure design standards manuals	Defines requirements for infrastructure to be taken over by the network operator or Council
Approving land development	City and District Councils	Land use or subdivision consents under RMA	Controls development activity and defines monitoring requirements, consistent with the District Plan
Approving building development	City and District Councils	Building permits under Building Act	Controls building/development activity and monitoring, and may include sediment control and control on discharges to approved outfalls to control effects on sensitive environments
Providing community infrastructure	City and District Councils, network operators and private developers	In accordance with the Local Government Act and any RMA requirements	Can be used to mitigate existing effects or facilitate new development
Providing major new development infrastructure	Land developers	In accordance with RMA and, in particular, any resource consent conditions	Must be undertaken in accordance with the relevant infrastructure design standards manual and conditions acceptable to relevant local council or network operator if it is to be taken over by the council or network operator
Small scale private infrastructure	Private parties	As above and Building Act	As above
Maintaining stream banks	Adjacent landowners	RMA and Building Act	Need to maintain stream banks to minimise erosion and allow free passage of water

Moving forward on Stormwater

In general, stormwater needs to be managed locally to address locality specific issues in accordance with levels of service agreed with communities. There are a number of important areas where regionally consistent policy directed towards minimising future stormwater problems would be beneficial.

Policy is required in relation to:

- Gulley trap design to minimise entry of stormwater into sanitary sewers under flood conditions.
- Small site sediment controls.
- Management of stormwater from roads, with control of transport derived contaminants at source, if practicable (requires central government initiatives).
- Control of other stormwater contaminants at source.
- Rainwater collection and use to reduce effects of stormwater run-off and provide a source of non-potable water.
- Overall urban, site and building design guidelines to eliminate poor stormwater design practices.
- Definition of areas where further building is restricted until existing stormwater problems are addressed.
- Infrastructure design standards for both stormwater and wastewater to minimise leakage into and/or out of both systems, as appropriate.

Through the Three Waters Strategic Plan envisages, the establishment of a multi party working group to address the policy issues and communicate outcomes to the wider regional community has been facilitated.

Part G Strategic Plan Summary

Three Waters Strategic Plan Summary

The Three Waters Strategic Planning Programme was initiated in 2004 to ensure the integrated and efficient delivery of water supply, wastewater and stormwater services throughout the Auckland region. After more than four years of investigations, undertaken jointly by all territorial councils and network operators in the region, the Final 2008 Strategic Plan has been prepared for consideration by regional decision-makers.

Key proposals set out in the draft Strategic Plan are:

1. To place a strong emphasis on water demand management to delay the need to provide a new water source for up to 20 years, with estimated deferred expenditure of $300 million;
2. To reduce the gross per person demand for water by 15% of 2004 levels by 2025. An additional 10% of total demand will be met by beneficially using treated wastewater for industrial purposes and rainwater for non-potable household purposes over the same period (To be confirmed by cost benefit analysis).
3. To plan for higher regulatory standards in relation to drinking water and wide-ranging changes to the way we manage our water supply systems, from source to tap;
4. To secure long-term access to the Waikato River as the main future water source for Auckland, but continuing to investigate a new northern water source, increased use of central Auckland aquifers and the use of rain tanks and/or treated wastewater as possible alternative future water sources;
5. To provide a new central interceptor to augment trunk wastewater sewer capacity as a matter of urgency, to provide for growth, meet agreed levels of service and satisfy regulatory requirements;
6. To ensure continued focus on maintaining and/or enhancing water quality of the Manukau Harbour by optimising and improving treatment provided by the Mangere Wastewater Treatment Plant;
7. To secure access to a second regional wastewater facility at Rosedale for use once the capacity of the Mangere Wastewater Treatment Plant is reached;
8. To manage stormwater locally in accordance with levels of service agreed with the local community for flood, stream and contaminant management and, in addition, to develop regionally consistent policy and infrastructure design and implementation standards for a range of issues that affect the delivery of both stormwater and wastewater services;
9. To plan future three waters services to reflect the need to minimise use of and conserve energy, as far as practicable, while still meeting agreed levels of service; and
10. To assess opportunities for efficiencies in resource use and cost savings that can be achieved through the joint planning and implementation of integrated solutions for the delivery of water supply, wastewater and stormwater services and develop an equitable basis of sharing the benefits achieved.

Key documents forming part of Strategic Planning Programme

Document Status

[1] **Final document**

[2] **Draft requires finalisation**

[3] **Nearing completion**

[4] **Supporting documents available**

Note: A number of the reports listed below were prepared by consultants and, in the case of TW 37, by North Shore City Council.

They are given TW numbers only for reference purposes.

- **TW 2** Issues Report, June 2006 [1]
- **TW 5** Condition of existing surface water environment [2]
- **TW 6** Strategic overview of the effects of three waters services on the regional surface water environment [2]
- **TW 7** Groundwater resources [1]
- **TW 8** Feasibility of treated wastewater reinjection into central Auckland isthmus groundwater aquifers [1]
- **TW 9** Regional growth and implications for three waters services [1]
- **TW 11** Regulatory requirements [3]
- **TW 13** Consultation feedback from previous projects of relevance [2]
- **TW 14** Kaupapa Maori [1]
- **TW 15** Options evaluation criteria and process [2]
- **TW 18** Water supply demand management [4]
- **TW 19** Water supply sources issues and options [4]
- **TW 20** Water treatment issues and options [4]
- **TW 21** Water supply network issues and options [4]
- **TW 22** Wastewater flows and quality – Preliminary report [1]
- **TW 23** Inflow and infiltration management options [2]
- **TW 24** Interim Trunk Wastewater Master Plan – Concept Development and Initial Assessment [1]
- **TW 25** Stormwater Issues and Options [2]
- **TW 26** Regional wastewater treatment plant locations [2]
- **TW 27** Management of Biosolids [2]
- **TW 28** Trade Wastes Management [4]
- **TW 30** Management of Wastewater Liquids – Direct beneficial use opportunities [2]
- **TW 31** Management of Wastewater Liquids – Indirect Use and Disposal Options [2]
- **TW 32** Review of conditions of Manukau Harbour following Mangere wastewater treatment plant upgrade [4]
- **TW 33** Capacity of different receiving environments to accept treated wastewater [2]
- **TW 34** Mangere wastewater treatment plant – Identification of options for future upgrading [1]
- **TW 35** North Shore City outfall discharge regime evaluation [1]
- **TW 36** Rosedale wastewater treatment plant upgrading options [1]
- **TW 37** Rosedale WWTP Outfall – Report No 5.06: Innovation Review Report [1]
- **TW 38** Decentralised wastewater treatment [2]
- **TW 40** Evaluation of complete wastewater collection, transfer, treatment and use/ disposal options [2]
- **TW 45** Mangere wastewater treatment effluent reuse feasibility study [1]
- **TW 46** Basis of Project Costings [1]
- **TW 47** Economic analyses [1]