Technical Memorandum

To:	Azman Reuben and Jaye Michalick, Far North District Council	**Date:**	18 February 2025
From:	Claire Scrimgeour	**Our Ref:**	4281901-1818476637-1263
Copy:		**:**	
Subject:	Te Pātukurea Kerikeri-Waipapa Spatial Plan - Hybrid D-E 3 Waters Commentary		

1 Introduction

This memo describes three waters planning inputs to Te Pātukurea, the Kerikeri Waipapa Spatial Plan, Hybrid Scenario appraisal. These inputs include identifying upgrades to existing treatment plants and networks and new infrastructure likely to be required to service the preferred future land use scenario (Hybrid Scenario). High level indicative cost ranges for the assumed upgrades and new infrastructure are also provided.

The purpose of this work is to provide an early indication of potential waters infrastructure and costs required over the long term (30 years) to support the Spatial Plan and potential risks.

This analysis follows a high-level method suitable for the Spatial Planning stage. Further, more detailed studies will be necessary in future stages, e.g. Structure Planning, Plan Change, Consenting and Business Case, etc over time.

2 Hybrid Scenario

Key inputs used to inform the three waters analysis for the Hybrid Scenario are from the Te Pātukurea Distribution of Growth Table summarised below.

Table 1 - Distribution of Future Growth (30 years)

Land Use	Kerikeri	Waipapa	Rural
Households	3,658	797	235
Retail / Commercial	13.9ha	7.4ha	-
Industrial	1.4ha	3.3ha	-

Growth in Kerikeri and Waipapa will be a combination of Brownfield (infill) and Greenfield. The number of additional households for Waipapa is informed by expected capacity constraints for the standalone WWTP. A capacity of up to 1000 households (which also allows for some existing households with on-site wastewater) is preferred to keep this system within the typical capacity for a modular type wastewater system which can be expanded as needed over time.

The location of additional growth is provided in the maps produced by Boffa Miskell and copied below.

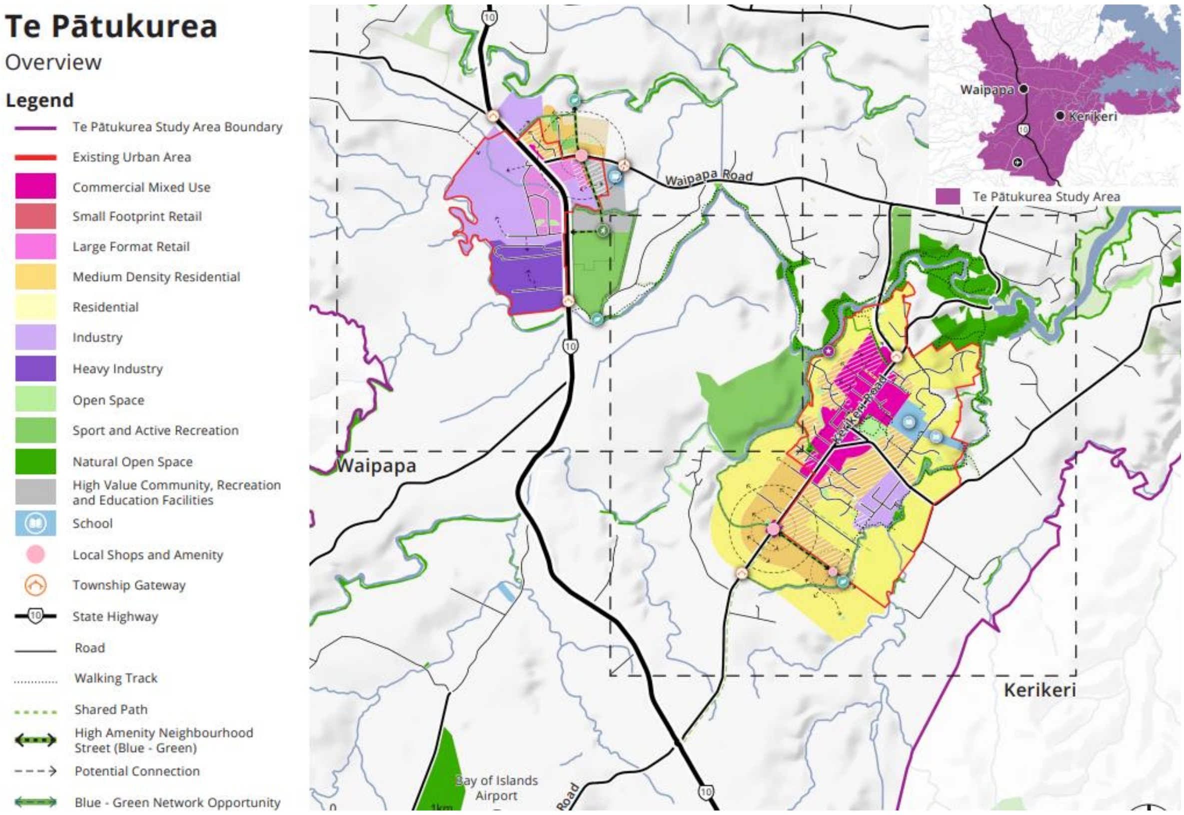

Figure 1 - Spatial Distribution of Growth (Boffa Miskell)

3 Stormwater in Waipapa

Further high level consideration of stormwater issues in Waipapa was undertaken for the Hybrid Scenario with residential development restricted to the north of Waipapa and servicing of industrial areas with wastewater to free up land currently used for on-site disposal fields. The regional scale flood maps for the area are provided below. These indicate the proposed residential area is free from flooding. Overland flow paths would need to be carefully considered during residential area development along with low-impact stormwater design to address stormwater quality.

For the industrial area in Waipapa, flooding impacts are already predicted due to the meandering nature and convergence of waterways in this area and constrictions related to the roading network (e.g. culverts under the state highway). More dense industrial development could increase flooding, erosion and water quality impacts if not carefully managed. On-site storage and treatment of stormwater is likely to be required.

An Integrated Catchment Management Plan would be a way to consider requirement mitigations and improvements for the whole development area and would also cover overland flow paths and potential blue/green network/restoration opportunities.

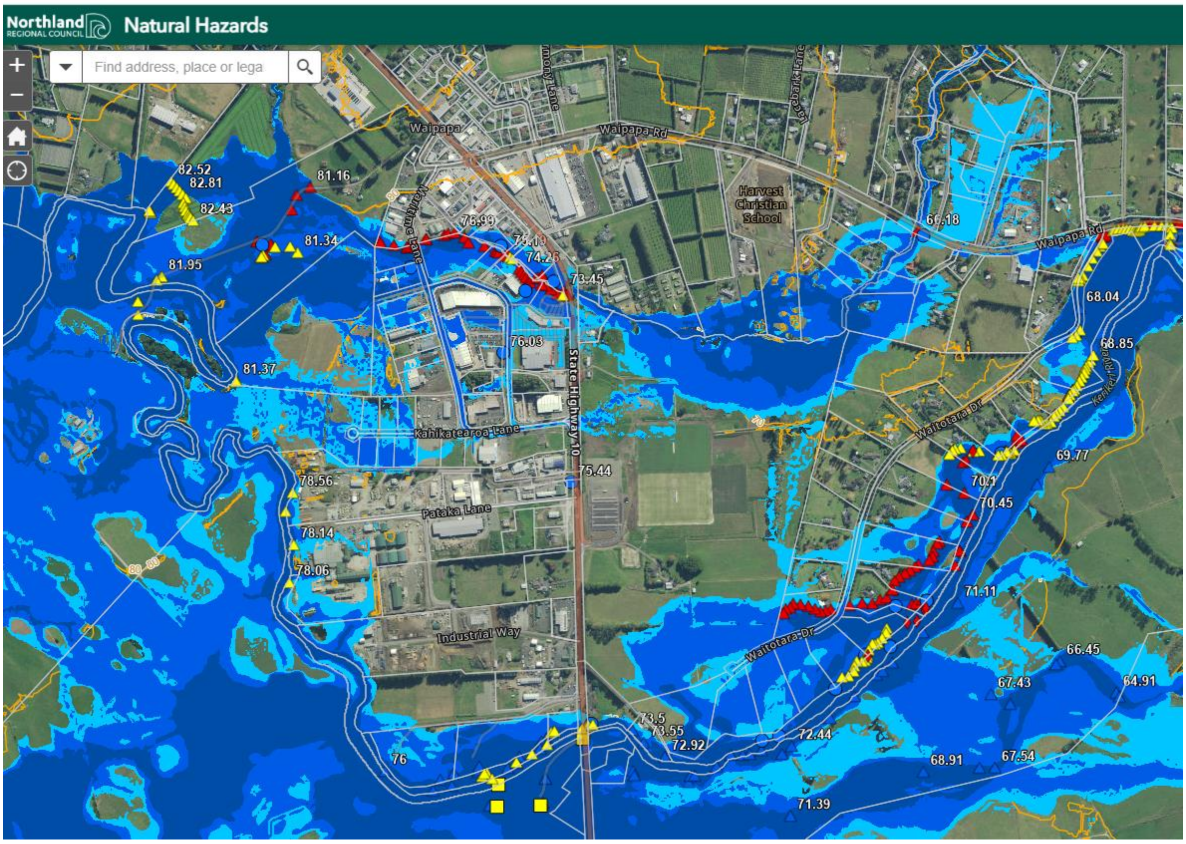

Figure 2 - Northland Regional Council Flooding Maps

The stormwater constraints associated with the Kerikeri growth areas in the Hybrid Scenario are the same as reported for Scenario D, with moderate constraints:

- Modelled flood extents have minimal effect on the developable area
- Second largest developable area
- Key transport and access links are in place, but generally without stormwater infrastructure to support higher density living
- Significant stormwater networks would be required to capture, manage and discharge runoff to Puketotara Stream to the west, or tributaries of the Wairoa Stream to the east
- Existing pipe networks will require investment into upgrades (at least in part) to manage growth.

4 Hybrid D-E Water/Wastewater Infrastructure Requirements

Water and Wastewater Network Infrastructure

The likely water/wastewater network infrastructure / upgrades required for the Hybrid Scenario are shown in the Figures below and are the same as Scenario D. Once the areas and staging of development in Waipapa are confirmed, further modelling is recommended to refine the infrastructure requirements and likely timing.

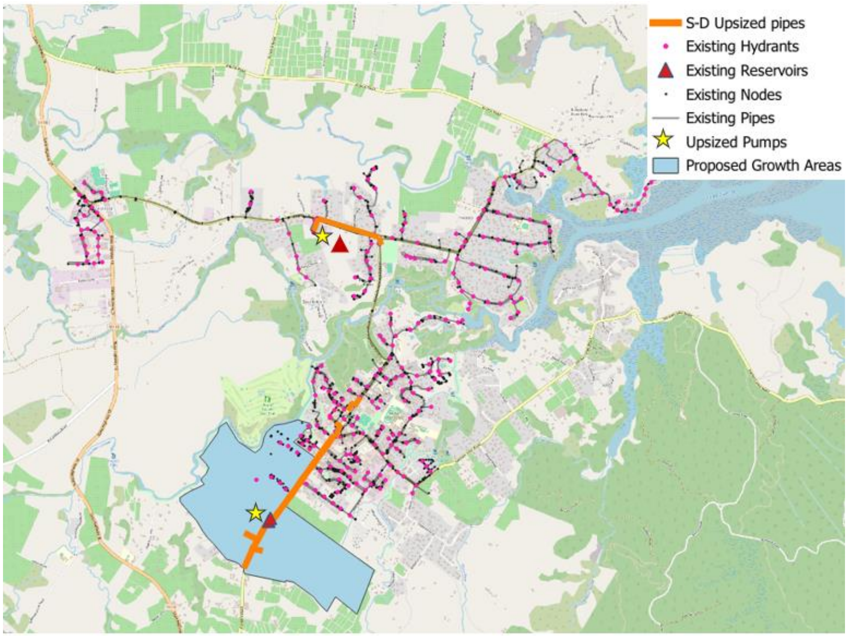

Figure 3 - Water network upgrades

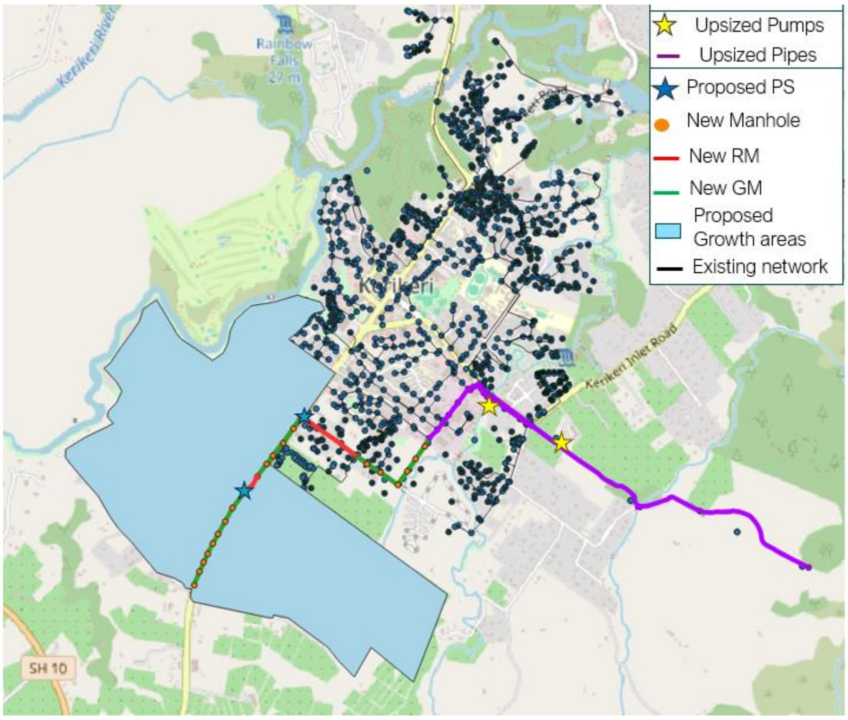

Figure 4 - Wastewater network upgrades

Wastewater Treatment

Waipapa could either have a standalone WWTP with discharge to land or a pipeline back to the Kerikeri wastewater network could be provided. The original costings for a standalone Waipapa WWTP assumed that the industrial and big-box commercial areas were not serviced for wastewater. If these areas were serviced, they could be equivalent to an additional 300-1,400 houses. If land was not available for the larger WWTP and discharge area, transferring wastewater back to Kerikeri could be investigated further.

With a standalone treatment plant for Waipapa, the expected inflows for Kerikeri WWTP reduce slightly and the long term upgrade for SBRs 5 and 6 may not be required ($9-18M). The flows to the Waitangi Wetlands do not increase as much but are still likely to be higher than the current consent limit.

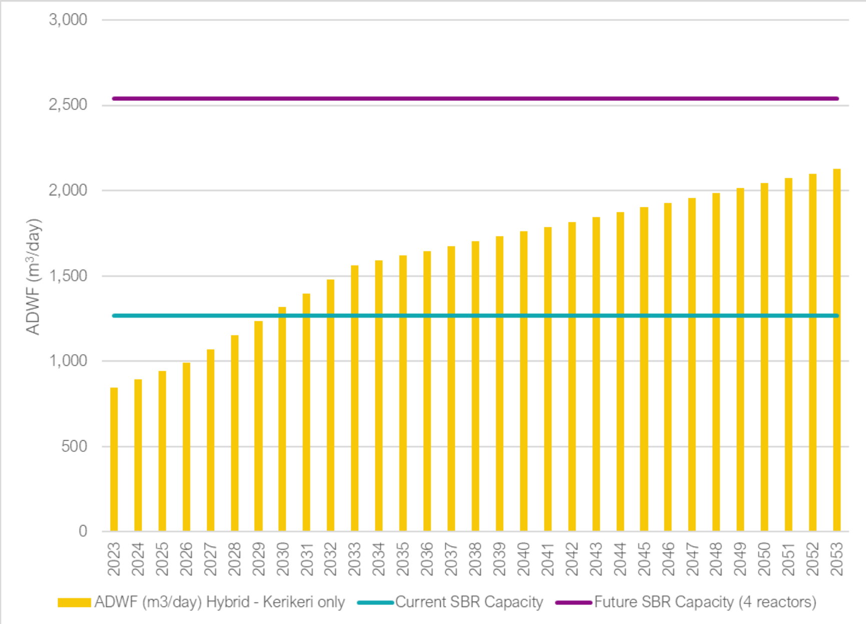

Figure 5 - Kerikeri WWTP capacity with Stand alone Waipapa WWTP

Water Treatment

No changes are expected for the Water Treatment Plant and Reservoir costs which were identical for Scenarios D/E.

5 Anticipated Cost Range

The high level indicative cost range for water and wastewater infrastructure is $68M to $145M. Escalation and GST is excluded. Stormwater infrastructure has not been costed as insufficient information is available at this stage and the majority is generally provided on-site by the developer.

Uncertainty in the cost estimate includes the final form of infrastructure, utilities / service changes, market conditions and construction contingencies to cover unforeseen items during construction. We have included an appropriate contingency allowance to provide a best estimate of the cost to completion for the most likely option.

The estimated costs included in this report are high-level, indicative assessments which have been developed solely for the purpose of comparing and evaluating the option. The estimate range is an indication of the degree to which the final cost outcome for a given project will vary from the estimated cost – it is not an additional Contingency. This estimate is based on pre-concept stage information. The estimate is deemed to be a Class 5 estimate in terms of the AACE Cost Estimate Classification System guidelines.

This cost range includes the key infrastructure listed in Section 4.

These estimates are based on pre-concepts and should not be used for budgeting purposes.

The initial cost estimate for Waipapa stand alone WWTP of $7M ($5-10M range) was based on approximately 200 existing dwellings and limited existing commercial properties. No servicing of the industrial areas was provided.

The potential cost impacts for the standalone WWTP at Waipapa with up to 1000 dwellings (approx. 200 existing and 800 new) are estimated below:

- WWTP $7M
- Irrigation system $3M (approx. 10 ha suitable land)
- Conveyance to WWTP $8M – will depend how far away – up to 3km assumed
- Land purchase for WWTP and irrigation $2M

This would total about $20M (e.g. range $14-30 Million).

Additional costs to provide a wastewater service to the industrial areas already zoned in Waipapa are difficult to predict due to the large variation in demand from industrial properties. A survey to understand likely demand would provide some information to develop demand predictions. Extra flows from the industrial area may result in a modular WWTP not being cost effective and a bespoke design may be required.

With the slight reduction in growth in Kerikeri it is unlikely there will be major reductions to the Scenario D wastewater network upgrades and costs (modelling is needed to confirm).

Table 2 - Hybrid Scenario Cost Range

Item	Description	Cost Range
Water Treatment	Raw water conveyance, increased WTP capacity, more reservoir storage	$34 – 71M
Wastewater Treatment	Kerikeri WWTP upgrades Waipapa WWTP (excluding industrial)	$9 – 20M $14 - 30M
Water network	Watermain upgrades – 3,262m Upgrade booster pumps at Kerikeri reservoir and Waipapa reservoir	$4 - 9M
Wastewater network	Upgrades to existing network – 1,513m Pump upgrades – 4 New network pipes – 1,797m New network pump stations - 2	$7 – 15M
Total		**$68 – 145M**

6 Future Assessments

The three waters assessment completed to date provides a high-level indication of potential upgrades and costs to enable the preferred Spatial Plan scenario. In future more detailed analysis will be necessary to confirm and advance planning to deliver three waters upgrades over time, this includes:

- Investigations to better understand demand for wastewater servicing in Waipapa industrial areas (including big box retail)
- Refining models for water, wastewater and stormwater to better understand upgrades required, timing and triggers
- Developing Integrated Catchment Management plans for growth areas to manage stormwater erosion, flooding and quality effects
- Further investigation of feasibility of a stand alone WWTP for Waipapa

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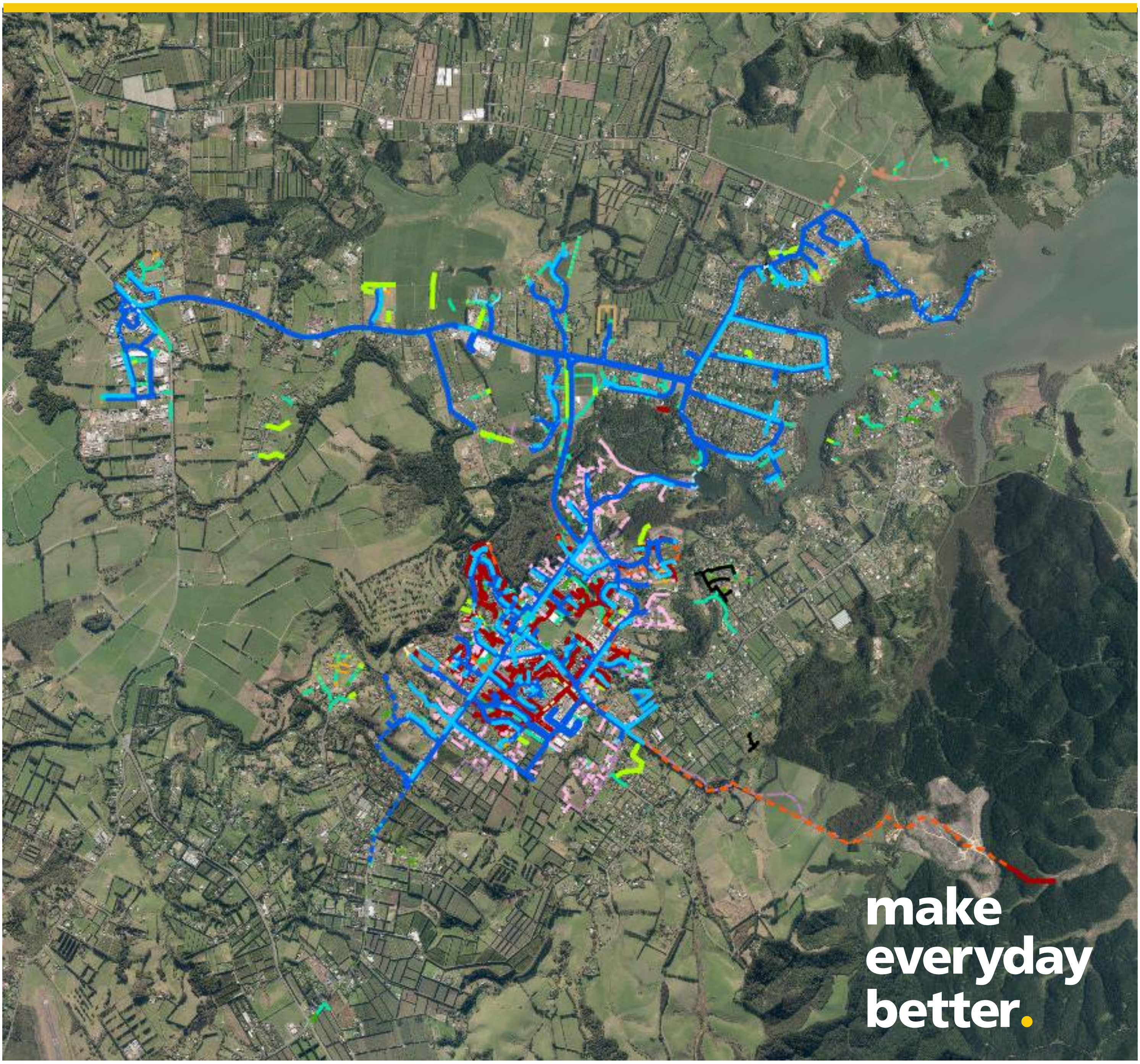
Kerikeri-Waipapa 3 Waters Capacity & Modelling Assessment

Prepared for Far North District Council
Prepared by Beca Limited

18 October 2024



Contents

Appendices

Revision History

Revision N°	Prepared By	Description	Date
A	Sarah Kennedy, Anvesh Ravula, Leighton Fletcher, Claire Scrimgeour	Draft for client review	13/09/20024
B	Claire Scrimgeour	Final	24/09/2024
C	Sarah Kennedy	Scenario F Update	18/10/2024

Document Acceptance

Action	Name	Signed	Date
Prepared by	Sarah Kennedy, Anvesh Ravula, Leighton Fletcher, Claire Scrimgeour		18/10/2024
Reviewed by	Philip La Roche, Logan Thomson		18/10/2024
Approved by	Claire Scrimgeour		18/10/2024
on behalf of	Beca Limited		

Executive Summary

A sub-area spatial plan for Kerikeri-Waipapa, known as Te Pātukurea, is being prepared by the Far North District Council (FNDC) in response to population growth in the area. Additionally, the plan aims to respond to challenges caused by natural hazards, the increasing severity of weather events, infrastructure resilience and levels of service that further compound the pressure of an expanding population. The purpose of this report is to support Te Pātukurea, providing a 3 Waters Capacity Assessment that will inform decision making and guide growth in this rapidly developing area.

The base scenario A allows for 3,260 new houses over the next 30 years within the spatial plan study area (urban and rural zones in the Operative and Proposed District Plan). The alternative scenarios B-F allow for 'blue sky' growth of approximately 4,690 new houses over the next 30 years with this growth split between the existing urban areas and proposed new urban areas.

Key assumptions were consistent with FNDC's Engineering standards other than for population per dwelling for new dwellings which was consistent with the Housing and Business Capacity Assessment which identifies demand of 2.5 people per new dwelling and 23 hectares of commercial/business demand. The average of 2.5 people per property for new areas was considered realistic for comparing scenarios as larger scale development will even out demand fluctuations.

Water Treatment

The existing Water Treatment Plant (WTP) is operating at close to its 3,500 m^3/d capacity at peak demand, with demand expected to match capacity within 3-5 years. Short-term improvements may be possible to reduce the short-term supply risk by completing the commissioning of the new lamella clarifiers and considering replacement of the filter media with higher specification media.

In terms of water sources, the Puketotara Stream does not have high drought resilience, and although this source provides some diversity, there is no room for expansion and in the worst-case drought, there will be no water available from this source. Drought resilient sources will need to include storage to enable supply during drought events. Future water resources are expected to be sourced primarily from the Kerikeri Irrigation Waingaro Dam and the Te Tai Tokerau Otawere Dam. There are sufficient water resources available to meet the medium-term demands from these sources, and long-term with the purchase of additional water allocation.

There are significant condition and performance issues with the existing WTP, space is confined for an expansion to double the capacity of the existing WTP now and ultimately develop the site to three times its current capacity. The required reservoir storage volume cannot be accommodated on this site, as well as the WTP expansions. Reservoirs would also be preferably located at a site with an elevation around 20 m higher to match the reticulation pressure requirements. The surrounding area does not appear to have this elevation available so pumping into the network from the reservoirs is likely to continue to be needed. Given the significant investment needed in the near term, consideration should be given to options to develop on the existing site or find an alternative WTP/reservoir site.

Key criteria that the upgraded WTP will need to meet include:

- An initial upgraded minimum capacity of 6,000 m^3/d, to be able to cater for at least 20-30 years of base growth with provision to expand to an ultimate capacity of up to 9,000 m^3/d.
- Have the ability to cater for elevated soluble iron and manganese, and algal taste and odour.
- Meet protozoa, bacterial and other compliance requirements.

Additional treated water storage of 3,300 m^3 initially is recommended, to cater for the next 10 years growth based on 48 hours at average demand.

There are increased future capacity requirements for blue sky growth. To accommodate the increase in growth the WTP capacity increase to 9,000 m^3/day will need to be implemented in the long term, likely in the mid-2040s and additional reservoir capacity is also needed compared to base growth.

Table 1: Forecast WTP upgrades.

Setting	Base Scenario	Blue Sky
Medium-term	• Raw Water Conveyance • 6,000 m^3/d total clarification and filter capacity and upgrade UV upgrade • 2 x 1,650 m^3 reservoirs	• Raw Water Conveyance • 6,000 m^3/d total clarification and filter capacity and upgrade UV upgrade • 2 x 2,250 m^3 reservoirs
Long-term	• 6,100 m^3 total reservoir capacity	• Capacity upgrade to 9,000 m^3/d • Additional reservoir capacity
Expected capital cost range	$23 - 49M	$34 - 71M

Wastewater Treatment

The individual capacity of different unit processes was assessed for the existing Wastewater Treatment Plant (WWTP) to offer a staged upgrade that addresses growth as necessary. A summary of the recommendations is provided below.

Table 2: Forecast WWTP upgrades.

Setting	Base Scenario	Blue Sky
Medium-term	• Installation of second set of Sequencing Batch Reactors (SBRs 3 & 4) to cater for long-term growth • Upgrade to UV disinfection treatment capacity • Screw press	• Installation of second set of SBR reactors (3 & 4) to cater for medium-term growth • Upgrade to UV disinfection treatment capacity • Screw press
Long-term	• Inlet works upgrade	• Inlet works upgrade • Additional SBR treatment capacity (reactors 5 & 6) expected in the mid-2040's
Expected capital cost range	$10 - 22M	$18 – 38M

For all growth scenarios, it is proposed to install the 3rd and 4th reactors at the same time but utilise the fourth SBR reactor once constructed as a decanter until it is required for biological capacity and to install an extra screw press for dewatering when extra solids are generated.

The current resource consent condition related to discharge flow allows for a maximum dry weather flow discharge to the wetlands of 1,350 m^3/d as a rolling average. This is expected to allow for growth under the base forecast to the end of the consent period (2036). The blue sky growth scenario will likely exceed the consent limit for flow prior to the consent expiry around 2031.

Water and Wastewater networks

The base Scenario A requires some water and wastewater network upgrades to allow for the infill growth over time. Scenarios B, C, E and F require significant new water and wastewater network infrastructure to service the new areas along with upgrades to existing infrastructure. Much of this infrastructure needs to be installed ahead of development due to the terrain and to provide connectivity. Scenario D requires less new infrastructure due to the proximity to the existing water and wastewater networks in Kerikeri. The cost ranges for the network infrastructure required is outlined below.

Table 3: Water and Wastewater Network Upgrades and New Infrastructure Cost Estimates.

Scenario	Water Network Cost Range	Wastewater Network Cost Range
A - Proposed District Plan Implementation	$3 – 6M	$3 – 7M
B – South Waipapa Road Expansion	$10 - 20M	$16 – 34M
C – North Waipapa Road Expansion	$9 - 20M	$16 – 33M
D – Kerikeri South Focused Expansion	$4 - 9M	$7 – 15M
E – Waipapa Focused Expansion	$10 - 21M	$24 – 51M
F – Kerikeri Northwest Expansion	$4 - 8M	$15 – 33M

Waipapa Servicing

A high-level review of water servicing for Waipapa indicates there is little benefit in a standalone WTP for Waipapa. For wastewater, a standalone WWTP option for Waipapa could mitigate the risk of exceeding future Waitangi Wetland discharge consent limits likely with blue sky growth and allow the currently un-serviced area to be connected. If Scenarios B, C, E or F were selected, individual development WWTPs could be established as an interim measure with eventual connection to a larger scale WWTP.

A Waipapa standalone WWTP to service new growth areas is expected to have similar costs to upgrading the Kerikeri WWTP and significant time required to implement. A new WWTP would likely require discharge to land for the treated wastewater which is complex to consent and manage. A standalone WWTP to service the existing un-serviced Waipapa residential and commercial properties only is expected to have a cost range of $5-10M.

Stormwater

Stormwater Infrastructure will need to meet the level of service required by the FNDC Engineering Standards and discharges from growth areas or individual sites will include requirements for both quantity and quality controls. A summary of the stormwater constraints predicted for the different growth scenarios has been provided below.

Table 4: Anticipated Stormwater Constraints for Different Growth Scenarios.

Scenario	Constraints	Comments
A - Proposed District Plan Implementation	Significant	• Development avoids much of flood extent • Southern industrial areas susceptible to flooding • Modelling indicates Kerikeri river will overtop during large storm events • New development will need to cater for stormwater on-site and manage increases in runoff quantity and any detrimental quality effects • Developers and smaller landholders likely to need to work together to ensure suitable areas are set aside for managing stormwater and identify a suitable outfall
B – South Waipapa Road Expansion	Moderate	• Flood extents likely to reduce actual available development area • Existing stormwater infrastructure limited • Significant new infrastructure required for gully and river crossings to unlock large development areas

Scenario	Constraints	Comments
		• Modelling indicates Waipekakoura River tributary may spill into surrounding land • Topography north of Waipapa Road is favourable for managing and disposing of stormwater runoff
C – North Waipapa Road Expansion	Minor	• Flood modelling indicate flood extents do not significantly impede developable areas • Fewer constraints/difficulty in unlocking development areas compared to scenario B • Largest area of developable land amongst the scenarios • Stormwater infrastructure would need to be increased to support additional development • Topography north of Waipapa Road is favourable for managing and disposing of stormwater runoff
D – Kerikeri South Focused Expansion	Moderate	• Modelled flood extents have minimal effect on the developable area • Second largest developable area • Key transport and access links are in place, but generally without stormwater infrastructure to support higher density living • Significant stormwater networks would be required to capture, manage and discharge runoff to Puketotara Stream to the west, or tributaries of the Wairoa Stream to the east • Existing pipe networks will require investment into upgrades (at least in part) to manage growth
E – Waipapa Focused Expansion	Moderate	• Constraints for land directly east of Waipapa and south of Waipapa Road due to predicted flood extents • Existing stormwater infrastructure east of Waipapa is very limited • Potential for significant investment in expensive stormwater infrastructure
F – Kerikeri Northwest Expansion	Moderate	• Flood extents likely to reduce actual available development area • Existing stormwater infrastructure limited

Conclusions

Blue sky growth (Scenarios B-F) requires significantly more investment in water treatment plant capacity, reservoir capacity and wastewater treatment plant capacity in the long term. Similar upgrades are required for base (Scenario A) and blue sky growth at water and wastewater treatment plants in the medium term. Sufficient raw water resources are available to service growth. The Waitangi Wetland discharge is likely to reach consent limits for nutrient discharge in the long term with blue sky growth.

Scenarios A and D have less requirement for new water and wastewater network infrastructure and network upgrades than Scenarios B, C, E and F. Scenarios A and D do not service the existing Waipapa urban area with on-site wastewater, however, these could be serviced with a small-scale standalone WWTP.

Cost estimate ranges have been prepared for the purposes of comparing scenarios. These should be developed further for the preferred option and are not suitable for budget setting. Cost uncertainties include staging of work, construction market conditions, internal council costs and requirements to purchase land.

The current water and wastewater network models have some limitations and further calibration, and improvements are recommended.

1 Purpose of this Report

A sub-area spatial plan for Kerikeri-Waipapa, known as Te Pātukurea, is being prepared by the Far North District Council (FNDC) in response to population growth in the area. Additionally, the plan aims to respond to challenges caused by natural hazards, the increasing severity of weather events, infrastructure resilience and levels of service that further compound the pressure of an expanding population. The purpose of this report is to support Te Pātukurea, providing a 3 Waters Capacity Assessment that will inform decision making and guide growth in this rapidly developing area.

The assessment includes a 30-year growth projection to evaluate treatment capacity requirements and consent limitations for the water and wastewater treatment plants servicing the area. Water and wastewater network modelling based on different growth scenarios is included to identify key networks upgrades necessary to meet demand, alongside a stormwater assessment to highlight potential constraints for the different scenarios.

2 Background

The existing Kerikeri-Waipapa water, wastewater and stormwater schemes only service a proportion of the population, with many households self-reliant without a connection to the reticulated networks.

2.1 Water Infrastructure

With a rated treatment capacity of 3,500 m^3/d, the Kerikeri water treatment plant (WTP) currently services Kerikeri, Skudders Beach, Riverview and Waipapa. It has two raw water sources of supply - the Lake Waingaro reservoir, owned and operated by the Kerikeri Irrigation Company (KIC) responsible for up to 70% of WTP intake, and the Puketotara stream, contributing the remainder.

Originally built in 1971, the WTP combines coagulation, clarification, filtration, UV and chlorine disinfection to achieve 4 log credits of treatment. Treated water is stored within three reservoirs, two onsite sized 500 m^3 and 1,000 m^3, and a third located in Waipapa with 1,790 m^3 in storage capacity.

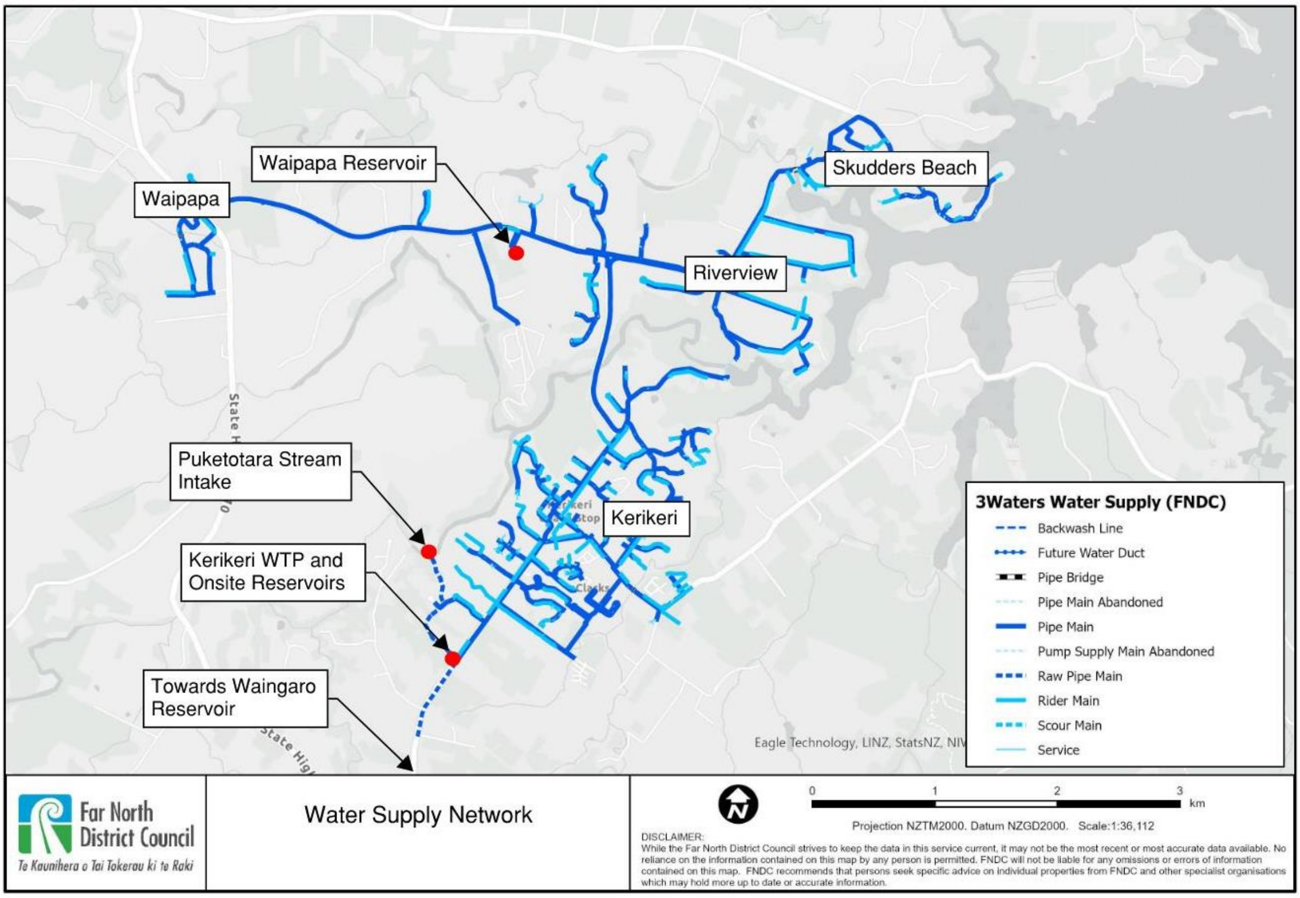


Figure 1: Water Supply Network (FNDC Maps, 2024).

2.2 Wastewater Infrastructure

Recently constructed in 2020, the Kerikeri wastewater treatment plant (WWTP) currently services around 1,500 households within urban Kerikeri. The treated wastewater releases treated discharge to a nearby tributary within the Waitangi Wetlands.

The plant uses biological activated sludge treatment within 2 parallel Sequencing Batch Reactors (SBRs) to remove wastewater contaminants, followed by tertiary filtration and UV disinfection before discharging treated wastewater into the Waitangi Wetlands.

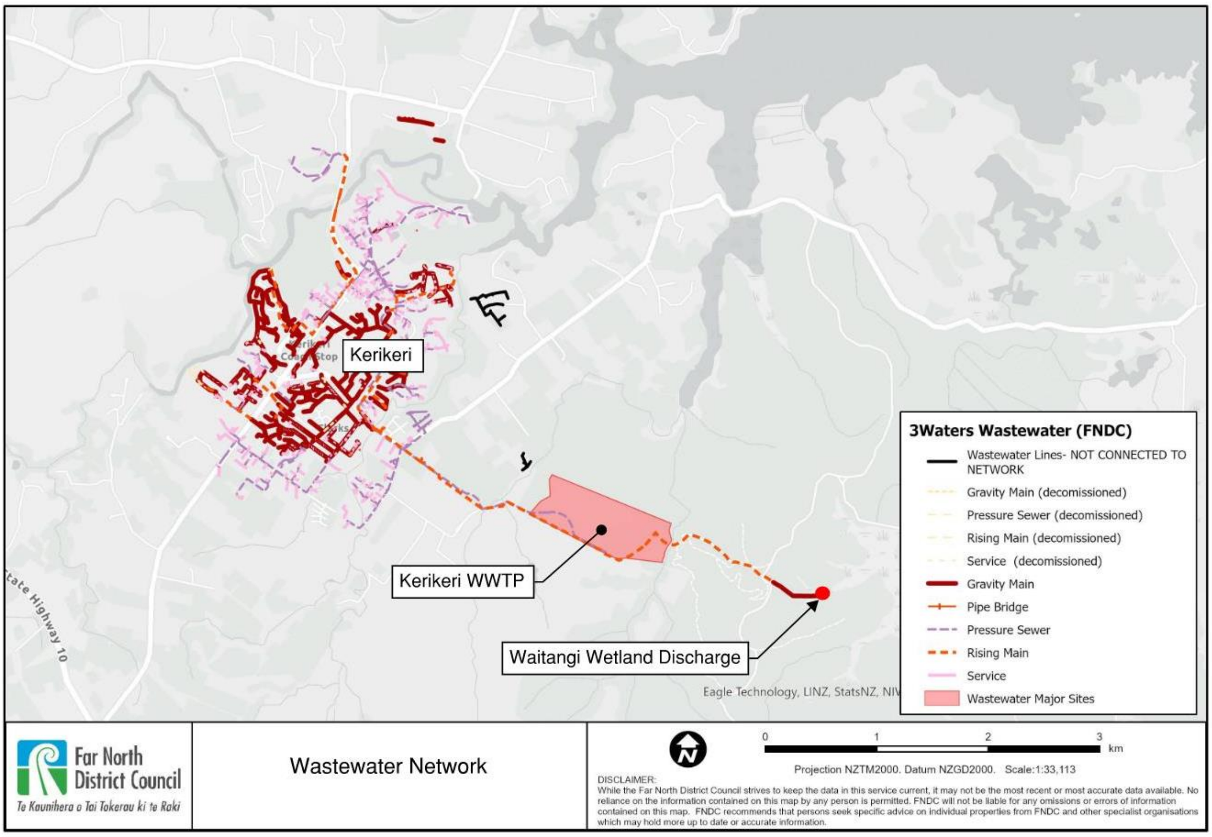


Figure 2: Wastewater Network (FNDC Maps, 2024).

2.3 Stormwater Infrastructure

Urban stormwater collection is currently provided to those areas also serviced with treated water, including Waipapa, Skudders Beach, Riverview and Kerikeri. Majority of the private subdivisions have an onsite collection and attenuation system (such as a pond or water tank) prior to stormwater entering the reticulation network. Following collection, the untreated stormwater is discharged from the network into streams, rivers or the sea. Future stormwater adaption will need account for not only population growth, but the increasing severity of storms as a result of climate change.

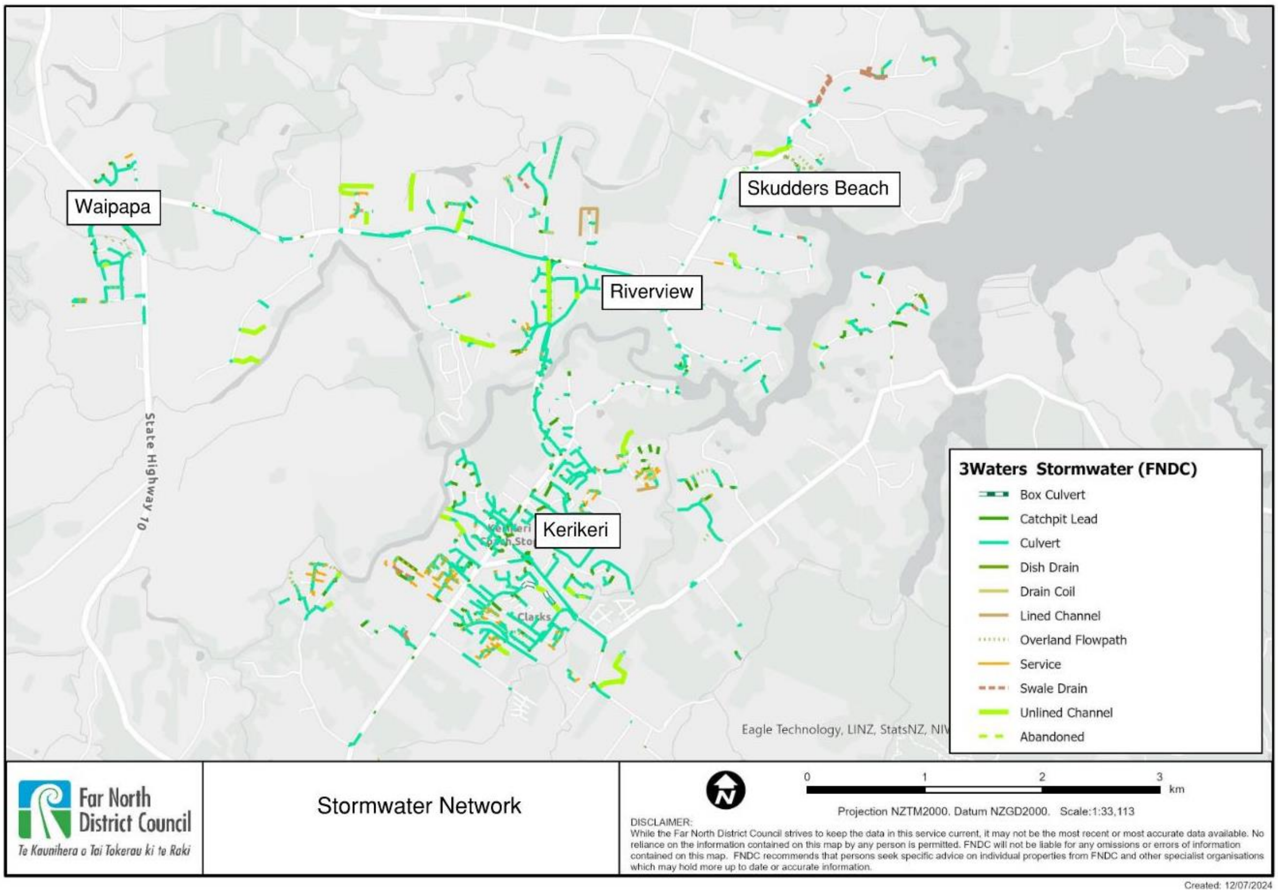
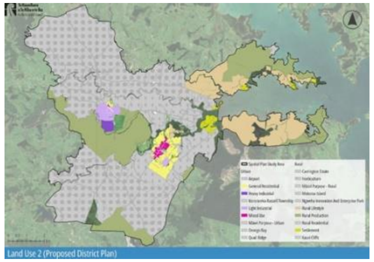
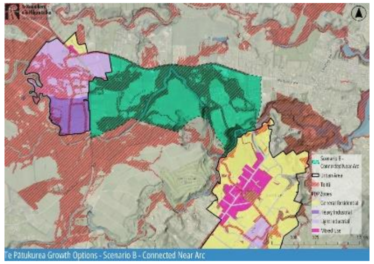
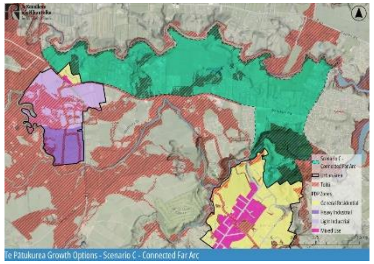


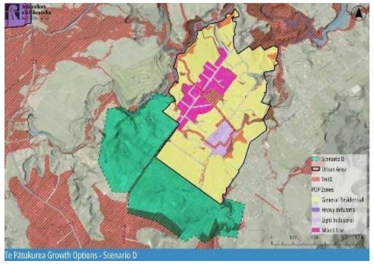
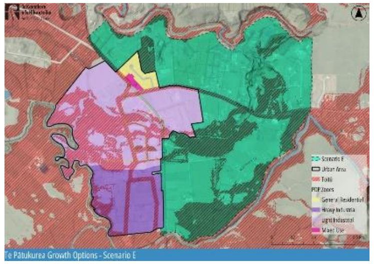
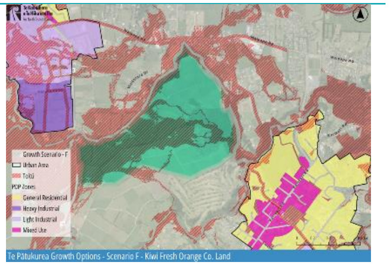
Figure 3: Stormwater Network (FNDC Maps, 2024).

3 Growth Assumptions

The following growth scenarios, as provided for the Te Pātukurea Spatial Plan, have been used to determine the impacts on water, wastewater and stormwater services for the potential residential, industrial and commercial growth over the next 30 years.

Table 5: Possible Growth Scenarios (FNDC, 2024).

Scenario	Name	Short Description	Comments	Map
Scenario A	Proposed District Plan (PDP) Implementation	Implement PDP – Industrial land increase (Waipapa) and intensification opportunities in central Kerikeri	• Historical patterns, space extensive • Going forward there is a need to protect valuable soils, provide more choice • Affordability is a challenge • Urban sprawl becomes a problem	
Scenario B	South Waipapa Road Expansion	Focus commercial and medium density growth in the established centres – Kerikeri & Waipapa. Lower density residential growth in the contiguous greenfield areas along Waipapa Road to the South	• Support public transport by focusing development along a key route • Significant constraints, including flood risk and the need for new river crossings - Mitigation possible • Close to existing reticulated services (including the water and wastewater networks)	
Scenario C	North Waipapa Road Expansion	Focus commercial and medium density growth in the established centres – Kerikeri & Waipapa. Lower density residential growth in the contiguous greenfield areas along Waipapa Road to the north	• Support public transport by focusing development along a key route • Some of the fewest mapped constraints in all of Te Pātukurea • Already serviced by reticulated water supply however it would require wastewater infrastructure	

Scenario	Name	Short Description	Comments	Map
Scenario D	Kerikeri South Focused Expansion	PDP with areas of higher growth in Kerikeri and to the south (along WW route) with more land unlocked for commercial/industrial growth in Waipapa	• Require capacity improvements to cater for this expansion • Few mapped constraints here • Little opposition to growth here • Reinvigorate some of the currently more deprived areas	
Scenario E	Waipapa Focused Expansion	Focusing growth in Waipapa while implementing PDP in Kerikeri. Develop the area as a hub for living, not just commerce and industry	• Significant investment in infrastructure would likely also be required	
Scenario F	Kerikeri Northwest Expansion	Focus commercial and medium density growth in the established centres – Kerikeri & Waipapa. Additional residential growth in a greenfield area northwest of Kerikeri	• Significant mapped constraints • Require capacity improvements to cater for this expansion	

To forecast water and wastewater demand, the total number of new dwellings over the projected timespan has been provided in Table 6 below. This includes both the base case - Scenario A, as well as the remaining Scenario's B – F.

Table 6: Total Forecast Dwellings.

Setting	Time Period	Total New Dwellings		
		Base Scenario A	Enhanced Growth (Scenarios B-F)	Blue Sky (Scenarios B-F)
Short-term	2023 – 2026	535	535	535
Medium-term	2027 – 2033	1,100	1,600	1,800
Long-term	2034 – 2053	1,626	2,125	2,355
Total		**3,260**	**4,260**	**4,690**

The table below shows where the dwellings are assumed to be distributed across the different growth scenarios for network modelling purposes. Note the modelling was undertaken with enhanced growth dwelling data before the blue sky option was confirmed, however the outputs are considered to be similar and suitable for the purpose of comparing options.

Table 7: Spatial Development of Forecast Dwellings – Enhanced Scenario.

Scenario	Name	Urban (Intensification)		Non-Urban	
		Kerikeri (Brownfield)	Waipapa (Brownfield)	Greenfield (Future Urban Zone)	Rural/Rural Residential
A	Proposed District Plan Implementation	2,608	489		163
B	South Waipapa Road Expansion	1,704	639	1,704	213
C	North Waipapa Road Expansion	1,704	639	1,704	213
D	Kerikeri South Focused Expansion	1,917	639	1,491	213
E	Waipapa Focused Expansion	1,704	852	1,491	213
F	Kerikeri Northwest Expansion	1,704	639	1,642	213

For Scenarios B-F, additional commercial and industrial demand is also expected. This has been included in the WTP and WWTP demand forecasts.

Table 8: Commercial/Industrial Demand - Enhanced and Blue Sky.

Commercial/Industrial Demand	
Additional Land	23 Ha
Total Population Equivalent (PE)	805 PE

4 Water Treatment

The key timings to increase WTP and reservoir capacity has been considered alongside a review of the raw water sources available and known issues impacting treatment efficiency at the plant.

4.1 Forecast Demand Projections

The following assumptions were made to calculate the forecast water supply demand for the projected population growth. The domestic per capita demand follows the FNDC's Engineering Standards (FNDC, 2022). The peaking factor is in line with historical flow rates. The population per dwelling for new dwellings is consistent with the Housing and Business Capacity Assessment which identifies demand of 2.5 people per new dwelling.

Table 9: WTP Assumptions for Projected Forecast Demand.

Assumption	Value
Daily Peaking Factor	1.5 x Average Daily Demand
Residential	
Household Occupancy	2.5 Persons
Average Per Capita Demand	300 L/person/day
Households Serviced	95%

Current water supply demand is based on the average daily WTP outflow between the period 1/01/2022 to 30/06/2024, as provided by the FNDC.

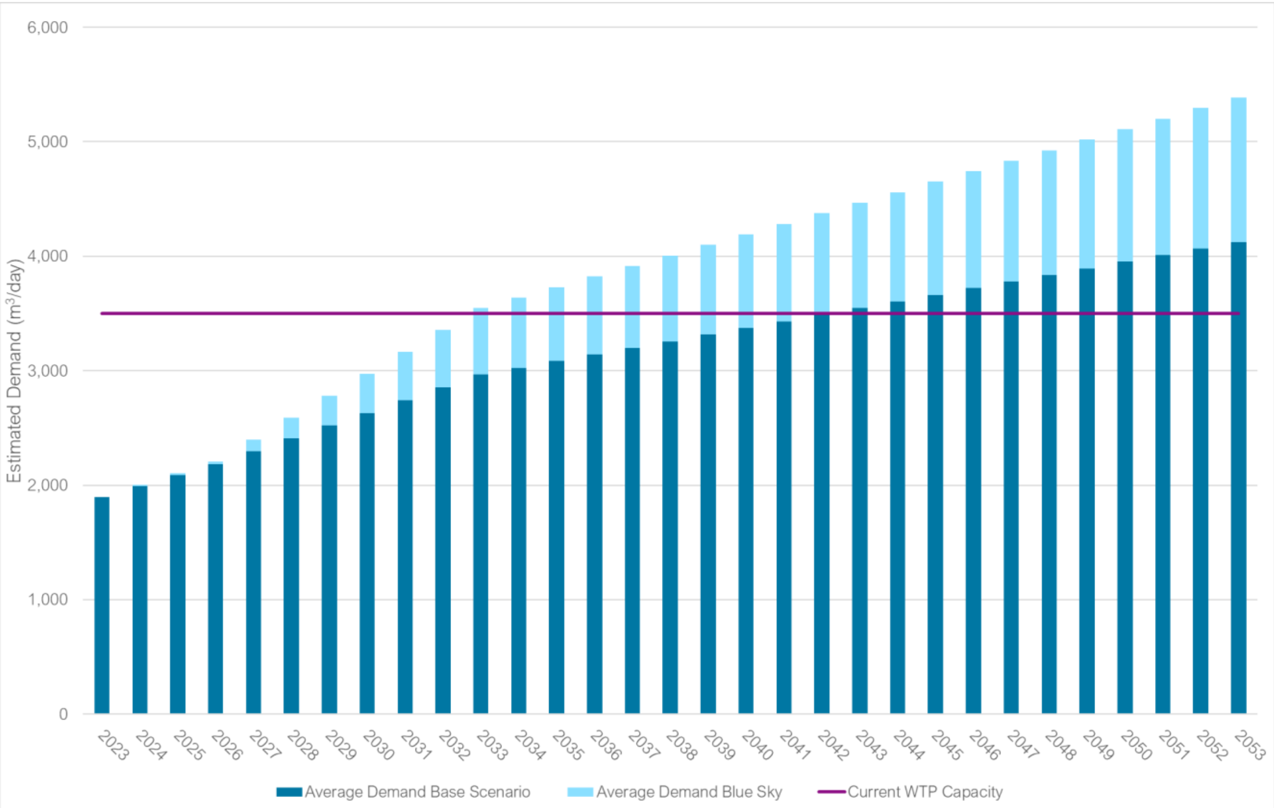


Figure 4: Forecast Average Water Treatment Demand.

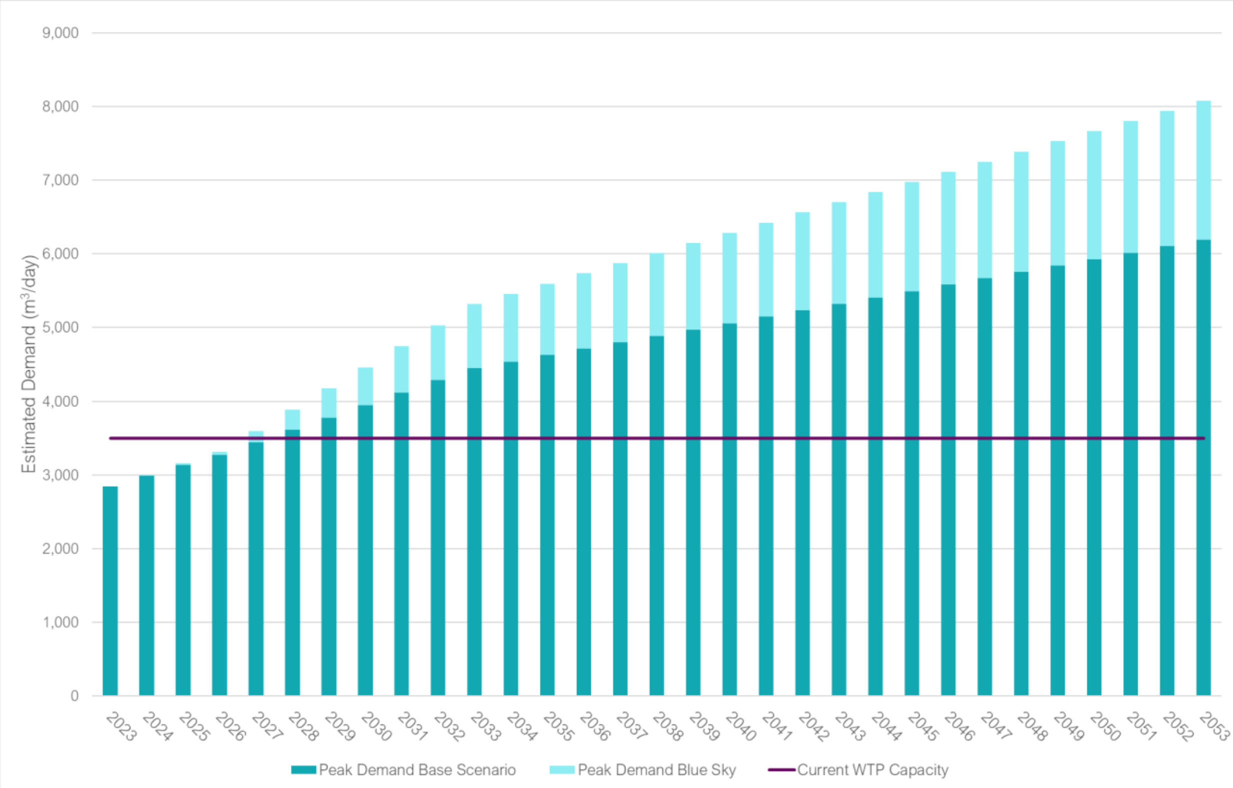


Figure 5: Forecast Peak Water Treatment Demand.

The peak demand is expected to exceed capacity in the short-medium term, and it will be necessary to manage peak demand – peak demand typically occurs during dry periods, which can also impact water resource availability.

Historically, a high peak summer demand has been seen in the area with water restrictions often utilised to help manage demand. This is thought due to higher populations and irrigation use, compounded by the increase in water tanker intake at the Waipapa reservoir during dry periods. The frequency of water restrictions will increase if supply capacity is not increased or demand management (e.g. water loss reduction) is not implemented.

To allow for WTP waste streams, an additional 7.5 % margin has been added to peak treated water demand to calculate forecast raw water intake demand.

Table 10: Forecast Raw Water Intake.

Setting	Time Period	Base Scenario A	Blue Sky
		Peak Daily (m^3/d)	Peak Daily (m^3/d)
Current	2023	3,060	3,060
Short-term	2023 – 2026	3,533	3,533
Medium-term	2027 – 2033	4,825	5,629
Long-term	2034 – 2053	6,773	8,416

This has been used to assess future process unit capacity requirements alongside raw water source availability and consent.

4.2 Water Resources

As the raw water intake is currently split between two sources, at present there are two relevant consents/agreements followed by the FNDC that determine total allowable intake- the Bulk WS Agreement for abstraction from the Waingaro Dam and the resource consent for the Puketotara Stream.

4.2.1 Puketotara Stream

Current consent for uptake from the Puketotara stream, expiring in 2056, allows for:

- 3,200 m^3/d for a maximum of 28 days per year
- 2,400 m^3/d for a maximum of 28 days per year
- 960 m^3/d for any other period of the year
- A total abstraction of 453,400 m^3 annually (equivalent to 1,242 m^3/d on average)

A residual flow of 113 l/s must be maintained in the stream. This limit has been breached 6 times in the last 5 years (refer Jacobs *Kerikeri WTP Upgrade Options Report*, September 2023).

As mentioned, this stream is currently responsible for 30% supply of raw water demand. There is no room or value in expansion of this source, with the source being unreliable during the critical dry periods, which coincide with peak demand.

4.2.2 Waingaro Dam

This 4,800,000 m^3 dam is owned and operated as an irrigation dam by Kerikeri Irrigation Company Ltd. The Bulk WS Agreement (revised July 2005, renewed every 5 years until May 2030) stipulates the WTP take from the Waingaro Dam must not exceed:

- 30 l/s (or 2,592 m^3/d)
- 60,800 m^3 over a 31-day month
- 730,000 m^3 annually

This FNDC allocation is currently around 80% utilised, and hence there is some headroom for short-term growth.

The total available water resource has been around 70-80% allocated by Kerikeri Irrigation Company Ltd, hence there is some capacity to obtain further water from this source.

Conveyance capacity in the Kerikeri Irrigation network is limited from the intersection of SH10 and Kerikeri Road. FNDC could consider retaining ownership of a pipeline from this intersection to the WTP to provide future flexibility to take water from either the Waingaro Dam / Kerikeri Irrigation or Otawere Dam / Te Tai Tokerau Water Trust. An alternative option to a pipeline would be to discharge into the river near the dam, and abstract using the Puketotara Stream intake.

4.2.3 Lake Manuwai

This 8,000,000 m^3 dam is also owned by Kerikeri Irrigation, north of Kerikeri and Waipapa. There is greater water resource available from this dam, with only around 50% allocated, in comparison to the 70-80% allocated from the Waingaro Dam.

This is an option that could be considered, establishing a new WTP closer to Waipapa and north of Kerikeri. This could either supplement the Kerikeri WTP or replace it. Given the need for significant investment in the Kerikeri WTP, and with the additional operating costs of operating two facilities, we expect having a single WTP would be the more economic option.

4.2.4 Otawere Dam

This 4,000,000 m^3 dam is currently under construction, by Te Tai Tokerau Water Trust. The dam will be filled by the natural catchment, diversion from another small catchment and eventually filled from an intake on the Waitangi River.

FNDC have purchased 250 shares, giving a water capacity allowance of 750,000 m^3 annually. Water would need to be conveyed to Kerikeri, and Te Tai Tokerau Water Trust don't have current plans to install pipelines in the direction of Kerikeri. There is a distance of approximately 8 km of pipelines that will be necessary.

With all sources considered, total intake allowance has been provided below. Although there is no daily maximum restriction for intake from the Otawere Dam, this has been input based on 1.5 times the yearly maximum for comparative purposes.

Table 11: Raw Water Intake Allowance.

Condition	Puketotara Stream Resource Consent #1	Bulk WS Agreement	Otawere Dam Allocation	Total
Expiry	2056	2030	N/A	
Daily Maximum	1,242 m^3/d (1)	2,592 m^3/d	3,080 m^3/d	6,914 m^3/d
Yearly Maximum	453,400 m^3/yr	730,000 m^3/yr	750,000 m^3/yr	1,933,400 m^3/yr

Note #1 - Consented maximum of 3,200 m^3/d however this is not realistic for the peak demand periods which are likely to coincide with dry periods. The annual average flow has been assumed, although it should be noted this also is not conservative, with no flow being available during drought events.

This indicates that the total raw water intake available is expected to cover forecast peak demand for the short-term with additional sources required moving into the medium-term should enhanced population growth occur. However, planning should be put into how the ultimate demand will be met and preserving water resources to meet this demand.

4.3 Groundwater

Groundwater would offer a more consistent supply of raw water compared to dams and streams. However, the supply is exhaustive and once depleted the aquifer will no longer be usable. According to the *Waipapa WS and WW Servicing Options – Long List Background Research* (Jacobs Ltd, March 2023) there are two potential groundwater sources – Te Puawaitangi Bore and the Kerikeri aquifer that lies beneath Waipapa.

The report estimates approximately 57,000 m^3/yr, or up to 698 m^3/d, out of the total annual consented take (122,144 m^3/yr) from the Te Puawaitangi Bore may be available for the WTP. The volume available in summer may be significantly less due to sports facility use.The basalt aquifer under Waipapa is reported to offer a significant allocation availability of 8,600,000 m^3/yr, however, the actual yield is predicted to be <10 m^3/d and the water is more susceptible to contamination due to its connectivity with surface water. Consent would also need to be discussed with the Northland Regional Council (NRC) who have placed groundwater allocation restrictions in the area. It is not anticipated the groundwater sources will offer the volume of water required to meet future demand but may instead be supplementary if other options are not sufficient.

4.4 Water Quality

The Puketotara Stream is reported to cause noticeable taste and odour in the treated water when river flows are low.

The Waingaro Reservoir stratifies, and there is no reservoir mixing. There are 3 intakes at varying levels, and typically the upper intake is used, but lower intakes can be used if algal blooms occur. In this event, elevated levels of soluble manganese and iron can be expected, which may result in discoloured treated water events. Consideration could be given to implementing destratification aeration of the reservoir, which would need to be negotiated with Kerikeri Irrigation.

With climate change the risk of algal blooms and risk of taste and odour events are expected to increase, and hence this risk needs to be considered in any treatment process upgrade.

4.5 Water Treatment Plant Existing

4.5.1 Clarification

The existing upflow sludge blanket clarifier structure, with a design capacity of 3,840 m^3/d, is reported to be in poor condition and hence two new lamella clarifiers were installed in 2022, designed by Apex, but not fully commissioned.

The following table provides the design parameters for the installed clarifiers.

Table 12: 2022 Lamella Clarifier Design Parameters.

Parameter	Value	Notes
Capacity	2 x 120 m^3/h	Sold as 120 m^3/h, however, the manufacturers 100 m^3/h (nominal capacity unit appears to have been installed.
Clarifier Number	2	2 x Jorsun LST100 clarifiers
Flocculation Volume	2 x ~13 m^3	Tender was based on a single 30 m^3 rotomolded polyethylene tank, a nominal ~13 m^3 tank appears to have been installed on each train.
Flocculation nominal retention time	6.5 minutes	At design flow rate.
Gross Plate Area	274 m^2	Per Clarifier
Projected Plate Area	136 m^2	Per Clarifier
Hydraulic Loading Rate	0.88 m/h	At design flow rate. No efficiency reduction factor allowed

These clarifiers remain unused due to performance issues. From a brief review of the design:

- The stated 120 m^3/h per clarifier design capacity appears unrealistically high, a substantially lower design capacity is expected to be realistic with the size of the installed equipment. We estimate a capacity between 60 to 75 m^3/h per clarifier to be more realistic with the installed equipment. This is equivalent to 1,440 - 1800 m^3/d per clarifier, or 3,600 m^3/d max combined.
- The design had pumps following flocculation in the tender which is a significant design issue, and satisfactory performance is not likely to be achieved with this arrangement. Fortunately, site layouts imply this arrangement was not constructed. As built records have not been made available.
- Flocculation – the flocculation tank (8 minutes at design flow) is well undersized for the application.

Operators also note desludging is not automated, which would be realistically expected to be necessary for consistent and efficient operation. The installed clarifier (assuming improvements are implemented to achieve appropriate flocculation) is only estimated to meet peak demand for the short-term with no headroom for capacity growth.

Further consideration of a masterplan for development of the existing site is recommended, ie where additional clarification capacity would be constructed to meet growth.

4.5.2 Filtration

There are four original 1971 pressure filters with a total treatment capacity of 3,480 m^3/d (145 m^3/hr). Sand filter media was recently replaced; however, operators report performance appears worse than the previous media, with backwashing now required daily. Filters are manually backwashed.

Similar to clarification capacity, filters appear to be working at close to the design 3,500 m^3/d capacity, and upgrades will be required in the short-term to anticipate future demand.

4.5.3 UV Disinfection

Installed in 2007, the UV disinfection system onsite consists of a single Trojan Swift SC D06 unit, certified under the DVGW guidelines to treat a maximum of 3,840 m^3/d at 94% UVT. Onsite monitoring between 2013 – 2022 has shown a UVT 94% or higher was achieved by the WTP across the period (refer Jacobs *Kerikeri WTP Upgrade Options Report*, September 2023).

Flow capacity may be extended to 4,110 m^3/d based on guidance from Trojan supplier, Filtec, or 7,260 m^3/d if the system was recertified under the USEPA guidelines. This would, however, require straight pipe length upstream of the unit equivalent to 5 pipe diameters.

Upgrading the installation to achieve the straight pipe lengths and hence compliance with the USEPA certification is recommended to extend the life of the existing UV disinfection units for up to another 10 years, by which time the demand is likely to exceed the capacity, and these units will be coming to the end of their expected life.

4.6 Sensitivity Testing

If four people per household occupancy was to occur, as per FNDC engineering standards, then the demand forecasts will be higher as shown in the graphs in Appendix A. This level of demand is unlikely to occur but should be considered during the design process for new pipelines and if a new site is selected for a WTP to allow sufficient space for future expansion.

Demand management initiatives such as water loss reduction, education and metering have potential to significantly reduce peak demand and delay WTP capacity upgrades.

4.7 Treated Water Storage

Total treated water reservoir storage capacity is currently 3,290 m^3, across the existing three reservoirs. FNDC Engineering Standards (FNDC, 2022) require a minimum storage capacity of two-days at peak daily demand. Future storage requirements have been calculated using the assumptions provided in Table 9, indicating an immediate increase is required as shown in Table 13. However, this is considered a conservative volume of storage with 48 hours average daily demand often used and included in the table.

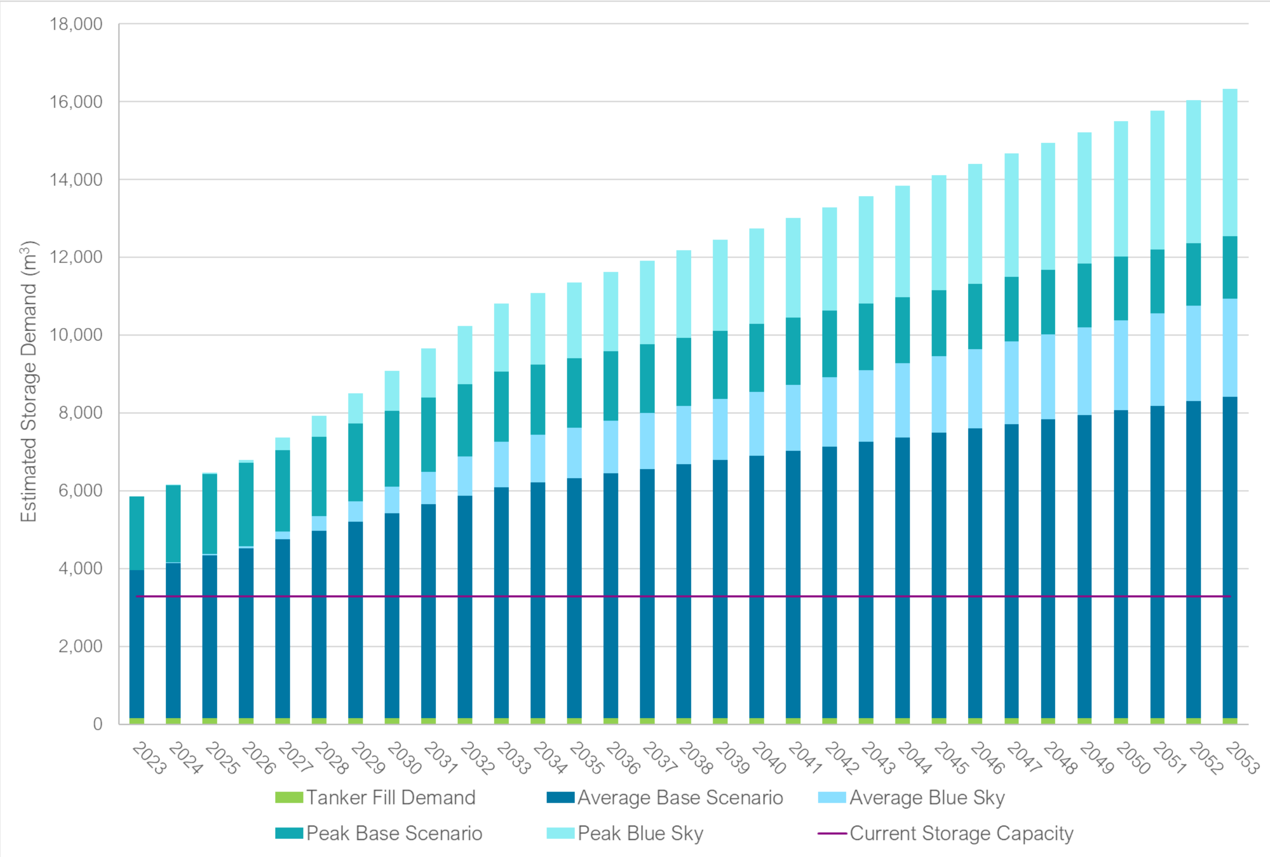


Figure 6: Forecast Treated Water Reservoir Storage Demand.

The following table summarises the treated water storage requirements.

Table 13: Treated Water Storage Requirements (Base Scenario A Growth).

Basis		Current	2024-2034	2034-2044	2044-2054
Existing	3,290 m^3				
FNDC Engineering Standards 48 hours peak demand	Required Total	6,000 m^3	10,000 m^3	12,000 m^3	14,000 m^3
	Additional Storage Required	2,700 m^3	6,700 m^3	8,700 m^3	10,700 m^3
Recommended 48 hours Average Demand	Required Total	4,000 m^3	6,600 m^3	8,000 m^3	9,400 m^3
	Additional Storage Required	700 m^3	3,300 m^3	4,700 m^3	6,100 m^3

As noted, the Waipapa reservoir is also a tanker fill location. According to the *Kerikeri Water Supply Strategy Study* (Jacobs, 2021), it is unclear whether the tanker filling point location is downstream or upstream of the reservoir and impacts treated water demand through peak summer periods when irrigation demand increases. The report found the monthly flow collected by bulk tankers usually less than 2,000 m^3/mth throughout the year with a considerable surge in January, reaching up to 7,000 m^3/mth or 250 m^3/d.

This can be averaged over an annual period to 81 m^3/d or 161 m^3 over a two-day storage period. When included with the total treated water storage demand it has a negligible impact, as shown in Figure 6.

We recommend an additional 3,300 m^3 reservoir volume constructed in the short-term, which would cover the next 10 years of base growth. This would allow for 48 hours storage at average day demand for around the next 10 years before the next increment in storage is needed. This storage could be split between the vicinity of the existing WTP, preferably a site to the south with around 20 m additional elevation, and to the

North of Kerikeri, in the Waipapa area. Consideration should also be given to the residual life of the existing reservoirs, the smaller 500 m^3 Reservoir 1 in particular which was noted to have some leakage.

Note to achieve the FNDC Engineering Standard 48 hours at peak demand, 6,700 m^3 of additional reservoir storage would be needed now to cater for the next 10 years base demand.

To address blue sky growth, approximately 5,000 m^3 additional reservoir volume is needed to meet design standards for the next 10 years of growth. To achieve 48 hours at peak demand, 9,400 m^3 of additional reservoir storage would be required over the same time period.

4.8 Water Treatment Upgrade Options and Summary

Short-term Upgrades

Peak demand is expected to exceed the capacity of the existing WTP within the next 3-5 years. Hence capacity expansion is needed in the short-term. Demand management initiatives such as restrictions and reducing water losses may also reduce peak demand.

Short-term improvements may be possible to reduce the short-term supply risk by completing the commissioning of the new lamella clarifiers and considering replacement of the filter media with higher specification media.

Water Resources

In terms of water sources, the Puketotara Stream does not have high drought resilience, and although this source provides some diversity, there is no room for expansion and in the worst-case drought, there will be no water available from this source. Drought resilient sources will need to include storage to enable supply during drought events.

Groundwater is unlikely to be able to supply the volume required to meet future demand. Any other surface water sources would need large storage dams, which would need a large investment in addition to identifying a suitable site.

Future water resources are expected to be sourced primarily from the Kerikeri Irrigation Waingaro Dam and the Te Tai Tokerau Otawere Dam. There are sufficient water resources available to meet the medium-long term demands from these sources. As an alternative, the Kerikeri Irrigation Lake Manuwai could also have water resource available and could be considered if a new WTP was to be built.

Risks with reliance being placed on irrigators for supply of raw water need to be considered – in particular the lower level of reliability expected of an irrigation supply, and hence the less rigor that is applied to asset management, and the reduced emphasis on water quality risks.

WTP Upgrading

There are significant condition and performance issues with the existing WTP, space is confined for an expansion to double the capacity of the existing WTP now and ultimately develop the site to three times its current capacity. The required reservoir storage volume cannot be accommodated on this site, as well as the WTP expansions. Reservoirs would also be preferably located at a site with an elevation around 20 m higher to match the reticulation pressure requirements. Options to develop on this site include:

- Remove the existing 500 m^3 reservoir.
- Purchase neighbouring additional land.
- Develop on the steeper sections of the site, which will have additional cost and technical challenges, particularly to achieve the ultimate capacity.

Key criteria that the upgraded WTP will need to meet include:

- An initial upgraded minimum capacity of 6,000 m^3/d, to cater for approximately 20-30 years of estimated base growth with provision to expand to an ultimate capacity of 9,000 m^3/d is recommended. A 5,000 m^3/d WTP capacity should be adequate for approximately 10 years base growth, however the incremental cost to construct for a 6,000 m^3/d capacity is probably only around 10% additional, and hence considered better value. The initial capacity could be refined once the treatment process is selected – a conventional treatment process will typically have a lower incremental cost for capacity increase, as well as a longer expected life, which would mean a higher initial capacity may be optimal.
- Have the ability to cater for elevated soluble iron and manganese, and algal taste and odour.
- Meet protozoa, bacterial and other compliance requirements.

Although membrane-based treatment options have been previously recommended, we consider a conventional treatment process may be better suited to this application, being more readily being able to cater for removal of iron, manganese and taste and odour.

The proposed process would consist of:

- Coagulation - with consideration given to alkalinity enhancement.
- Clarification – either upflow sludge blanket clarification or lamella plate clarification could be considered, although sludge blanket clarification may be preferred for this source water quality.
- BAC (Biologically Activated Carbon) – media filters designed for biological degradation of taste and odour compounds and soluble iron and manganese, in addition to the primary purpose of particulate removal would be recommended.
- UV Disinfection – although not essential for compliance, UV disinfection could be included to achieve a multi barrier protozoa and disinfection barrier, and for consistency with other FNDC WTP's.

There are increased future capacity requirements for blue sky growth. To accommodate the increase in growth the WTP capacity increase to 9,000 m^3/day will need to be implemented in the long term, likely in mid 2040s and additional reservoir capacity is also needed compared to base growth.

5 Wastewater Treatment

The key timings to increase WWTP process unit capacity and discharge consent limits to meet the demand growth have been assessed.

5.1 Forecast Demand Projections

To calculate the forecast wastewater demand, key WWTP component capacities, as shown below, were combined with the assumptions provided in Table 15.

Table 14: Capacity of Plant Components.

Plant Component	Number	Arrangement	Max Capacity (m^3/d or specified)[1]
Rising Main to WWTP	-		4,592
Screening	1		4,493
Grit removal	1		4,493
SBR Aeration Blowers	3	Duty / Assist / Standby	2,400 m^3/h air flow
SBR Decanter	1		61.3 l/s

[1] *Kerikeri Wastewater Treatment Plant Capacity Review* (Beca, 2019),

Plant Component	Number	Arrangement	Max Capacity (m^3/d or specified)[1]
SBR Reactors	2 Parallel	Duty / Duty	1,270
Tertiary Filters	2 Parallel	Duty / Duty	4,018
UV Disinfection	2 in Channel		3,370
Discharge main	-		4,211

The following assumptions have been used for the demand forecast. The 200 l/p/d average demand and daily peaking factor are consistent with the FNDC Engineering Standards. The population per dwelling for new dwellings is consistent with the Housing and Business Capacity Assessment which identifies demand of 2.5 people per new dwelling.

Table 15: WWTP Assumptions for Projected Forecast Demand.

Assumption	Value
Daily Peaking Factor	2.5 x ADF
Residential	
Household Occupancy	2.5 Persons
Average Per Capita Demand	200 l/person/day
Households Serviced (base scenario)	80%

Using WWTP inflow data provided by FNDC for 01/01/2022 to 30/06/2024, the average daily flow (ADF) of 846 m^3/d was used as the current WWTP demand (2023). This allowed future average and peak flow to the WWTP to be estimated as shown below.

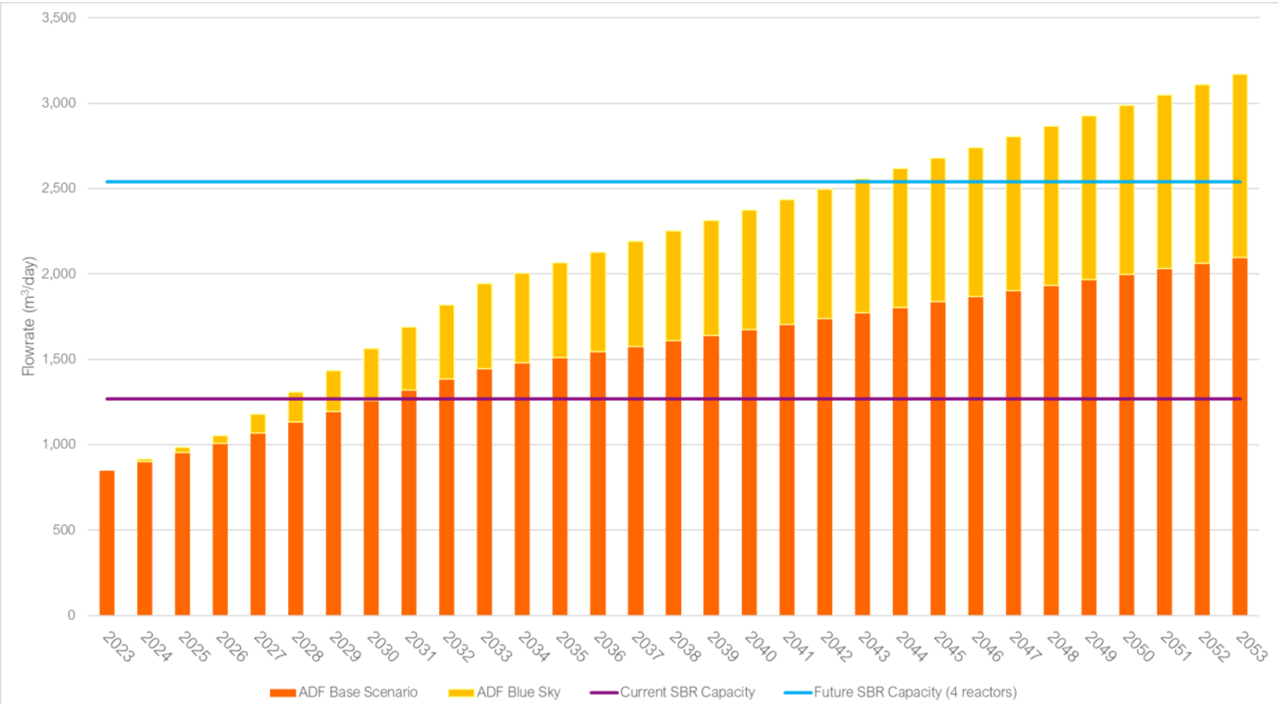


Figure 7: Forecast ADF Wastewater Treatment Inflow

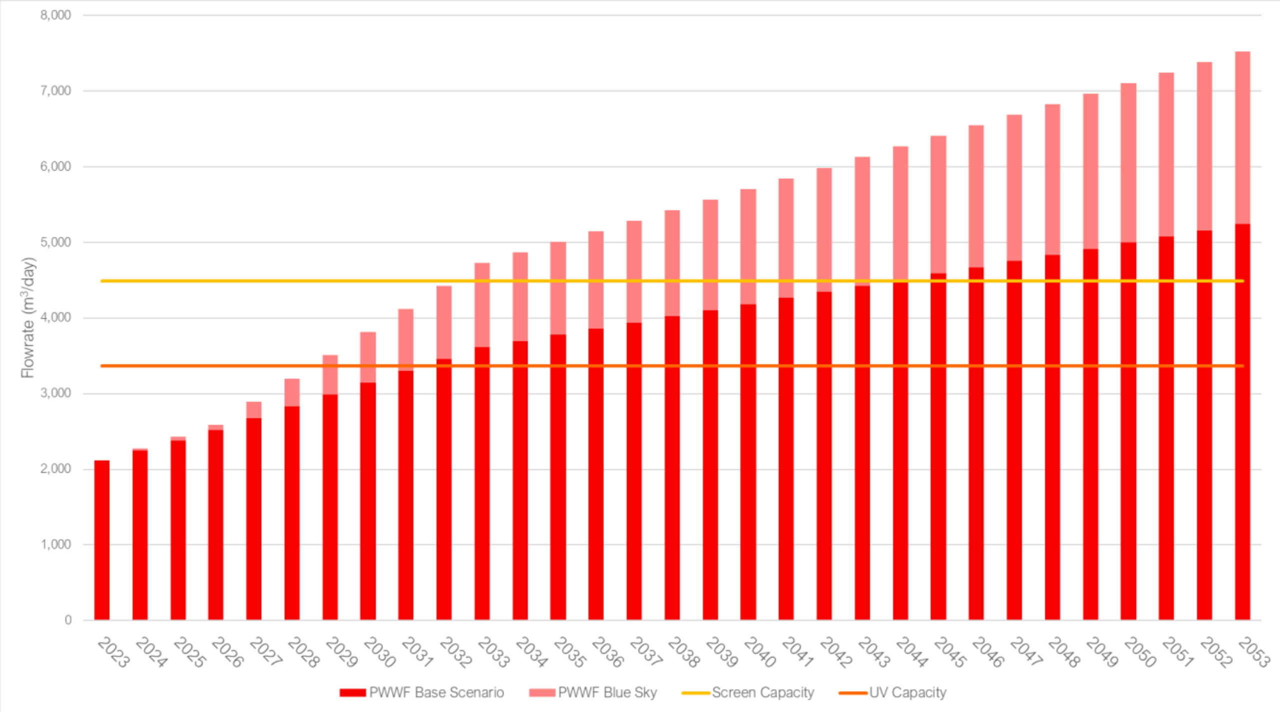


Figure 8: Forecast PWWF Wastewater Treatment Inflow

5.2 Wastewater Treatment Plant

Using the WWTP capacities above, process unit capacity was assessed against future flow projections.

5.2.1 Inlet Works/Screens

With a nominal capacity of 4,493 m^3/d (52 l/s), both the inlet screens and grit removal are likely to require an upgrade long-term based on PWWF for the base scenario. For blue sky growth the screen upgrade is likely to be required in the medium-term (refer Figure 8).

5.2.2 Reactors

As shown in Figure 7, forecast base treatment demand will exceed current SBR capacity (1,270 m^3/d) in the medium-term. At this point it would be recommended to install a second set of reactors (3&4). The fourth reactor could be used as a decanter until it was needed for biological capacity. The additional reactors would cater for the long-term base growth. For the blue sky growth projections, the next set of reactors will be needed in the medium-term and further reactor capacity is likely to be needed in the mid 2040's. For all scenarios with extra solids generated by the reactors, an extra screw press is recommended for dewatering.

5.2.3 UV Disinfection

With a nominal capacity of 3,370 m^3/d, the UV disinfection system is estimated to require an upgrade in the medium-term for all scenarios (refer Figure 8).

5.3 Sensitivity Testing

If 4 people per household occupancy was to occur as per FNDC engineering standards then the demand forecasts will increase as shown in the graphs in Appendix A. This level of demand should be considered during the design of pipe and pump station upgrades and for master planning at the WWTP site. The forecasts assume that demand for the current Kerikeri businesses will also stay the same, with improved water efficient devices for domestic and commercial buildings and an aging population, demand may decrease over time.

5.4 Discharge Consent

The current resource consent allows for a maximum dry weather flow discharge of 1,350 m^3/d as a rolling average into the Waitangi Wetlands along with load limits for other parameters including total nitrogen. This limit is expected to allow for growth under the base forecast growth to the end of the consent period (2036). The blue sky growth scenario will likely exceed the consent limit for flow prior to the consent expiry.

Based on the forecast treatment demand, following consent expiry in September 2036, the daily discharge limit would need to be increased to around 1,700 m^3/d to allow for 2053 demand as a base case, or closer to 2,700 m^3/d for blue sky growth.

If the current total nitrogen (TN) limit was able to be retained and flow increased based on current TN in the treated wastewater, the theoretical flow equivalent capacity at the wetlands would be 2,400 m^3/d as rolling dry weather average. This assumes that the environmental effects of the 15 kg TN per day, additional hydraulic load and other contaminant loads are acceptable.

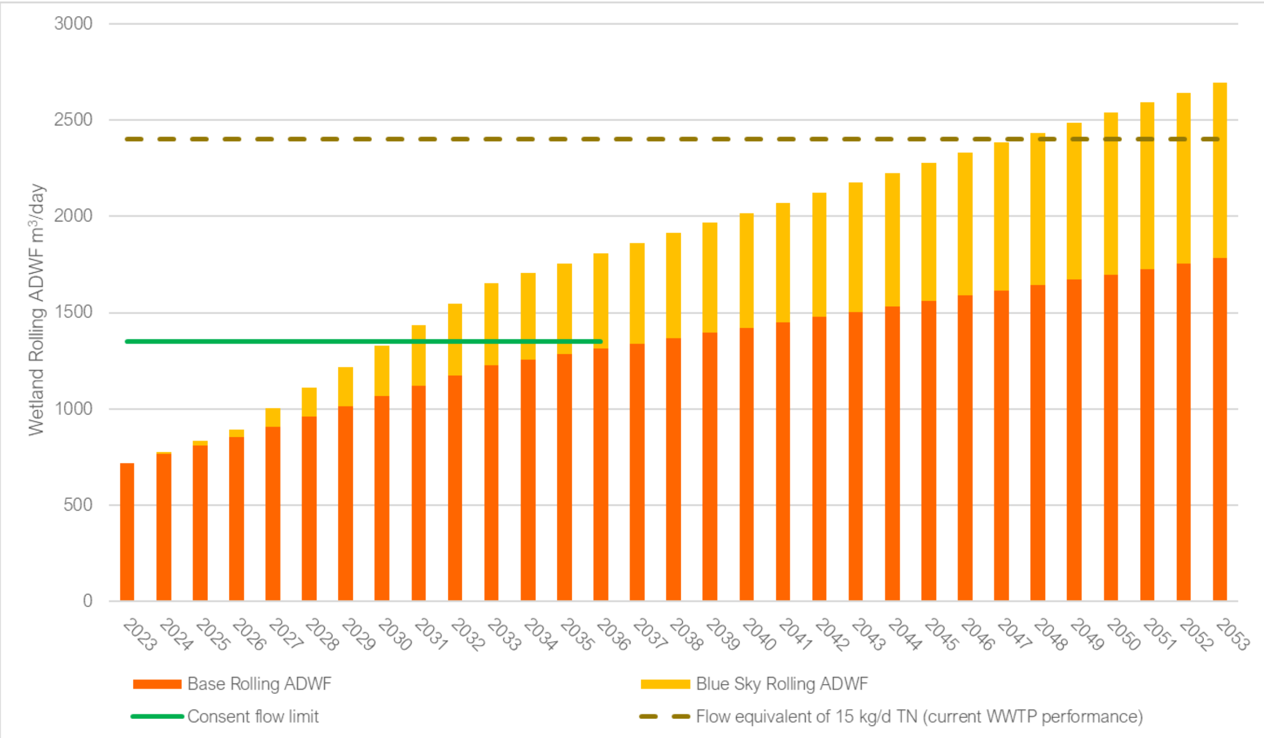


Figure 9: Wetland Discharge Capacity.

6 Network Modelling

6.1 Methodology

The water and wastewater network modelling methodology included the following steps:

- Assets since 2021 were added to the existing water and wastewater models (in Infoworks WS Pro and ICM)
- Scenario areas and existing brownfield zones were assigned new populations for 30 years in the future

- No information was available on planned upgrades for the networks, so these were not able to be added to the models
- Greenfields areas were modelled by adding new sub-catchments to best fit the new areas with the relevant populations spread across several catchments
- Brownfields areas had the existing population evenly scaled up to match the new growth population across all existing catchments
- The models were run to identify areas where levels of service were not met (i.e. low pressure at connections/high pressure loss in pipes for water and overflows/pipe surcharging for wastewater)
- Infrastructure was added/upsized to connect new areas and resolve the level of service issues highlighted when the model was run for the 30-year timeframe

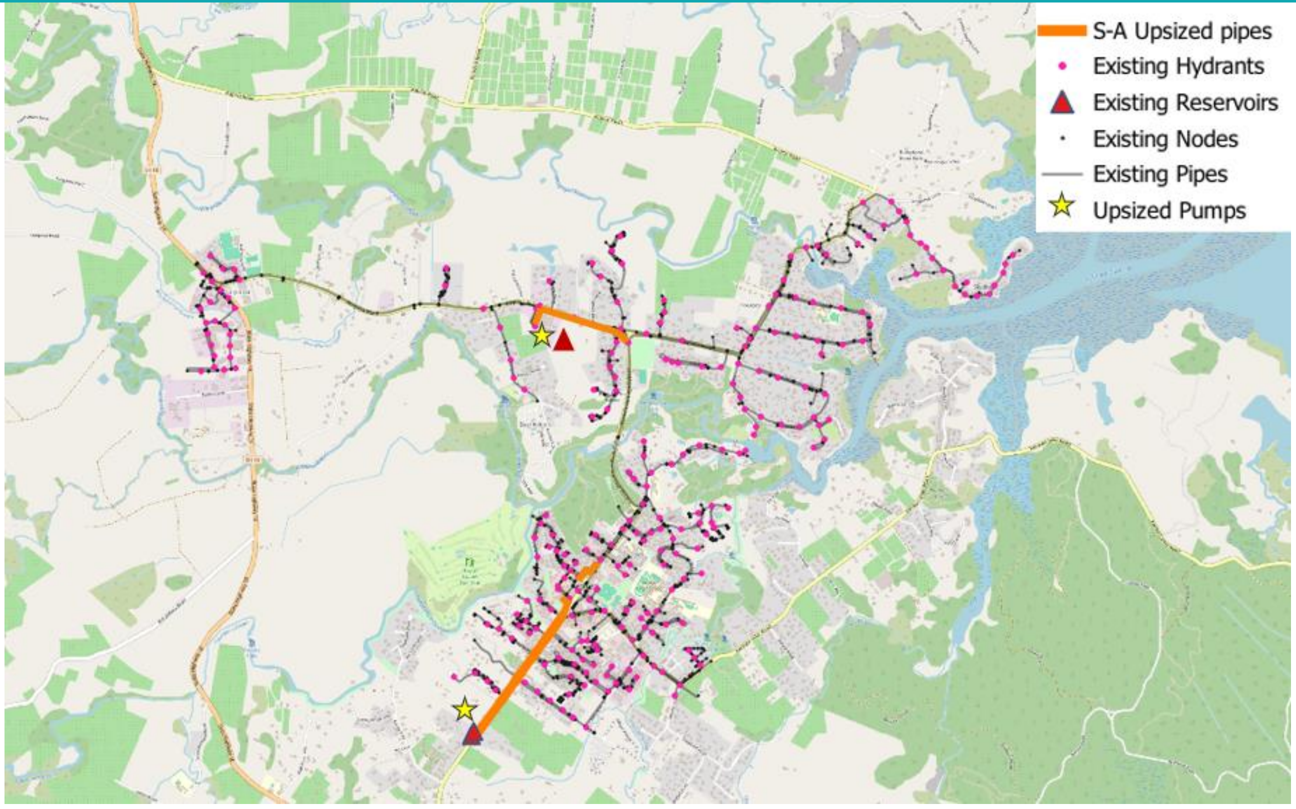
Key assumptions used in the modelling were:

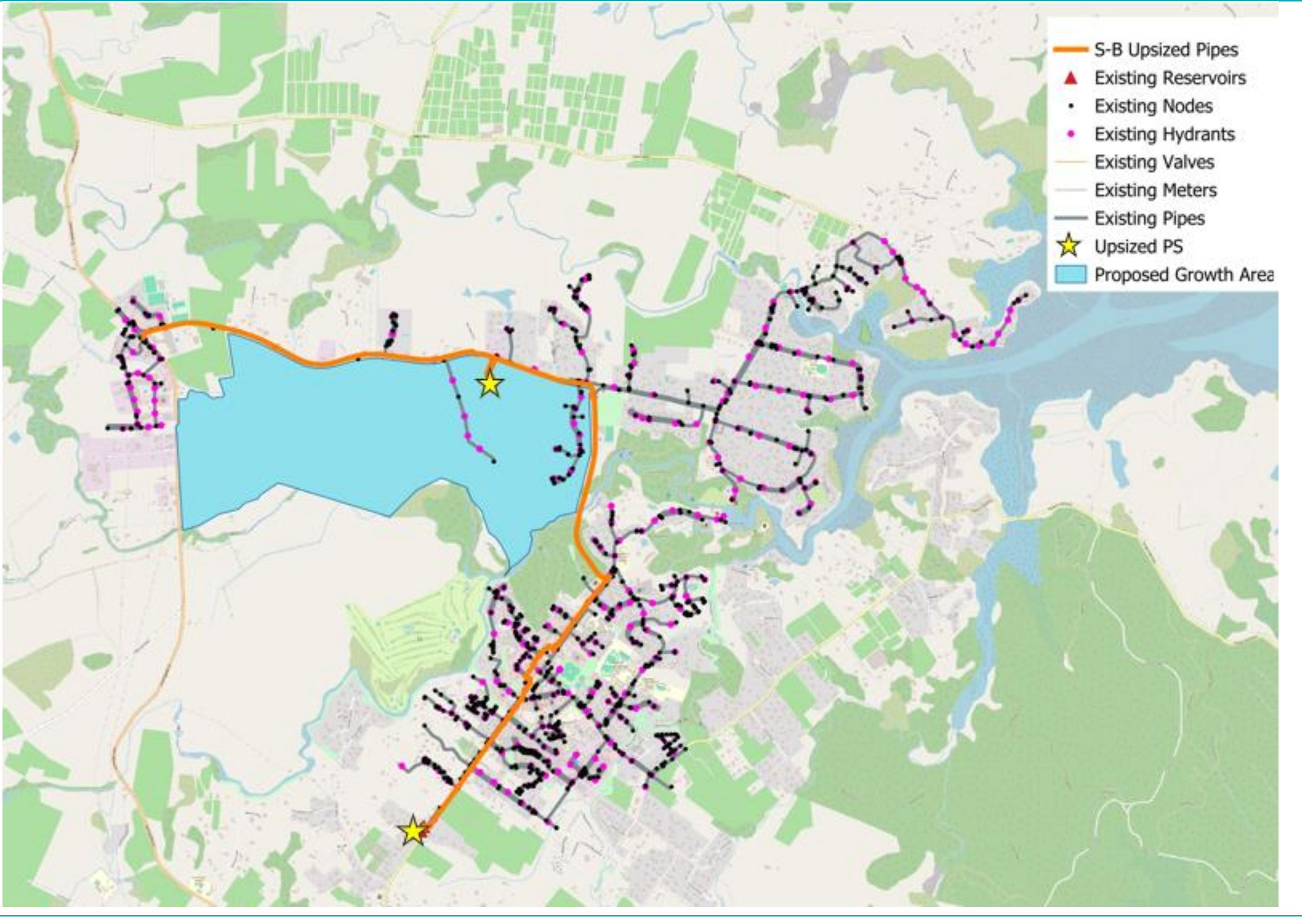
- 2.5 people per dwelling for new residential areas
- New business land – assume light water usage as per FNDC engineering standard (0.4 l/s/ha.
- Heavy Industrial zoned land (PDP) in Waipapa not serviced for wastewater
- 200 l/p/day per capita demand for wastewater is considered for the greenfield areas as per FNDC Engineering standards
- For Wastewater a factor of 2.5 times the ADWF is considered for peak DWF and 5 times ADWF is considered for peak WWF for the greenfield areas
- 300 l/p/day per capita demand for water usage as per FNDC engineering standards
- Existing brownfield areas used the peaking factors in the models
- Per capita wastewater flow of 160-305 l/p/day is used for the brownfield areas based on existing sub-catchments demand profiles
- Existing Waipapa residential and commercial properties were not included in the wastewater model
- Optioneering and optimisation of new infrastructure and pipe/pump upgrades was not undertaken.
- Approximately 269 new customer points have been added to the current water model. As the specific consumption data for these new points is unavailable a standard consumption rate of 300 l/p/day has been assumed and the existing domestic profile has been applied.
- The additional population for the greenfield areas is assumed to be distributed evenly across the polygon

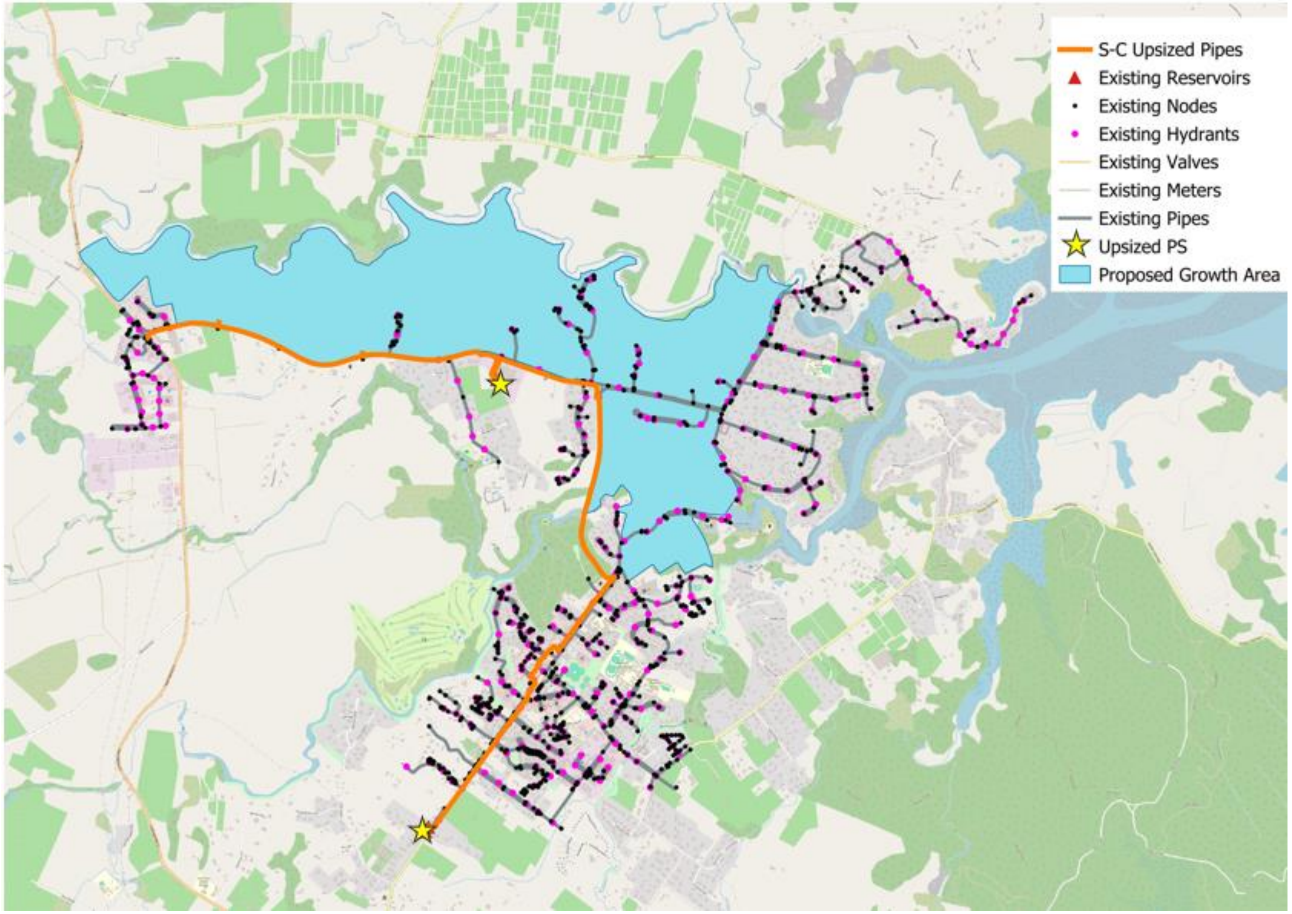
6.2 Water

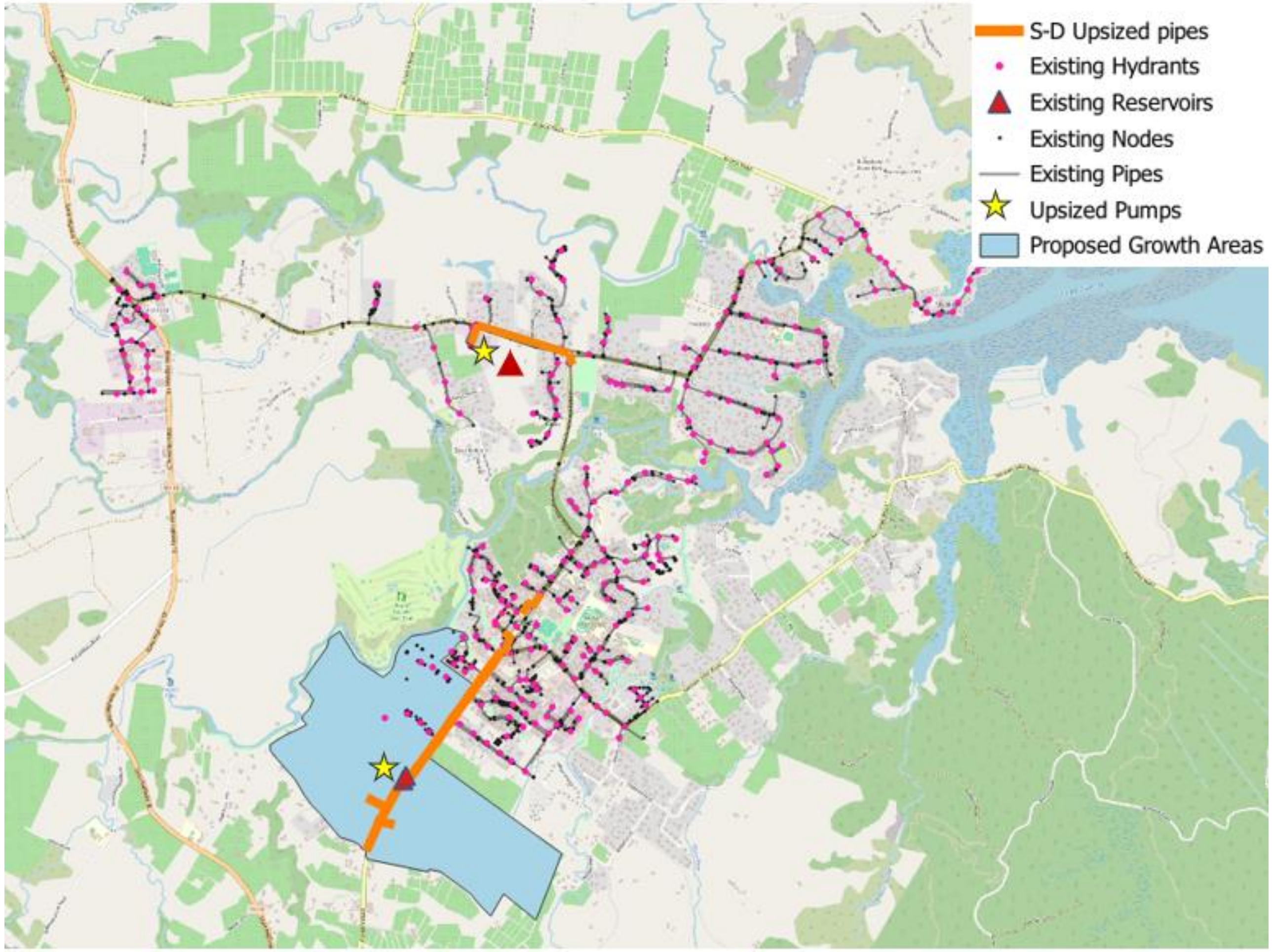
The water network infrastructure requirements for each scenario are provided below.

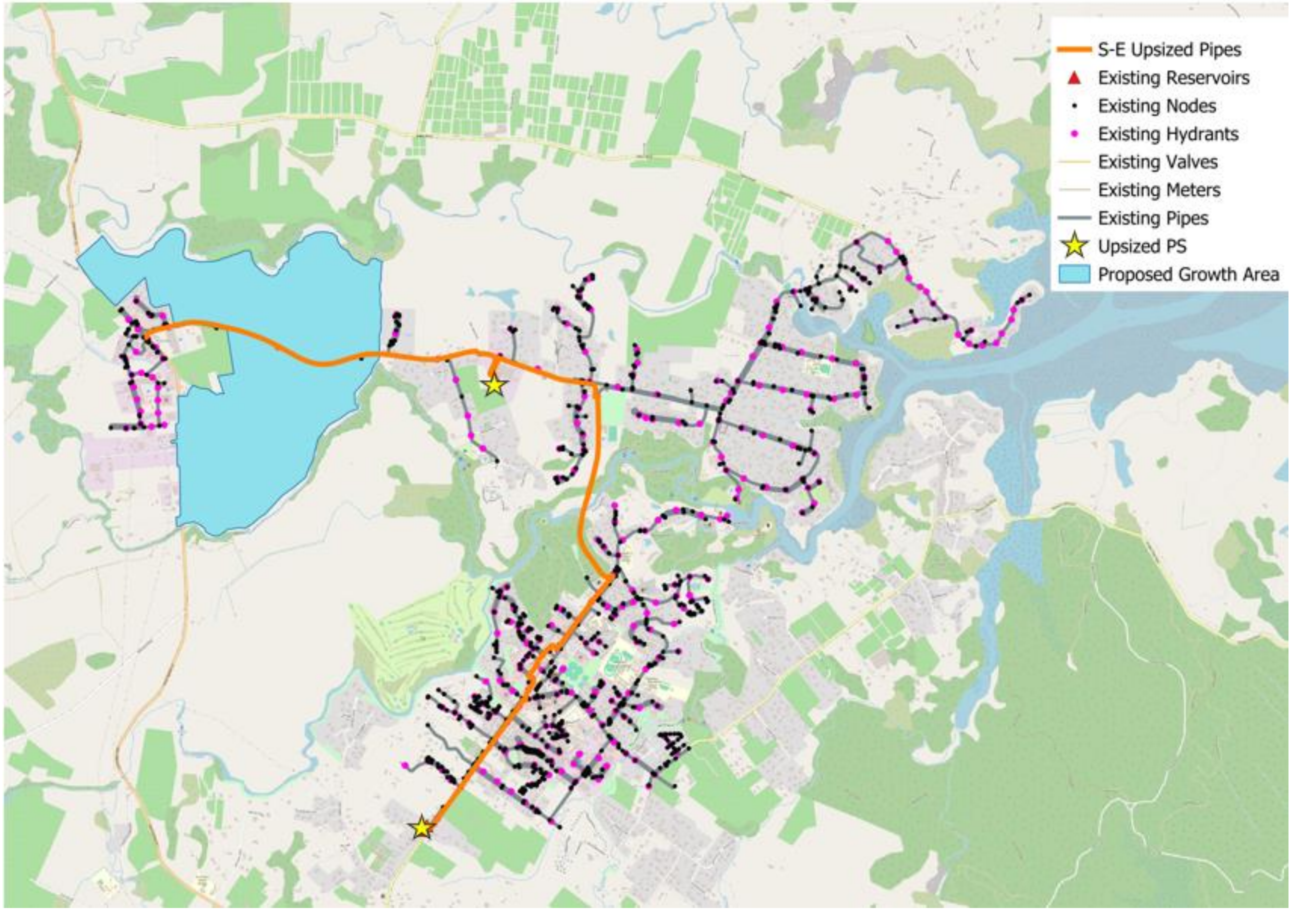
Table 16: Water Network Infrastructure Requirements

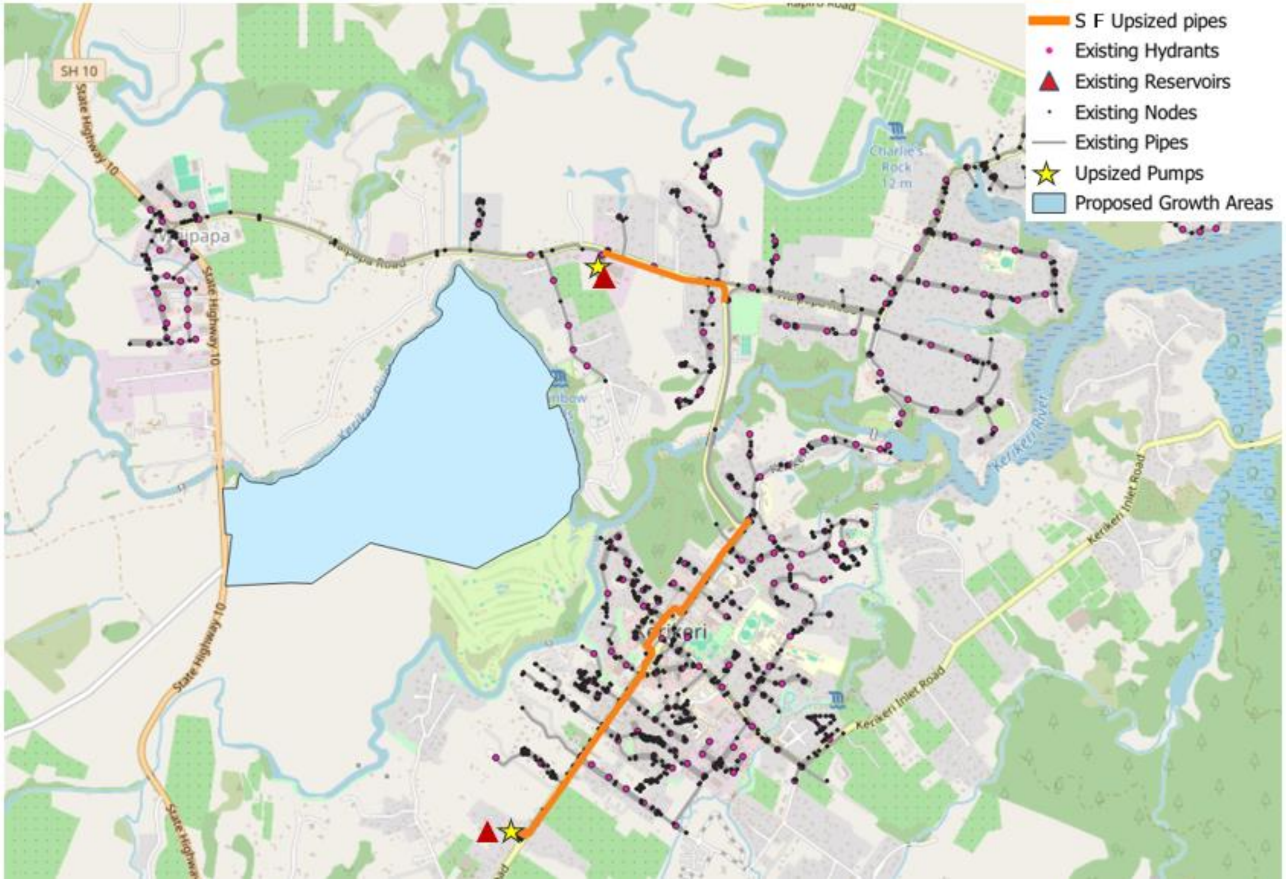
Scenario	Map of upgrades	Description
A		Larger pumps are required at both the Waipapa and Kerikeri reservoirs to maintain sufficient pressure in the network. Approximately 2,454 m of pipelines need to be upsized to reduce pressure losses and provide sufficient flow (250-355 mm diameter).

Scenario	Map of upgrades	Description
B		Larger pumps are required at both the Waipapa and Kerikeri reservoirs to maintain sufficient pressure in the network. Approximately 7,537 m of pipelines need to be upsized to reduce pressure losses and provide sufficient flow (140-500 mm diameter).

<table>
<tr><th>Scenario</th><th>Map of upgrades</th><th>Description</th></tr>
<tr><td>C</td><td>
</td><td>Larger pumps are required at both the Waipapa and Kerikeri reservoirs to maintain sufficient pressure in the network. Approximately 7,281 m of pipelines need to be upsized to reduce pressure losses and provide sufficient flow (140-500 mm diameter).</td></tr>
</table>

Scenario	Map of upgrades	Description
D		Larger pumps are required at both the Waipapa and Kerikeri reservoirs to maintain sufficient pressure in the network. Approximately 3,263 m of pipelines need to be upsized to reduce pressure losses and provide sufficient flow (250-400 mm diameter).

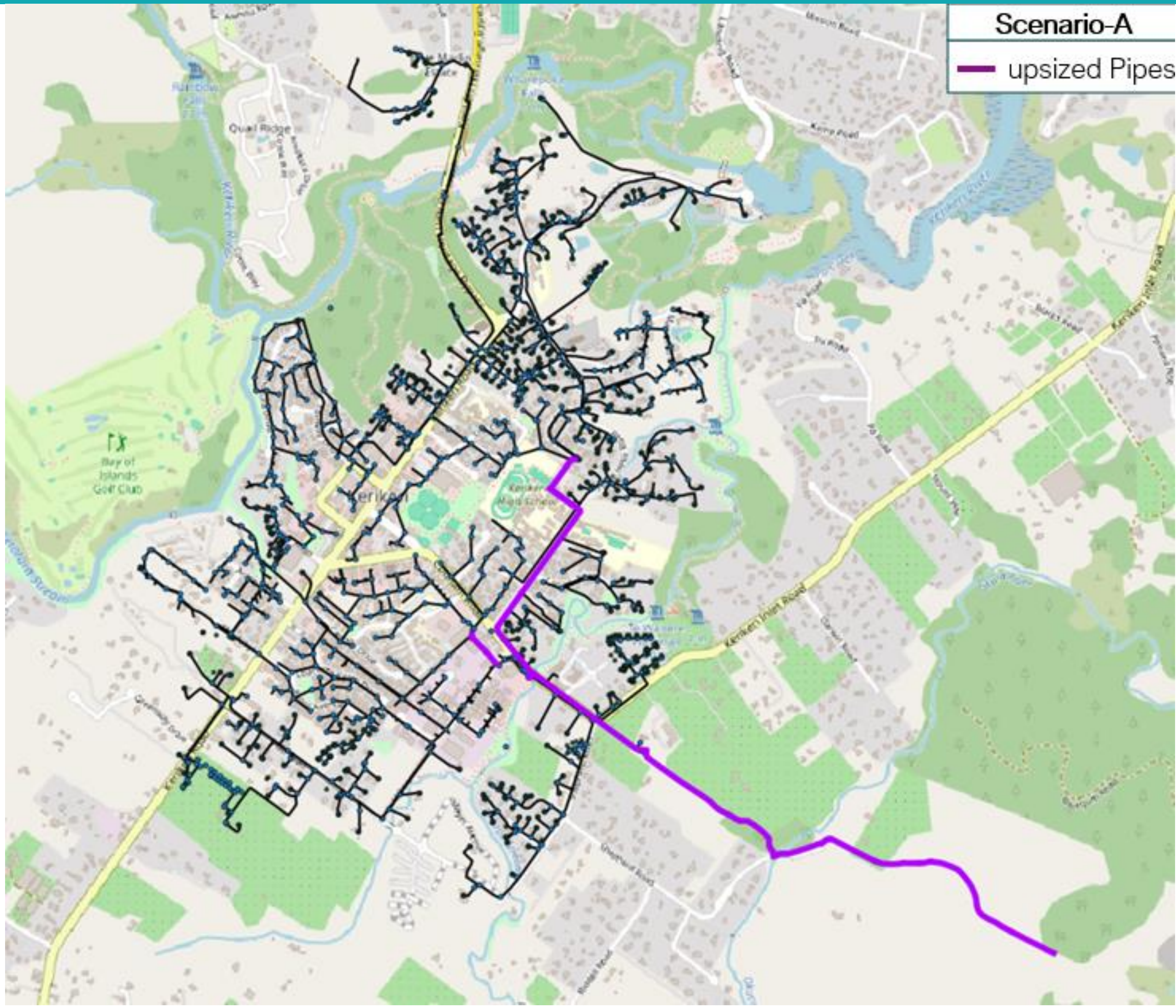
Scenario	Map of upgrades	Description
E		Larger pumps are required at both the Waipapa and Kerikeri reservoirs to maintain sufficient pressure in the network. Approximately 7,281 m of pipelines need to be upsized to reduce pressure losses and provide sufficient flow (140-500 mm diameter).

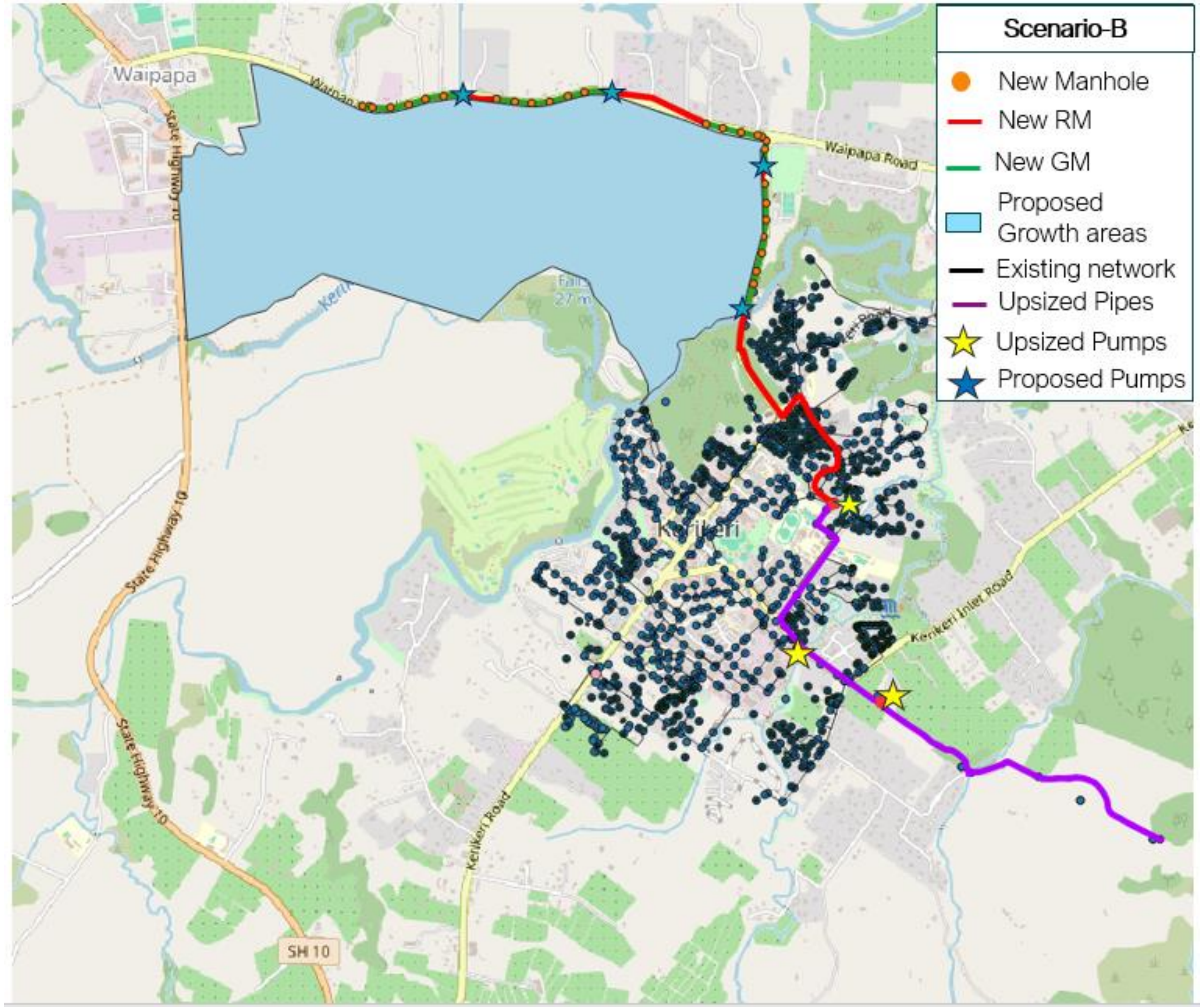
Scenario	Map of upgrades	Description
F		Larger pumps are required at both the Waipapa and Kerikeri reservoirs to maintain sufficient pressure in the network. Approximately 3,168 m of pipelines need to be upsized to reduce pressure losses and provide sufficient flow (280-450 mm diameter).

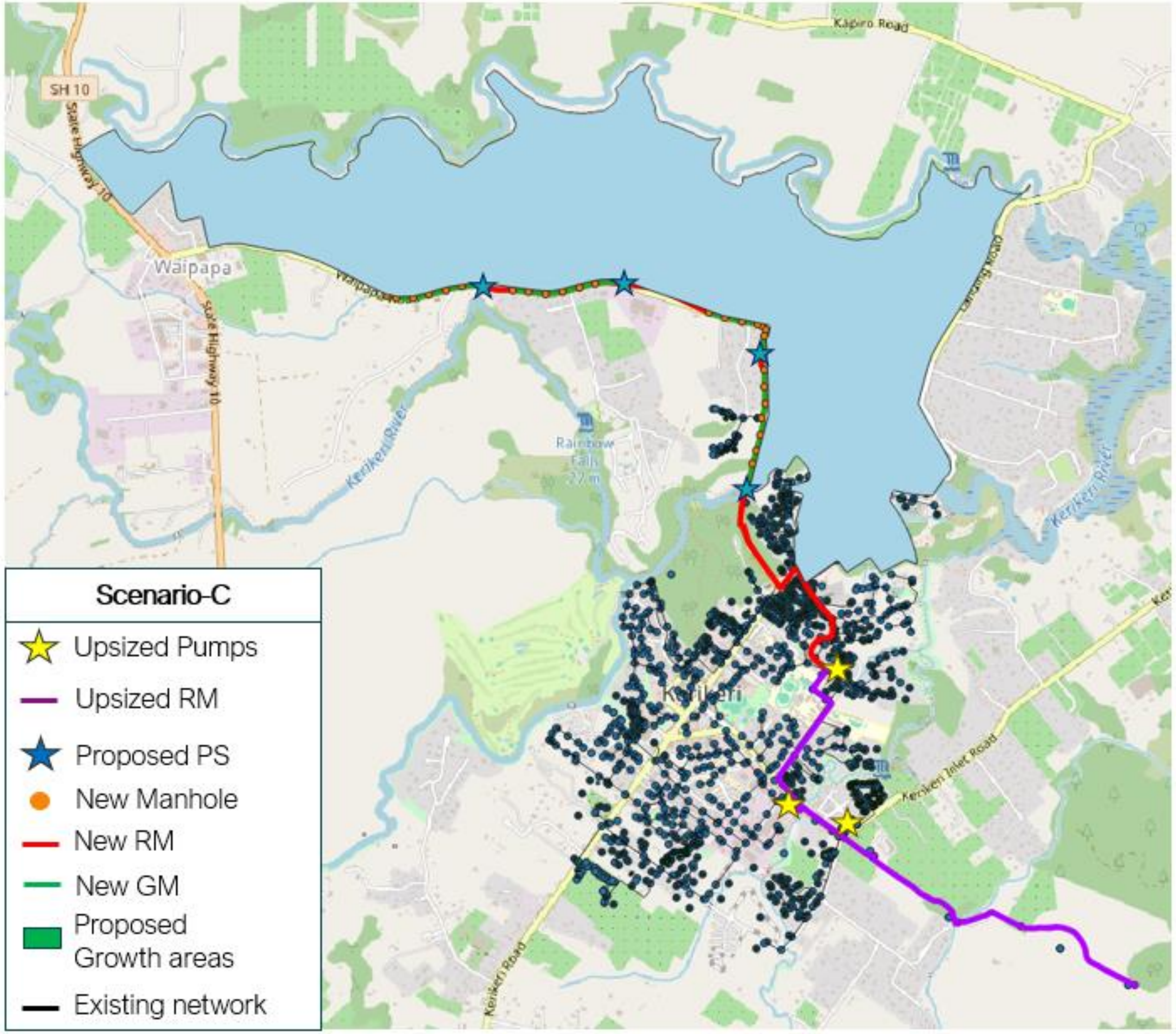
6.3 Wastewater

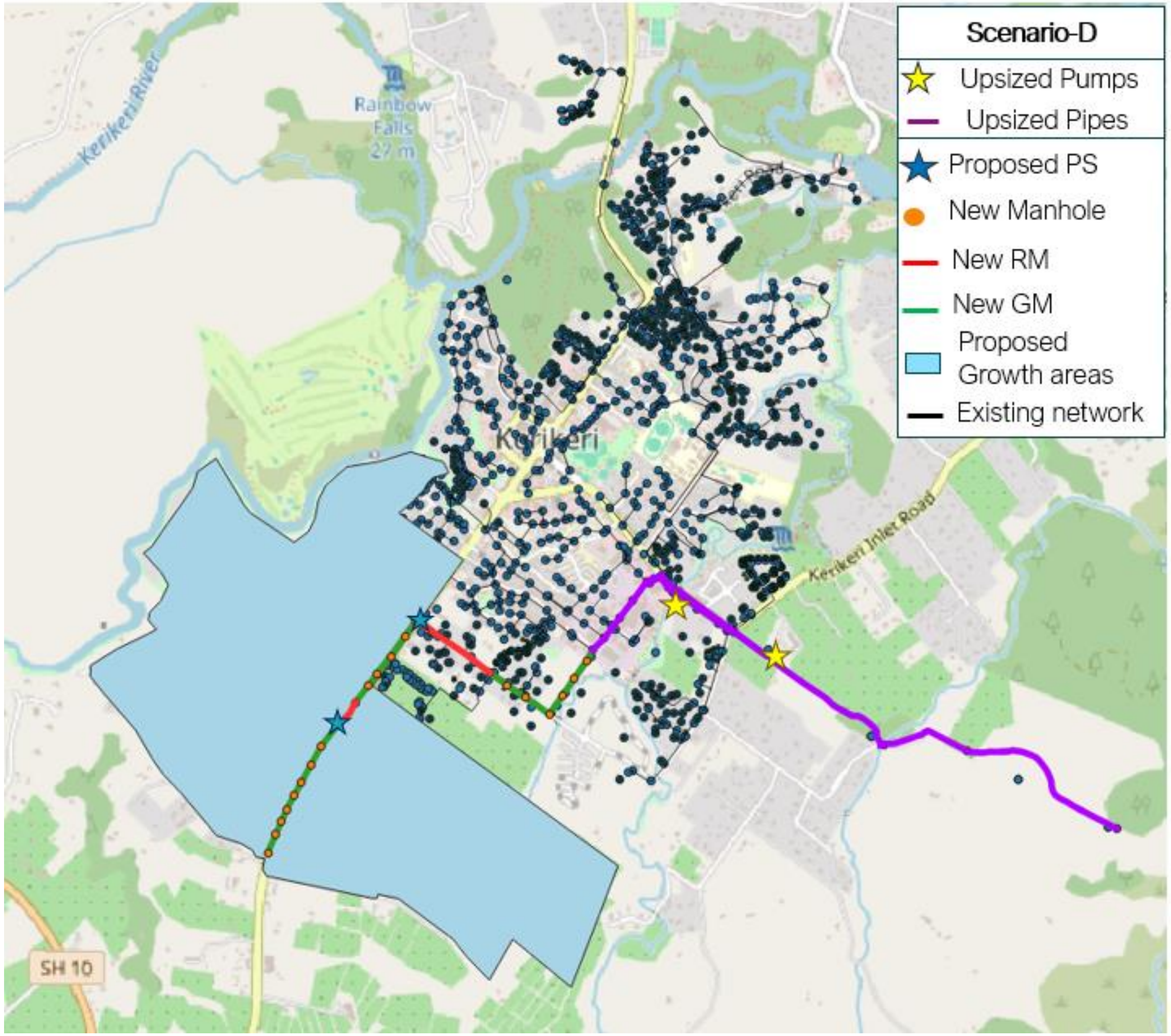
The wastewater network infrastructure requirements for each scenario are provided below.

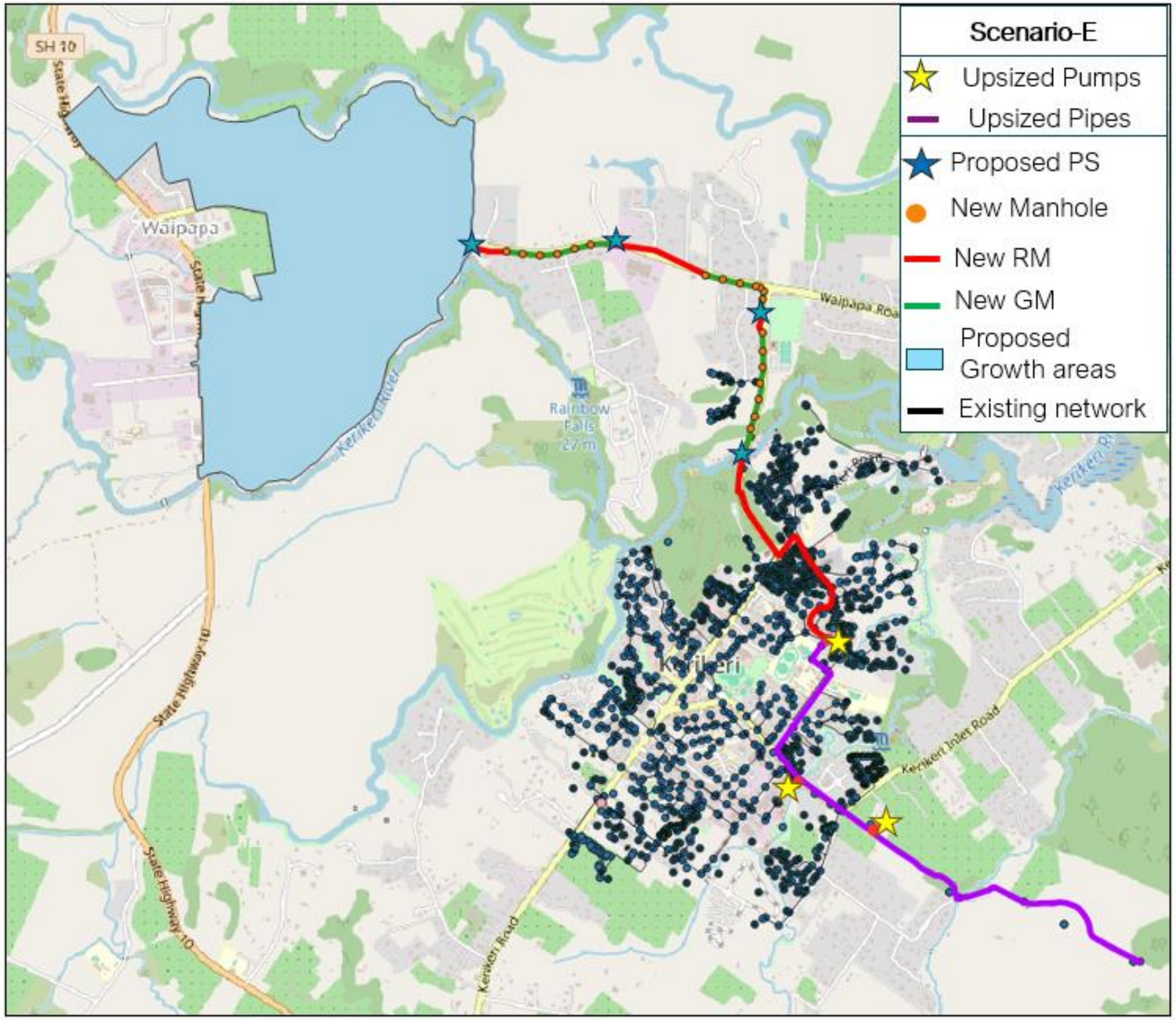
Table 17: Wastewater Network Infrastructure Requirements

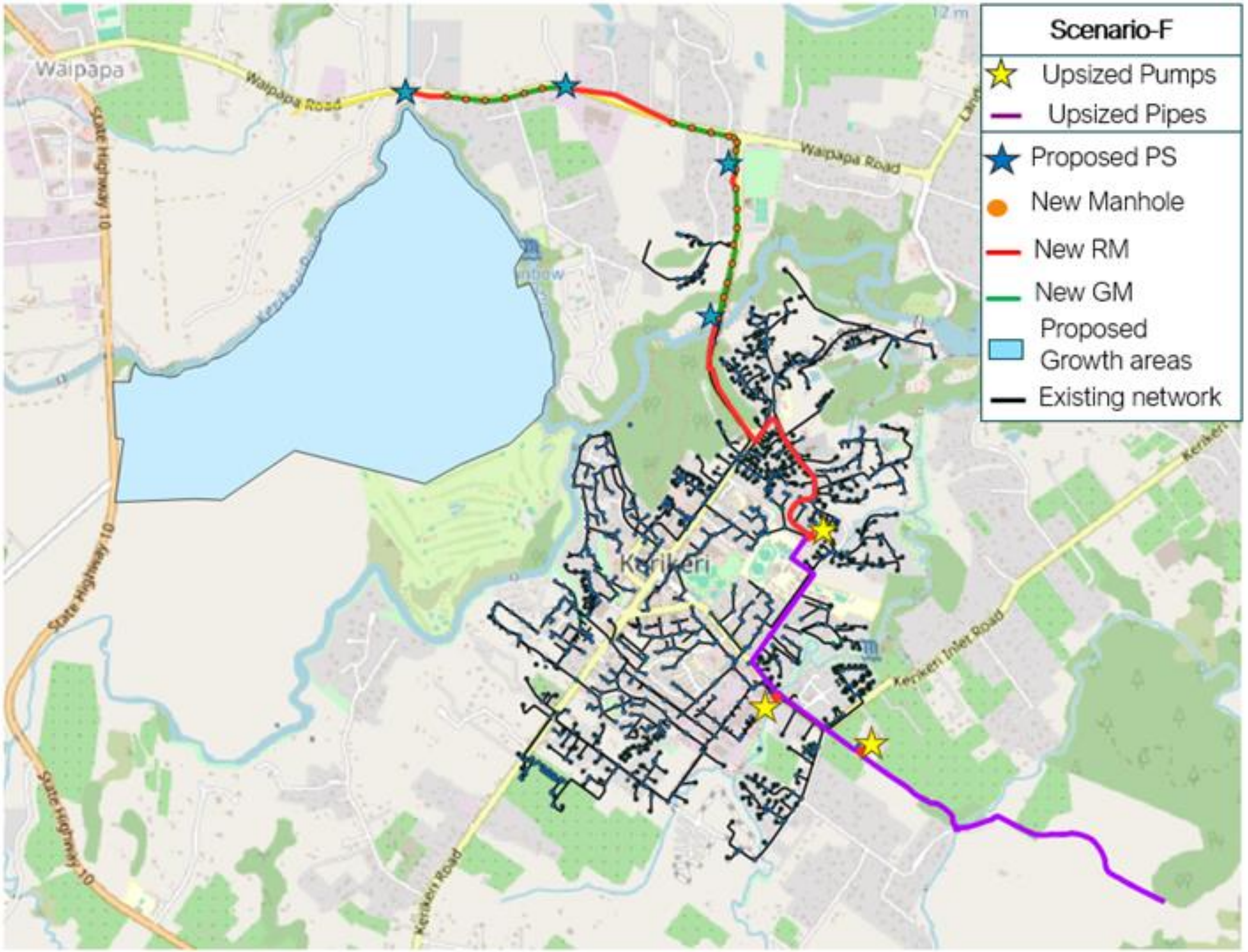
Scenario	Map of upgrades	Description
A		To minimise overflows, pumps at 2 pump stations need to be upgraded. Approximately 3,389 m of pipe needs to be upsized to avoid surcharging and excessive velocities in rising mains.

Scenario	Map of upgrades	Description
B		To service the new growth area 4 pump stations and associated gravity/rising mains are required due to the terrain. To minimise overflows, pumps at 3 pump stations need to be upgraded. Approximately 3,258 m of pipe needs to be upsized to avoid surcharging and excessive velocities in rising mains.

Scenario	Map of upgrades	Description
C		To service the new growth area 4 pump stations and associated gravity/rising mains are required due to the terrain. To minimise overflows, pumps at 3 pump stations need to be upgraded. Approximately 3,325 m of pipe needs to be upsized to avoid surcharging and excessive velocities in rising mains.

<table>
<tr><th>Scenario</th><th>Map of upgrades</th><th>Description</th></tr>
<tr><td>D</td><td>
</td><td>To service the new growth area 2 pump stations and associated gravity/rising mains are required due to the terrain. To minimise overflows, pumps at 2 pump stations need to be upgraded. Approximately 1,513 m of pipe needs to be upsized to avoid surcharging and excessive velocities in rising mains.</td></tr>
</table>

<table>
<tr><th>Scenario</th><th>Map of upgrades</th><th>Description</th></tr>
<tr><td>E</td><td>
</td><td>To service the new growth area 4 pump stations and associated gravity/rising mains are required due to the terrain. To minimise overflows, pumps at 3 pump stations need to be upgraded. Approximately 3,265 m of pipe needs to be upsized to avoid surcharging and excessive velocities in rising mains.</td></tr>
</table>

Scenario	Map of upgrades	Description
F		To service the new growth area 4 pump stations and associated gravity/rising mains are required due to the terrain. To minimise overflows, pumps at 3 pump stations need to be upgraded. Approximately 3,317 m of pipe needs to be upsized to avoid surcharging and excessive velocities in rising mains.

6.4 Implications of current model limitations

FNDC completed a gap analysis for the current models which identified some of the limitations for the models. The aspects which are most likely to impact the outputs of this assessment are:

- The confidence of the current wastewater model is low therefore the proposed options should be treated with caution.
- Any change to the assumed number of dwellings in the greenfield and brownfield areas would necessitate adjustments to the estimated pipe sizes and pump capacities.
- Changes to the spatial distribution of developments within greenfield and brownfield areas will impact the proposed upgrades. As more detail around developments becomes apparent the proposed upgrades recommended in this report should be refined.
- The model does not include the raw water system and the network connecting the treatment plants to the reservoirs. Therefore, adequacy of the source and the existing reservoirs is not included in the modelling assessment.
- The current water network exhibits high head losses in a few rider mains, upsizing these pipes is not considered in the current assessments. Upgrade recommendations have focused on trunk mains only.
- The existing model LiDAR is used to update the elevations for the new network. Any changes to the LiDAR data would change the results.

It is recommended that the following improvements are prioritised for the models:

- The confidence of the wastewater model is low due to the gauging issues encountered during flow survey. It is recommended to recalibrate the model to improve its accuracy and confidence.
- Planned upgrades should be added to the water and wastewater networks.

7 Stormwater

Stormwater Infrastructure will need to meet the level of service required by the FNDC Engineering Standards and discharges from growth areas or individual sites will include requirements for both quantity and quality controls.

Low Impact Design (LID) solutions are preferred for managing stormwater runoff where possible and should be supported by site specific geotechnical assessments to determine suitability for any disposal to ground and suitable discharge locations. Where disposal to ground (soakage) is not feasible, alternative methods such as on-site storage, re-use or attenuation will be required to achieve runoff volume control.

Kerikeri and Waipapa have a number of Wāhi Toitū areas that will inhibit future development in some cases. Wāhi Toitū are zones of land that have been identified as either being subject to flooding or having Class 1 and/or Class 2 highly productive soils, and development is to be avoided within these areas.

Road berms formed with vegetated swales are recommended for conveyance. This will require sufficient width in the road corridor which may not be available in all locations or may be limited by site topography. Swales may include LID treatment systems such as rain gardens or soakage basins that can provide a treatment train approach.

7.1 Growth Scenario A: Proposed District Plan Implementation

Significant Constraints

The existing stormwater network generally comprises discrete pipe networks connected to an outfall. Numerous outlets are located along Waipekakoura River and Kerikeri Inlet, serving a mix of roading and private properties including sections of road carriageway and/or private connections. A mix of public and private stormwater ponds are located across the Growth Areas acting as attenuation and treatment devices prior to discharging to tributaries of the Kerikeri River. Private stormwater ponds are predominantly situated around more recent residential development areas.

Development within the confines of the Proposed District Plan within Kerikeri avoids much of the Wāhi Toitū and flooding extents. The flood modelling undertaken by GHD (2007) includes 5year, 10year and 100year floodplain extents and MPD and Climate Change allowances. The resulting flood extents within Growth Scenario A areas generally follow the Kerkeri Inlet and its' tributaries and do not appear to spill far.

Properties within the southern Waipapa industrial areas are susceptible to flooding, with modelling indicating Kerikeri River will overtop during large storm events onto surround pastoral and nearby industrial parcels. There is limited scope to develop these areas noted as Wāhi Toitū.

New development will need to cater for stormwater on-site and manage increases in runoff quantity and any detrimental quality effects. Typically, stormwater ponds/basins or wetlands would be provided as part of a treatment train prior to discharging to an existing watercourse. This will likely require some developers and smaller landholders to work together to ensure suitable areas are set aside for managing stormwater, and a suitable outfall identified.

Connections to existing pipe networks are unlikely to be sufficient except for smaller development sites. Pipe networks are available within existing built-up areas but are smaller in diameter and likely only sized to cater for existing development.

Development under Growth Scenario A is likely to be of an infill nature, and smaller in scale than required under the FNDC Housing and Business Capacity Assessment (HBA), indicating 45% of growth in Kerikeri-Waipapa areas (being 3,260 additional households) over the next 30 years.

7.2 Growth Scenario B: South Waipapa Road Expansion

Moderate Constraints

Growth Scenario B focuses on commercial and medium density growth near established centres of Kerikeri and Waipapa. The proposed growth area follows existing transport links between Kerikeri and Waipapa, opening the area to development and "bridging" the gap between the two townships.

The growth area falls mostly within Rural Living and Rural Production zones – areas that have historically been used for food/agriculture and large-lot residential uses. Facilitating medium-density residential development on these highly productive soils may trigger consenting and re-zoning complications through the National Policy Statement for Highly Productive Land (NPS-HPL) given its' purpose to ensure availability of such land now and for future generations.

Existing stormwater infrastructure is limited within the Scenario B area, to some short networks catering for runoff from Waipapa Road, Waipekakoura River crosses through the growth area and would be used as a discharge point for future pipe networks. Significant new infrastructure will be required for gully and river crossings to unlock large development areas, although this scenario is understood to be favoured by some landowners with interest in progressing development.

Flood mapping of the area indicates the Waipekakoura River tributary may spill onto surrounding land even under the existing development scenario, which is exacerbated when considering MPD and Climate Change effects and reduces the area of suitable development. The predicted flood extents (and Wāhi Toitū areas) are likely to reduce the actual available development area for Scenario B, particularly when updated flood modelling is completed.

Additionally, further studies may be required to understand the capacity of the tributary to accommodate additional outfalls and runoff volumes from a fully developed Scenario B, given the modelled flood extents by GHD (2007) show some overtopping.

7.3 Growth Scenario C: North Waipapa Road Expansion

Minor Constraints

Growth Scenario C proposes medium density housing north of Waipapa Road and intensification in Kerikeri and Waipapa. This follows the existing transport links between Kerikeri and Waipapa in a similar fashion to Scenario B but with fewer constraints/difficulty in unlocking development areas, and the largest area of developable land amongst the scenarios.

Some recent development is already evident along the northern side of Waipapa Road – although at a lower density than proposed – and indicates a willingness (and ability) to develop this area. The "Connected Far Arc" is seen as a logical extension to existing development patterns in the region.

Some existing infrastructure has been constructed to support residential development, including a mix of pipework, channels and drains, and private stormwater ponds. Generally, the existing development discharges to existing natural features or Waipapa Stream to the north. To support additional development, the stormwater infrastructure would need to be increased, with additional stormwater pipe networks to support transport routes and medium density residential development. There may be opportunity to enlarge existing stormwater management areas and ponds, or alternatively sufficient area is available for new devices and stormwater controls.

The growth area falls mostly within Rural Production and Rural Living zones – areas that have historically been used for food/agriculture and large-lot residential uses. Facilitating medium-density residential development on these highly productive soils may trigger consenting and re-zoning complications through the National Policy Statement for Highly Productive Land (NPS-HPL) given its' purpose to ensure availability of such land now and for future generations.

Similarly to Scenario B, the topography north of Waipapa Road is favourable for managing and disposing of stormwater runoff, with a mix of relatively flat developable land, and natural contours towards Waipapa Stream. Flood modelling from GHD (2007) indicate flood extents are broadly constrained within the stream banks, and do not impede significantly on developable areas.

It is expected that new developments could utilise outfalls to the tributary subject to pre-development and post-development quality and quantity criteria.

7.4 Growth Scenario D: Kerikeri South Focused Expansion

Moderate Constraints

With concentrated growth proposed south of Kerikeri and additional commercial and industrial growth in Waipapa, Scenario D proposes the second largest developable area of all the options. This scenario is in line with the Proposed District Plan for growth – including high-demand areas for housing and business activities, and consultation indicates little opposition to growth and some developer interest in progressing this option.

Development towards the south of Kerikeri provides opportunity to construct a new "gateway" to the town allowing for renewal of more deprived areas. Currently zoned Rural Living under the District Plan, an increase in residential density would necessitate significant new infrastructure for managing stormwater runoff.

Key transport and access links are in place, but generally without stormwater infrastructure to support higher density living. Significant stormwater networks would be required to capture, manage and discharge runoff to Puketotara Stream to the west, or tributaries of the Wairoa Stream to the east. Current land parcels are generally smaller than for Scenario B, C, or E and will require landowners to work together to create workable solutions for stormwater management – which is likely to be a mix of above ground devices such as stormwater ponds, treatment swales and channel drains, or proprietary devices for infill development areas.

Existing stormwater networks are larger and more inter-connected than in other areas of Kerikeri, however there is likely to be limited capacity for additional runoff from higher density developments. Existing pipe networks will require investment into upgrades (at least in part) to manage growth.

Topography in the southern areas is generally higher in elevation, which may limit suitable outlet/discharge locations to existing water courses, and surface water protection zones to the Kerikeri River network may make water quality criteria more rigorous for developers (i.e. higher water treatment standards may be required). Modelled flood extents have minimal effect on the developable area and are relatively well defined/constrained to existing stream tributaries.

7.5 Growth Scenario E: Waipapa Focused Expansion

Moderate Constraints

Growth Scenario E focusses primarily on greenfield development in Waipapa, whilst allowing for brownfield (infill) development in accordance with the District Plan around Kerikeri. The area east of Waipapa has been identified for residential development and would support the growing commercial and industrial employment hubs.

The growth area falls mostly within Rural Living and Rural Production zones – areas that have historically been used for food/agriculture and large-lot residential uses. Facilitating medium-density residential development on these highly productive soils may trigger consenting and re-zoning complications through the National Policy Statement for Highly Productive Land (NPS-HPL) given its' purpose to ensure availability of such land now and for future generations.

Scenario E adopts a mix of areas proposed under Scenarios B and C, combining developable land parcels directly east of Waipapa, whilst attempting to minimise the coverage into flood extents and Wāhi Toitū areas. Despite this, some constraints remain for land directly east of Waipapa and south of Waipapa Road due to predicted flood extents, which could result in isolated pockets of development occurring and expensive stormwater infrastructure required around the fringes of floodplains.

Existing stormwater infrastructure east of Waipapa is very limited, and significant investment into capturing, managing, and treating stormwater would be required to support development, although this could be managed through above-ground devices such as swales and drainage channels, stormwater ponds or similar. Careful consideration should be given for any outlet and discharge locations south of Waiapa Road where flood extents are indicated, while land north of Waipapa Road appears to be less constrained by flooding.

Topography is supportive for development, with land either side of Waipapa Road either flat or generally grading towards existing watercourses. Land parcels are generally larger (fewer individual landowners than in other scenarios) and undeveloped, allowing for best-practice stormwater management options to be adopted without the space or capacity constraints normally experienced with infill developments.

7.6 Growth Scenario F: Kerikeri Northwest Expansion

Moderate Constraints

Growth Scenario F focuses on commercial and medium density growth near established centres of Kerikeri and Waipapa and greenfield growth to the Northwest of Kerikeri.

The growth area falls mostly within Rural Production zone – area that has historically been used for food/agriculture. Facilitating medium-density residential development on these highly productive soils may trigger consenting and re-zoning complications through the National Policy Statement for Highly Productive Land (NPS-HPL) given its' purpose to ensure availability of such land now and for future generations.

Existing stormwater infrastructure is very limited within the Scenario F area. Significant new infrastructure will be required to unlock large development areas. Flood mapping of the area indicates significant flood extents within the area (and Wāhi Toitū areas) which will reduce the actual available development area for Scenario F.

8 Waipapa Servicing

A high-level review of water servicing for Waipapa was undertaken based on information already available including the Waipapa WS and WW Servicing Options Report (Jacobs, 2022) and experience with other areas in New Zealand with rapid growth.

Table 18 reviews the servicing options for water. This indicates there is little benefit in a standalone WTP for Waipapa due to the need to upgrade the Kerikeri WTP in the short-medium term and the operational/compliance complexities with multiple plants. A combined WTP has significant economies of scale for both capital work and operational costs.

Table 19 reviews the servicing options for wastewater. A standalone WWTP option for Waipapa could mitigate the risk of exceeding future discharge consent limits (likely with blue sky growth) and allow the currently un-serviced area to be connected. If Scenarios B, C, E or F were selected, individual development WWTPs with discharge to land could be established as an interim measure with eventual connection to a larger scale WWTP. A Waipapa standalone WWTP comes with similar costs to upgrading the Kerikeri WWTP, similar new wastewater network requirements and significant time required to implement. Operating discharge to land schemes adds complexity and additional operational resources are required for multiple treatment plants.

A standalone WWTP for the existing un-serviced Waipapa residential and commercial area only could involve collecting existing septic tank effluent and treating in a small package WWTP with land discharge (expected cost range $5 - 10M).

Table 18: Waipapa Water Servicing Options.

Option	Cost	Resilience	Operational Complexity	Risks/Opportunities
Standalone Waipapa WTP	Less economies of scale for capital and operating costs Avoid the cost of upgrading the watermain to Waipapa	Likely to be individual source so less resilient but could retain existing connection to Kerikeri WTP	2 sites to operate and maintain	New site required with space for reservoirs Site would need to be designated
Individual sub-division servicing (up to 500 households)	Less economies of scale for capital and operating costs	Likely to be individual source so less resilient. Groundwater has limited availability, potential for contamination	Multiple supplies to operate, maintain and sampling for compliance with DWSNZ	If retained in private ownership, FNDC may be required to take over at some future point
Upgrade existing Kerikeri WTP	Some existing assets at end of life or not performing	Options for source water 1 feed pipeline to Waipapa	1 site to operate and maintain	Limited space current site and slopes

Table 19: Waipapa Wastewater Servicing Options.

Option	Cost	Resilience	Operational Complexity	Risks/Opportunities
Standalone Waipapa WWTP with discharge to land	Scale is too large for package plant High cost of purchasing and consenting new site - large land area required 20-40 ha (approx. $13 – 27M) Avoids the cost of upgrading the rising main to Kerikeri WWTP	Likely similar system to Kerikeri WWTP Reserve land area needed Reduces load on Kerikeri WWTP and Waitangi Wetlands	Land management required e.g. cut and carry for dry stock	Consenting could take a long time Neighbours may not want WWTP or irrigation system nearby Large land area required approx. 20-40 ha
Individual sub-division servicing (up to 500 houses) with discharge to land	Proven package WWTPs with discharge to land (approx. 5 ha) at this size Avoids the cost of upgrading the rising main to Kerikeri WWTP	Simple system to operate Reserve land area needed Reduces load on Waitangi Wetlands	Land management required e.g. cut and carry for dry stock Households retain a septic tank or have a LPS pump.	Discharge to land system uses up area suitable for housing If retained in private ownership, FNDC may be required to take over at some future point Could be an interim stage before connection to larger WWTP
Upgrade existing Kerikeri WWTP with discharge to Waitangi Wetlands	Modern WWTP in good condition, space available to duplicate process Economies of scale for operation and capital costs	Larger WWTP has more process/ equipment redundancy	Operators familiar with current process	Wetland load capacity reduced (via consent conditions) due to effects Stakeholder views on wetlands discharge at consent renewal

9 Cost Estimates

9.1 Assumptions

The following optioneering cost estimate values have been prepared for the water treatment upgrades, wastewater treatment Plant, and the water/wastewater network upgrades to compare the different scenarios. The estimated costs included in this report are high-level, indicative assessments that have been developed solely for the purpose of comparing and evaluating the scenarios.

These assessments are generally considered a Class 5 estimate with a level of accuracy of -30% (P5) to +50% (P95), with elements being a Pre-Class 5 (Rough Order of Cost Estimate). For the totals below we have added a funding risk/management reserve to take the costs to the P95 level for the upper range.

Out estimate of costs are based on the following working assumptions:

- The works will be procured under competitive bid scenario via specialist contractors.
- Unrestricted access to carry out the works.
- The works will be undertaken under normal working hours.
- The works will be carried out by a Single Main Contractor. No allowance has been made for multiple contracts.
- Higher market interest and competition is expected due to the economic slowdown.
- Assumes site available with reasonably flat land and without significant ground improvement or similar costs.
- Land purchase is excluded.

9.2 Water Treatment Upgrades

Although the site for the WTP, existing or new, has not been determined, costs are likely to be similar, although this does increase the level of uncertainty. A new site may need additional services and site works, in addition to land acquisition costs but may be easier to construct on a flat site with good ground conditions and avoiding the need to work around existing assets. The following are the estimated cost ranges for the different scenarios with all having expanded to a 6,000 m^3/d capacity WTP in the medium-term.

Table 20: Water Treatment Cost Ranges.

Scenario	Indicative Timing	Description	Cost Range	Total
Base	Medium-term	Raw Water Conveyance - 9,000 m^3/d capacity pipeline from intersection of SH1. 2 km. 6,000 m^3/d total clarification capacity (cost reduction of approximately 25% if the existing clarifier is retained). 3 no. filters, 6,000 m^3/d total capacity 7,260 m^3/d total capacity. Upgrade installation reusing existing UV units. 2 x 1,650 m^3 reservoirs assumed. At least one would need to be off the WTP site due to a lack of space.	$17 - 37M	$23 - 49M
	Long-term	Additional reservoir capacity	$6 - 12M	
Blue Sky	Medium-term	Same as Base above	$17 - 37M	$34 - 71M
	Long-term	Capacity upgrade to 9,000 m^3/d Additional reservoir capacity	$5 - 10M $12 - 24M	

9.3 Wastewater Treatment Plant

The table below outlines the costs to upgrade the existing WWTP under the base and blue sky scenarios. It is assumed sufficient space is available at the WWTP site and most existing processes will be duplicated to a similar design and performance.

Table 21: Wastewater Treatment Cost Ranges.

Scenario	Indicative Timing	Description	Cost Range	Total
Base	Medium-term	SBRs (3+4), UV disinfection and screw press	$9 - 20M	$10 - 22M
	Long-term	Inlet works upgrade	$1 - 2M	
Blue Sky	Medium-term	Same as Base above	$9 - 20M	$18 - 38M
	Long term	SBRs (5+6) Inlet works upgrade	$9 - 18M	

9.4 Water and Wastewater Network

Using the pipe lengths and pump station capacities identified in the water and wastewater network modelling, capital cost estimates were developed to compare the scenarios as outlined below.

Table 22: Water Network Upgrades and New Infrastructure Cost Estimate

Scenario	Description	Water Network Cost Range
A - Proposed District Plan Implementation	Watermain upgrades – 2,453 m Upgrade booster pumps at Kerikeri reservoir and Waipapa reservoir	$3 - 6M
B – South Waipapa Road Expansion	Watermain upgrades – 7,537 m Upgrade booster pumps at Kerikeri reservoir and Waipapa reservoir	$10 - 20M

Scenario	Description	Water Network Cost Range
C – North Waipapa Road Expansion	Watermain upgrades – 7,281 m Upgrade booster pumps at Kerikeri reservoir and Waipapa reservoir	$9 – 20M
D – Kerikeri South Focused Expansion	Watermain upgrades – 3,262 m Upgrade booster pumps at Kerikeri reservoir and Waipapa reservoir	$4 - 9M
E – Waipapa Focused Expansion	Watermain upgrades – 7,281 m Upgrade booster pumps at Kerikeri reservoir and Waipapa reservoir	$10 - 21M
F – Kerikeri Northwest Expansion	Watermain upgrades – 3,168 m Upgrade booster pumps at Kerikeri reservoir and Waipapa reservoir	$4 - 8M

Table 23: Wastewater Network Upgrades and New Infrastructure Cost Estimate

Scenario	Description	Wastewater Network Cost Range
A - Proposed District Plan Implementation	Upgrades to existing network – 3,389 m Pump upgrades - 4	$3 – 7M
B – South Waipapa Road Expansion	Upgrades to existing network – 3,258 m Pump upgrades – 6 New network pipes – 4,051m New network pump stations - 5	$16 – 34M
C – North Waipapa Road Expansion	Upgrades to existing network – 3,325 m Pump upgrades – 6 New network pipes – 4,865m New network pump stations - 5	$16 – 33M
D – Kerikeri South Focused Expansion	Upgrades to existing network – 1,513 m Pump upgrades – 4 New network pipes – 1,797m New network pump stations - 2	$7 – 15M
E – Waipapa Focused Expansion	Upgrades to existing network – 3,265 m Pump upgrades – 6 New network pipes – 5,373m New network pump stations - 6	$24 – 51M
F – Kerikeri Northwest Expansion	Upgrades to existing network – 3,317 m Pump upgrades – 3 New network pipes – New network pump stations - 4	$15 – 33M

10 Conclusions

More WTP and reservoir capacity is needed for all scenarios. Raw water sources are available to meet expected demand. With blue sky growth, further water treatment plant capacity and additional reservoir capacity is needed in the long term.

For the WWTP, more capacity, including the third and fourth SBRs, is needed for all scenarios. With blue sky growth additional SBR capacity is needed in the long-term. The discharge consent expires in 2036 around the time that the existing flow limit for the discharge to the wetlands is reached under the base scenario. Blue sky growth would result in the current flow limit being exceeded prior to consent expiry. If the flow limit can be increased with no increase to nutrient load, discharge capacity is available over the long term for the base scenario. Under the blue sky growth, the discharge capacity could be exceeded towards the end of the 30 year period.

A high-level review of water servicing for Waipapa indicates there is little benefit in a standalone WTP for Waipapa. For wastewater, a standalone WWTP option for Waipapa could mitigate the risk of exceeding future discharge consent limits likely with blue sky growth and allow the currently un-serviced area to be connected. If Scenarios B, C, E or F were selected, individual development WWTPs could be established as an interim measure with eventual connection to a larger scale WWTP. A Waipapa standalone WWTP to service new growth areas is expected to have similar costs to upgrading the Kerikeri WWTP plus significant time required to implement.

The base Scenario A requires some network upgrades to allow for the infill growth over time. Scenarios B, C, E and F require significant new water and wastewater network infrastructure to service the new areas along with upgrades to existing infrastructure. Much of this infrastructure needs to be installed ahead of development due to the terrain and to provide connectivity. Scenario D requires less new infrastructure due to the proximity to the existing water and wastewater networks in Kerikeri.

Scenario C has the least constraints for stormwater with the topography north of Waipapa Road being favourable for managing and disposing of stormwater runoff, with a mix of relatively flat developable land, and natural contours towards Waipapa Stream. Scenarios B, D, E and F have moderate constraints for stormwater with more existing developed areas and existing networks. The base Scenario A has more constraints as new development will need to cater for stormwater on-site and manage increases in runoff quantity and any detrimental quality effects. Typically, stormwater ponds/basins or wetlands would be provided as part of a treatment train prior to discharging to an existing watercourse. This will likely require some developers and smaller landholders to work together to ensure suitable areas are set aside for managing stormwater, and a suitable outfall identified.

A

Appendix A – Future Demand Sensitivity Testing

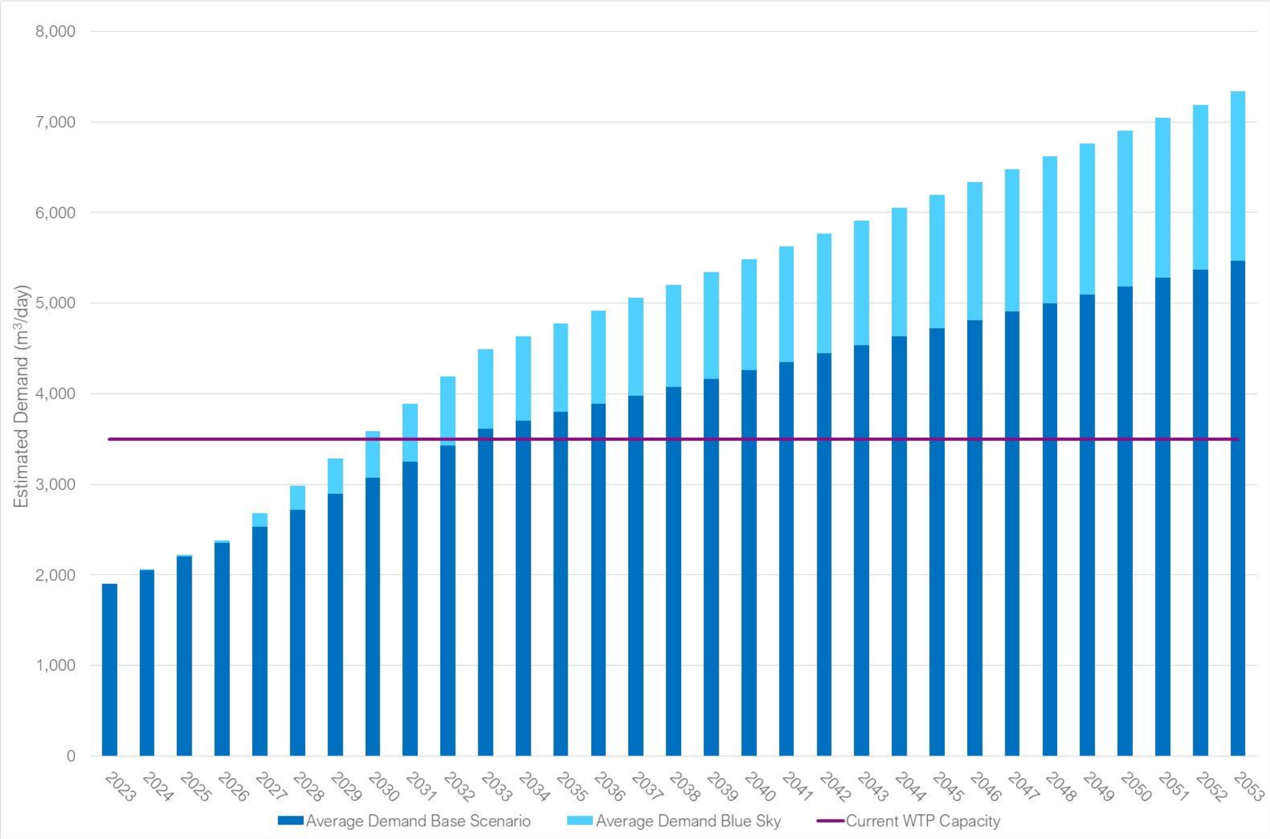


Figure 10: Future Average WTP Demand with Four Persons Per Household.

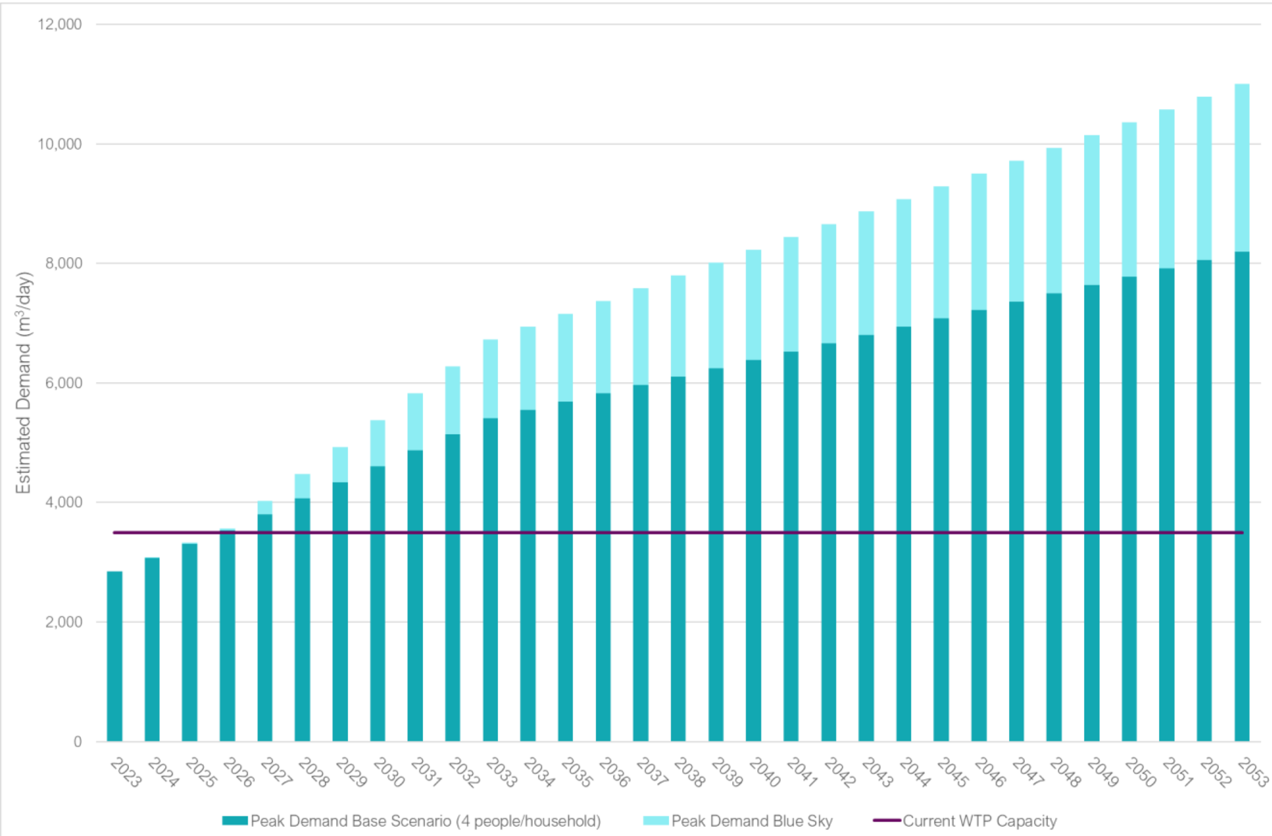


Figure 11: Future Peak WTP Demand with Four Persons Per Household.

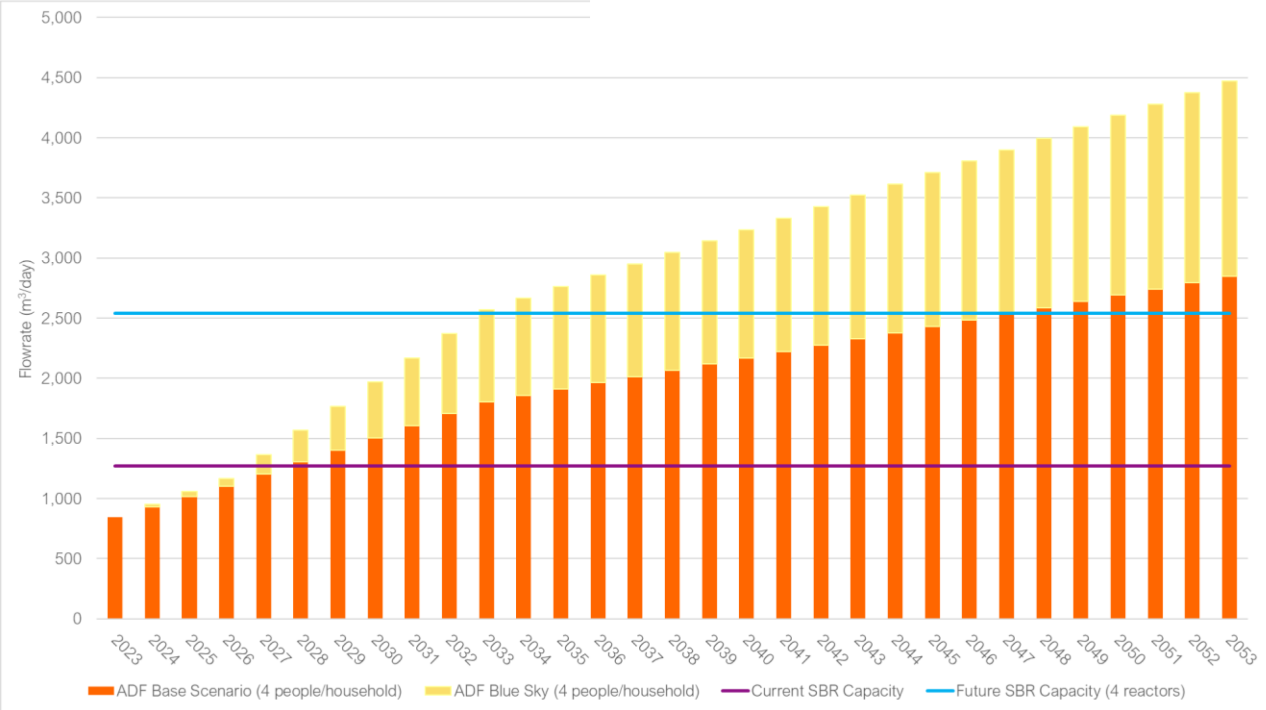


Figure 12: Future Average WWTP Demand with Four Persons Per Household.

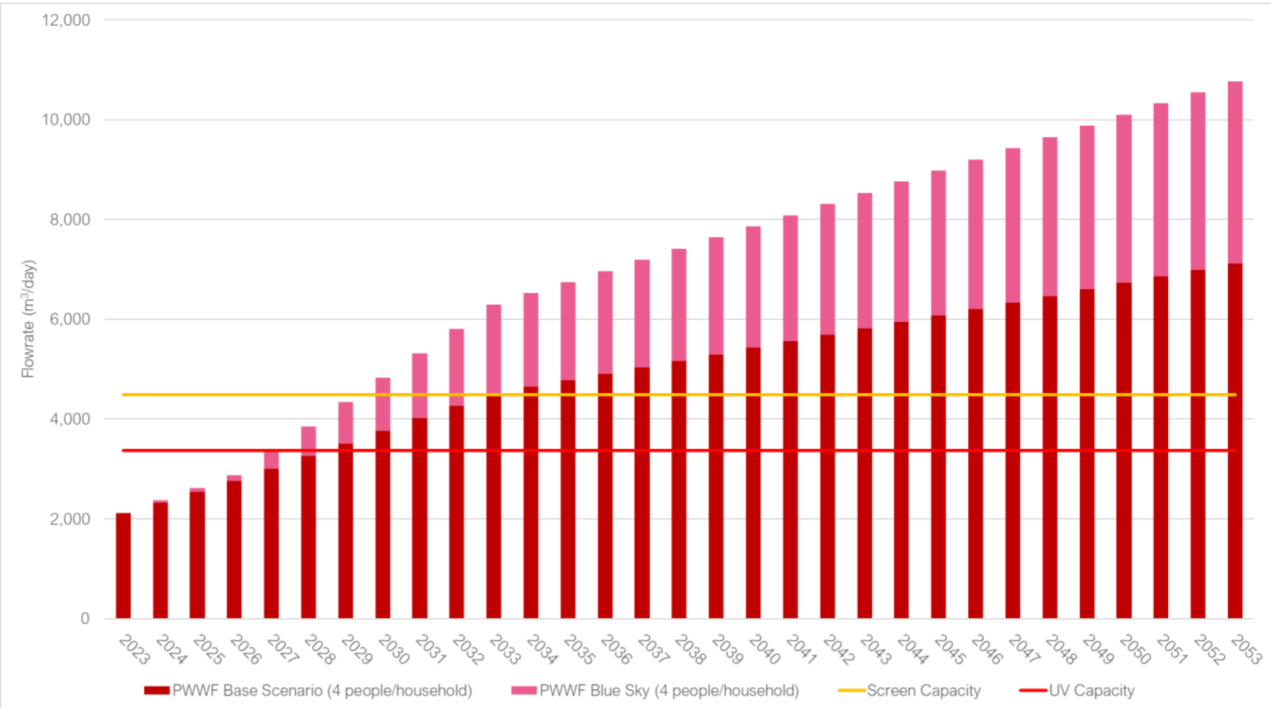


Figure 13: Future Peak WWTP Demand with Four Persons Per Household.