Wellington Water

# WCC's Spatial Plan - Preferred Growth Scenario

## Three Waters Assessment

Our water, our future.

# Document information

## Quality Assurance

**The content of this report has been reviewed and prepared with the expert advice of Wellington Water's Chief Advisers and Three Waters Decision Making Committee.**

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## Revision history

| Date | Version number | Description of change |
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| 20 September 2019 | 0.1 | Draft for Discussion |
| 15 November 2019 | 2.0 | Feedback from WCC Officers |

# Executive Summary

This study provides information for the Wellington City Council Spatial Plan and aims to assist with understanding long-term growth demands outlined in Wellington City Council's (WCC) preferred growth scenario (July, 2019) and the potential impacts to three waters infrastructure.

Wellington City Council's Preferred Growth Scenario is for the city to remain compact, with significant support for intensification in and around suburban centres and high growth in the Central City. A new population growth forecast over the next 30 years estimates an additional 50,000 to 80,000 people.

It is understood that the development plan of the Spatial Plan will assess the preferred growth scenario against a number of criteria to determine the suitability of enabling the growth areas through changes to the District Plan. These criteria include the environment, natural hazards, transport, community facilities and other relevant matters. Therefore, it is possible that while a suburb may have significant water infrastructure constraints, it may be beneficial on a number of other criteria to be identified for intensified growth.

The potential implications for three waters infrastructure are investigated in this report based on the best information available at the time of writing.

The approach to this study has been to take a city-wide level of impact to understand the potential demands on three waters infrastructure based on the current projected growth scenario.

Enabling urban growth will require investment in existing infrastructure as well as new infrastructure required specifically for growth. Each suburb that has been identified for growth has been assessed for the implications to water services and summarised into this study.

The existing networks were found to be operating below the expected levels of service that were defined for the study (see Figure 3 in Section 2.2 of the report).

New or proposed upgrades are identified for system-wide assets in a 30-year outlook, such as:

- Upgrades to each of the three existing wastewater trunk network including treatment plants at Moa Point, Karori Wastewater Treatment Plant and the Porirua Wastewater Treatment Plant (Joint Venture with Porirua City Council);
- Upgrade of wastewater pipes and water supply mains to cater for additional population;
- New wastewater storage tanks for the city – further investigation is needed to determine the number, size and location of the tanks(s);
- New and/or upgraded reservoirs in the outer suburbs to increase storage for drinking water supply, particularly in the northern and eastern suburbs. The planned Moe-i-Te-Ra Reservoir will benefit future demand in the central suburbs;
- Provision of stormwater runoff treatment especially in medium and high density growth areas;
- For flood protection and managing stormwater, the proposed options are limited to increasing capacity via pipes and pumps, even though the likely options would be a mix of blue-green infrastructure and planning controls.

The proportion of cost between levels of service for existing populations and future population was not assessed, including cost of renewals – a separate study would be needed to determine this.

In addition to the proposed upgrades, an associated cost band was determined for each of the 22 growth areas. For comparative purposes, the results were:

- Cost Band A, B, C and D $10M -$100M, applicable to 7 suburbs: Crofton Downs, Lyall Bay, Ngaio, Aro Valley, Mount Victoria, Berhampore, and Brooklyn.
- Cost Band E $100M -$200M, applicable to 10 suburbs: Kelburn, Khandallah, Kilbirnie, Miramar, Mount Cook, Newlands, Newtown, Pipitea, Thorndon, and Wellington Central
- Cost Band F $200M -$550M, applicable to 5 suburbs: Island Bay, Johnsonville, Karori, Tawa, and Te Aro.

The comparatively high costs associated with Cost Band F suburbs, were due to the challenges for:

- Karori, which would require a new or extensive upgrades to the wastewater treatment plant;
- Island Bay and Johnsonville, which would each require extensive flood protection; and
- Tawa and Te Aro, which need multiple infrastructure upgrades for each of the three waters.

The study strongly recommends that further detailed investigations would be needed to determine viable options, feasibility, and design of any potential upgrades.

The priority and timing to progress any further detailed investigative studies would need to be determined with WCC. Prioritisation decision-making is likely to give consideration to a number of factors such as, the final growth scenario for WCC, scale of an issue/constraint, strategic policy directives, environmental factors, and access to adequate funding.

The study was prepared in 8 weeks. In order to meet this short deadline, three key decisions were made on Levels of Service, Level of Investigation, and Cost Estimation Methodology.

The Level of Service (LOS) and performance measures were determined. These levels of service are described in relation to our four key challenges being growth, sustainable water, fresh and coastal water quality, and climate change and carbon reduction.

The Level of Investigation used for any upgrade options were assessed based on existing information and the projected populations were not analysed with our hydraulic models.

As an example, reservoir storage volumes to support growth in each growth area were calculated, but no attempt has been made to identify if these volumes will be in a single zone or shared reservoir, or where the exact location of the storage would be.

Similarly for wastewater, overflow storage volumes needed to support growth for each network were estimated, but the number of storage tanks or locations were not assessed.

Therefore the options are considered “pre-feasibility”.

Because the WWL Cost Estimation Manual (Revision D) is clear that a confidence at the 95% level can only be provided for Level One or higher designs, we needed an alternative way to provide the likely scale of investment.

The alternative approach, is to cost each pre-feasibility option based on the WWL Cost Estimation Method for a Level One concept and then sum the costs for all options across all three waters. This sum would then be presented as a Cost Band, which represents the scale of investment needed to support growth in each of the 22 growth areas. The summed cost for each water would be shown as a percentage of the cost band. The Cost Bands used are:

- Band A, $10 to $25M
- Band B, $25M to $50M
- Band C, $50M to $75M
- Band D, $75M to $100M
- Band E, $100M to $200M
- Band F, $200Mto $550M

The investment needed in three waters infrastructure to support growth in each area is shown in the table below:

| Growth Area | Population Growth | Investment Cost Band | Cost range |
|---|---|---|---|
| **Crofton Downs** | 300 | A | $10 to $25M |
| **Lyall Bay** | 500 | A | $10 to $25M |
| **Ngaio** | 1,300 | B | $25 to $50M |
| **Aro Valley** | 1,100 | C | $50 to $75M |
| **Mount Victoria** | 200 | C | $50 to $75M |
| **Berhampore** | 1,600 | D | $75 to $100M |
| **Brooklyn** | 1,800 | D | $75 to $100M |
| **Kelburn** | 1,900 | E | $100 to $200M |
| **Khandallah** | 2,800 | E | $100 to $200M |
| **Kilbirnie** | 1,300 | E | $100 to $200M |
| **Miramar** | 800 | E | $100 to $200M |
| **Mount Cook** | 2,500 | E | $100 to $200M |
| **Newlands** | 2,400 | E | $100 to $200M |
| **Newtown** | 2,900 | E | $100 to $200M |
| **Pipitea** | 2,100 | E | $100 to $200M |
| **Thorndon** | 1,300 | E | $100 to $200M |
| **Wellington Central** | 2,900 | E | $100 to $200M |
| **Island Bay** | 3,500 | F | $200 to $550M |
| **Johnsonville** | 5,700 | F | $200 to $550M |
| **Karori** | 6,600 | F | $200 to $550M |

| | | | |
|---|---|---|---|
| **Tawa** | 5,300 | F | $200 to $550M |
| **Te Aro** | 17,600 | F | $200 to $550M |

The next steps following this study would be for the information in this report to be used a layer of information in the development of the WCC Spatial Plan to help inform the suitability and cost of growth in each of the proposed 22 growth areas.

Once the Spatial Plan is adopted, more detailed investigations would be needed to determine preferred solutions, costs and a programme for delivery for three waters infrastructure.

# Table of contents

# List of figures

# Abbreviations

| Abbreviation | Meaning |
|---|---|
| AC | Asbestos cement |
| CBD | Central business area |
| District Plan | Wellington City Council District Plan |
| DMA | District Metered Area |
| I&I | Inflow of stormwater and infiltration of groundwater |
| km | Kilometre |
| L/s | Litres per second |
| m | Metre |
| M | Million |
| ML | Megalitres. 1 ML equals 1,000,000 litres |
| mm | Millimetre |
| NPS-FM | National Policy Statement for Freshwater Management |
| NPS-UDC | National Policy Statement for Urban Development Capacity |
| PCC | Porirua City Council |
| PRV | Pressure reducing valve |
| Regional Plan | Natural Resource Management Plan for the Wellington Region |
| TWL | Top water level |
| WCC | Wellington City Council |
| WWL | Wellington Water Ltd |
| WWTP | Wastewater Treatment Plant |

# 1. Purpose

The purpose of this report is to provide information in regards to the provision of water supply, wastewater and stormwater services as they relate to urban growth in Wellington City. Wellington City Council (WCC) is forecasted to grow by approximately 80,000 more residents over the next 30 years, according to Statistics NZ's high growth population scenario.

To decide on the best way to accommodate this growth, Wellington City Council commissioned the 'Planning for Growth' project. Planning for Growth responds to the National Policy Statement on Urban Development Capacity (NPS-UDC) which requires the Council to provide sufficient capacity to meet residential demand over the short, medium and long term.

The Planning for Growth project developed a short list of growth scenarios and has undertaken public consultation to determine the preferred scenario of where zoning provisions should be revised to encourage future urban growth. This project resulted in WCC's Preferred Growth Scenario for the city to remain compact, with significant support for intensification in and around suburban centres and some growth in the Central City.

This report by Wellington Water Ltd (WWL) provides information to support the development of the WCC Spatial Plan. Contained in this report is information on the ability of the existing three water services to support growth in the 22 areas identified in Preferred Growth Scenario. It also identifies pre-feasibility level upgrades that are needed where the existing capacity for providing water supply, wastewater services and stormwater protection is a constraint on growth. This information will be incorporated into the WCC Spatial Plan to help decision-making on the revision of the Wellington City Council District Plan (District Plan) to provide for projected urban growth.

# 2. Background

Wellington City Council is planning for how their city will grow to accommodate projected population increases. This includes providing suitable zoning and planning rules and the provision of adequate infrastructure, such as roads and water services. Water services include the delivery of water for drinking, fire-fighting, commercial and sanitary needs, the collection, conveyance and treatment of wastewater, treatment of contaminated stormwater and protection from flooding. These services are referred to as the three waters.

Planning for population growth is not only a good idea, it is a requirement under the NPS-UDC. One of the ways WCC is responding to this requirement is through the development of the WCC Spatial Plan.

## 2.1. WCC Spatial Plan

Spatial planning is, at its most basic level:

> *A visual illustration of the intended future location, form and mix of residential, rural and business areas, along with the critical transport and infrastructure required to service those areas and any relevant environmental constraints*[1]

The WCC Spatial Plan will implement the WCC Preferred Growth Scenario by incorporating aspects (visual layers) that must be managed to achieve the desired distribution and density of urban growth. This includes aspects such as the provision of parks, schools, community centres, commercial areas and the roads, utilities and other services that make a city liveable. The management of these layers in the spatial plan includes providing information on the costs of these services.

[1] As adapted from Boffa Miskell Limited 2016. *Spatial Planning: Opportunities and Options for Metropolitan Wellington*. Report prepared by Boffa Miskell Limited for the Local Government Commission and the Ministry for the Environment. 2010 *Building Competitive Cities: Reform of the Urban and Infrastructure Planning System - A Discussion Document*, p.72.

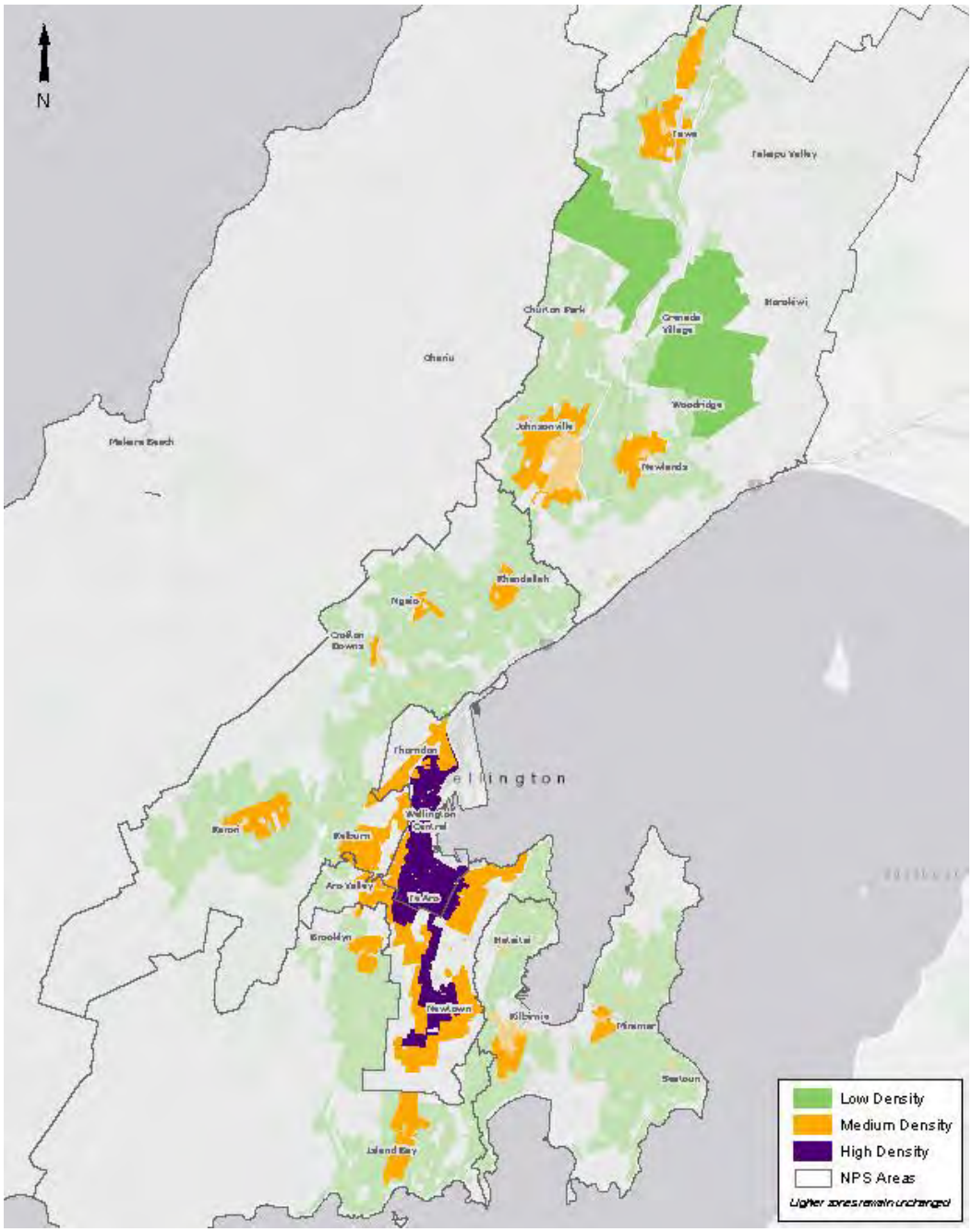


**Figure 1 - Preferred Growth Scenario for Wellington City[2]**

Specific to the provision of three water services, costs can vary across proposed growth areas depending for example if there is not available capacity in existing reservoirs, if the area is serviced by undersized wastewater pipes or if the suburb is prone to flooding. This type of information is needed in the spatial plan to inform decision-making about zoning, infrastructure and investment.

[2] Image Source: BECA. 2019. Wellington City- Planning for Future Growth. Preferred Scenario Development. Prepared for Wellington City Council. July 2019

WCC's schedule for the development of the Spatial Plan is shown below:

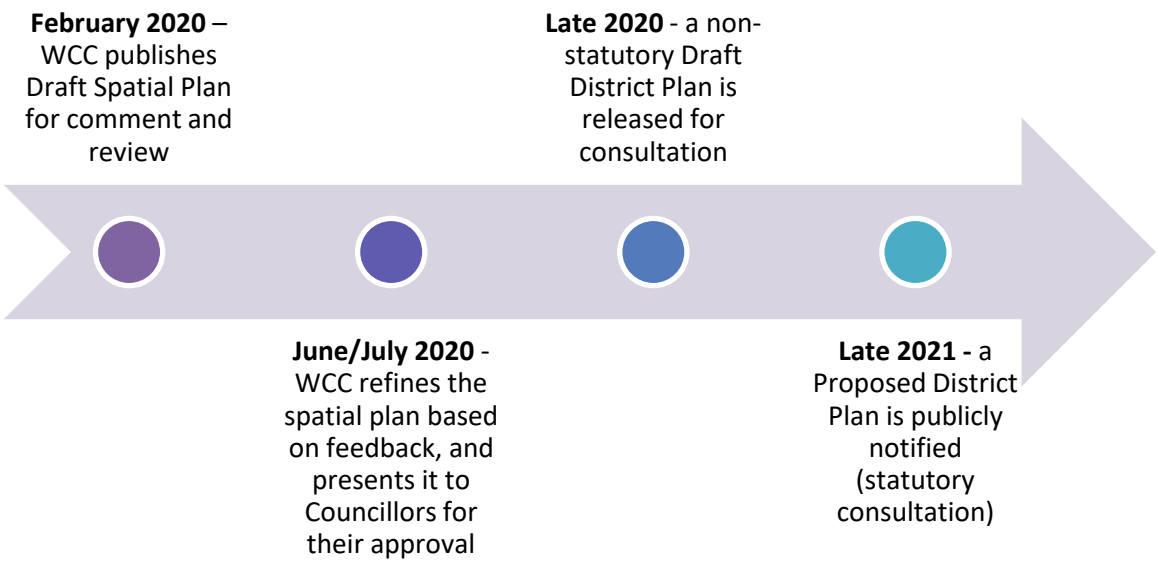


**Figure 2 – Timeline for the WCC Spatial Plan**

## 2.2. Three Waters Strategic Direction

Wellington Water was created in 2014 to manage the water supply, wastewater and stormwater services for Greater Wellington Regional Council, Upper Hutt, Hutt, Porirua and Wellington city councils. Our whakatauki is:

*He wai, he wai*
*He wai herenga tāngata*
*He wai herenga whenua*
*We waiora*
*He wairua*

*Tis water, tis water*
*Water that joins us*
*Water that necessitated the land*
*Soul of life*
*Life forever*

Wellington Water does not own any drinking water, stormwater, wastewater or bulk water assets. Nor do we set policies or control rates or user charges. These functions remain with our client councils.

The company philosophy is to manage the three water services to achieve three outcomes - safe and healthy water, respectful of the environment and resilient networks that support our economy. We assess service performance and recommended investments across 12 service goals.

We acknowledge that the performance in each of these service goals is variable across the region and will require decades of investment to meet the desired levels of service. We also understand that achievement of our strategic outcomes is a long term endeavour that will require regular adjustment as policy, standards and levels of service change over time. For

example, in the recent past we were able to manage and design stormwater systems for a level of service that prevented nuisance flooding during average rainfall events. Today, we must consider the effects of climate change and planning direction to manage flood risks from 1 in 100 year flood events. We also now need to consider the effects of wastewater and stormwater on the water quality of the receiving environment.

Looking forward, we have identified four key challenges for managing and planning investment:

- Servicing growth
- Providing a sustainable water supply
- Maintaining or enhancing water quality of the receiving environment
- Planning for the effects of climate change and reducing carbon emissions.

WCC and the wider region is experiencing unprecedented growth which is putting pressure on networks that already have identified constraints. An increase in population will increase water consumption (based on current demand) and increase wastewater volumes. A significant level of investment is needed over the next 30 years to accommodate projected growth and respond to current performance deficiencies. Growth brings a range of opportunities for innovation that can increase service goal performance over time.

In regards to a sustainable water supply, the regional demand of 374 litres per person per day is high by international standards. Given that WCC water is supplied by a regional water source, if we don't reduce demand by around 10 percent, then we will need to start planning for an additional water source and/or regional storage before 2030. This would not only be expensive, but it would also involve numerous environmental hurdles.

Achieving environmental water quality targets set by National Policy Statement for Freshwater Management (NPS-FM) is one of the most complex issues that we will face over the next 30 years. Deficient wastewater networks (overflows and leaky networks) and stormwater runoff contribute to high levels of contamination across our urban environments.

To respond to climate change, we have already incorporated the predicted effects of climate change into our hydraulic models for stormwater. In particular, our level of service for stormwater is the protection of habitable floors from flooding during a 1 in 100-year rainfall event plus climate change (increased rainfall and sea level rise). We will also need to consider activities and investments to help achieve New Zealand's 2050 carbon zero target.

The levels of service in this report that were used to inform the WCC Spatial Plan focus on providing adequate capacity in the three water networks to support growth. Upgrades identified for wastewater and stormwater also address the evolving need to manage these networks for their effects on the water quality of our streams and coastal waters, and predicted flooding from stormwater during a 1 in 100-year event including climate change.

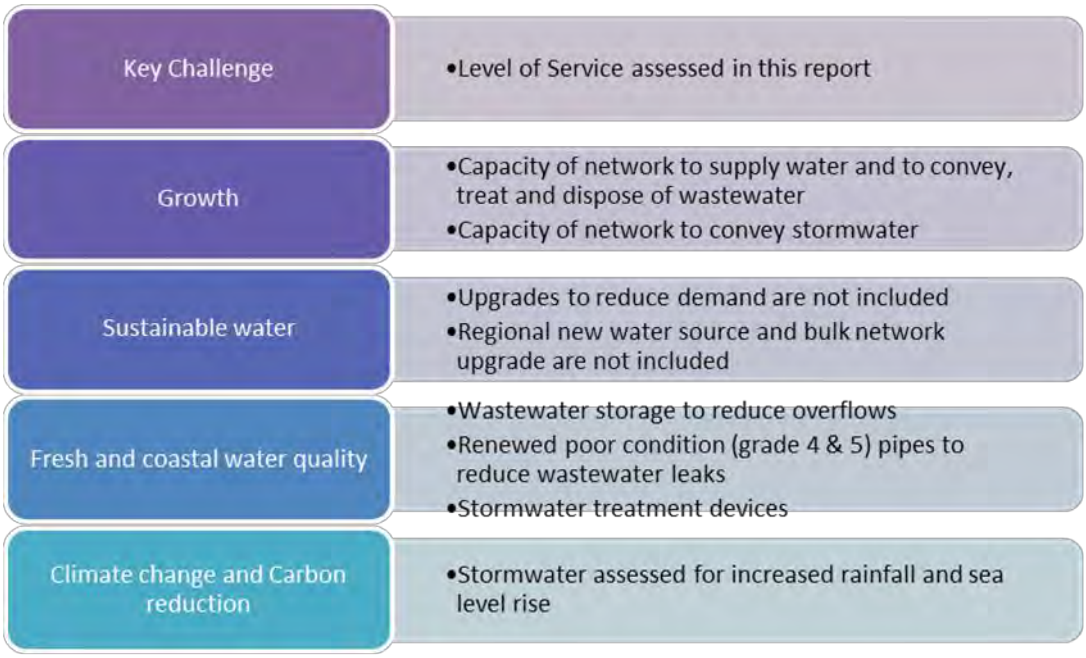


**Figure 3 – Four key challenges and Levels of Service for the management of three waters**

## 2.3. Strategic Context of this Report

This report by WWL provides information to inform the WCC Spatial Plan by identifying upgrades to three-waters infrastructure that would be needed to support development in each of the 22 growth areas identified in the Preferred Growth Scenario, so that the:

- value of water supply, wastewater management and stormwater protection is incorporated into the decision-making that enables urban development over the next 30 years
- constraints in the existing performance of the three water networks that services the existing population can be understood
- pre-feasibility costs required for infrastructure upgrades can be used as a comparative analysis of the suitability and costs associated with each of the 22 growth areas.

Once the WCC Spatial Plan is finalised, more detailed investigations are needed to finalise the infrastructure options needed to service this growth. These options would need to be funded and planned for in Wellington City's Long Term Plan and Infrastructure Strategy.

## 2.4. The Three Water Networks

### 2.4.1. Water supply network

A safe and reliable water supply is essential to public health and the social and economic development of a city. The water that is delivered to Wellington is sourced from the headwaters of the Te Awakairangi/Hutt River, The Wainuiomata and Orongorongo catchments and the Waiwhetu aquifer. It is delivered via a regional bulk water system that supplies water to Wellington, Hutt, Upper Hutt and Porirua cities.

The bulk water is treated and delivered to local reservoirs that are positioned at elevations that can provide adequate water pressure for an uninterrupted reticulated supply for drinking water, domestic and commercial use, fire-fighting and emergency storage.

At the current level of per capita water use, a new water supply source for the region will be required in approximately 2040. However, the ability to take additional volumes of water from our rivers and aquifers is limited by new provisions in the Natural Resource Management Plan for the Wellington Region (Regional Plan).

### 2.4.2. Wastewater network

After the water delivered to houses and businesses has been used, it becomes wastewater. This wastewater needs to be safely conveyed through reticulated networks to the wastewater treatment plants where it is treated and disposed of in an appropriate way to minimise risks to human and environmental health.

Wastewater in Wellington is treated at one of three treatment plants – Moa Point Wastewater Treatment Plant (WWTP) by Strathmore, Western WWTP in Karori or the Porirua WWTP near Titahi Bay.

During heavy rain events, stormwater, groundwater, and even seawater can enter the wastewater network resulting in overloading the capacity of the wastewater networks and overflow to the environment. These overflows are exacerbated by cross connections where stormwater downpipes are incorrectly connected into the wastewater system.

The pipes that make up the wastewater network are aging and prone to leaking and overflowing of untreated wastewater in rain events. Network capacity constraints and declining condition, coupled with population growth, and sea level rise may result in increased overflows and contamination of receiving waters, social and cultural offense and risk to public health. The level of service for the wastewater network, which is currently based on managing overflows during rain events rather than preventing leaks during dry weather, may not be sufficient for achieving the desired water quality in Wellington's streams under the NPS-FM.

### 2.4.3. Stormwater network

Stormwater services are essential to the protection of public health impacts and property damage as rainfall needs to be drained away to prevent damp ground and the various illnesses that can develop affecting people and property.

Stormwater pipe networks historically were designed to carry away only the low to medium intensity rainfall events. When the storm intensity exceeds this pipe design capacity then water flows overland and low lying residences and businesses can be at risk of flooding. Increased urban development can result in increased flood risks when more water runs off the land instead of soaking into undeveloped areas and where overland flow paths are altered or restricted.

As stormwater picks up sediment and contaminants, such as petrochemicals, zinc, copper and lead, it can result in harmful water quality where it discharges to streams or coastal waters. Stormwater from greenfield development in particular, can result in excessive discharges of sediment.

# 3. Project scope, assumptions and methods

The following sections describe the scope of this report and the project assumptions and methods.

## 3.1. Project Scope

An assessment of the three waters infrastructure was prepared for use as an information layer in the WCC Spatial Plan. The scope was limited to:

1. identification of constraints in the capacity of the water supply, wastewater networks and stormwater systems based on previous investigations, and
2. cost bands that illustrate the investment needed for pre-feasibility level infrastructure upgrades needed within each of the 22 growth areas.

Some constraints are existing, such as where there is insufficient water storage, overflows of wastewater or flooding of habitable floors. Other constraints are predicted based on projected population growth.

In general, options to alleviate capacity constraints were identified for this report at a pre-feasibility level. This means that the proposed infrastructure upgrades identified as needed to provide adequate levels of service were not incorporated into hydraulic models and tested for practicality or feasibility.

Nonetheless, the investment cost bands needed for the pre-feasibility level infrastructure upgrades identified for each growth area should provide a useful information layer in the WCC Spatial Plan to help compare the suitability and cost of growth across each of the 22 areas identified in the Preferred Growth Scenario.

Projects funded in the LTP within the next 10 years such as Moe-i-te-Ra, Brooklyn and the Omāroro Reservoirs have not been included in the estimates.

Excluded from the project scope were:

1. Assessments of infrastructure requirements needed to service greenfield areas
2. Cost estimates for specific infrastructure upgrades. Instead cost bands are provided to indicate the sum of all upgrades needed to support growth within each of the 22 growth areas
3. Preliminary or detailed design and site investigations. All upgrade options were identified at a pre-feasibility level only
4. Upgrades associated with the regional bulk water network and source supply
5. Upgrade of the Wellington City Interceptor
6. Ongoing renewals that don't include upgrades, other than renewals of poor or very poor condition (grade 4 and 5) wastewater pipes
7. Site investigation to confirm GIS/asset data, optimisation of options, performance testing, and the timing or staging of options
8. Operational (Opex) costs after construction is complete that are needed for matters such as staffing, maintaining, monitoring , depreciation, insurance and reporting
9. Additional exclusion specific to water supply, wastewater or stormwater are detailed in the following sections.

## 3.2. Assumptions for assessing existing and future water supply services

Hydraulic models are available for most of the water zones that service WCC. Where available, these models were used to identify existing areas that have low water pressure. Excluded from

the assessment for this report was the use of the hydraulic models to assess the performance of potential upgrades needed to support urban growth (optioneering). Within the available time frame for this report, it was not possible to use the models in this way.

As an alternative, a broad-brush approach was used to identify water supply trunk mains that would need to be upgraded based on calculations to provide suitable water pressure at the centre of the proposed increased population within each growth area.

In addition, this assessment of water supply to provide information for the WCC Spatial Plan did not consider the potential implications of the growth on upgrades needed to the regional bulk water supply (source of water, treatment plants, and bulk supply pipelines).

The amount of additional water storage (reservoirs) that would be needed to inform the WCC Spatial Plan was assessed based on the storage requirements per person in the Regional Standards for Water Services (2019), taking into account the existing (surplus or deficit) storage. Where a larger or new reservoir was required, a nominal length of main to service this reservoir was included.

Where calculations indicated additional storage would be required, further investigations would need to confirm the actual capacity and reservoir location, if the Preferred Scenario were enabled through zoning provisions in the District Plan. The results are sensitive to the assumptions used for number of existing dwellings, current and future population per dwelling, estimated average and peak residential demand per dwelling, commercial consumption and estimated leakage per connection. Some of these assumptions will be confirmed when the current study of Wellington Low Level Zone Management Plan is finalised (anticipated to be completed June 2020).

For this report, a reservoir that would service more than one growth area (apart from Miramar and Kilbirnie growth areas) is generally considered a 'system-wide' upgrade. For these assets the costs for the upgrade are shared proportionally among each relevant growth area based on projected population increase.

The identified water supply upgrades for this report exclude the cost of all ongoing renewals.

In summary, excluded from this assessment are:

1. The use of hydraulic models to assess the performance (feasibility) of potential upgrades needed to support urban growth (optioneering).
2. Renewals not associated with required upgrades to accommodate growth.
3. Investment in the regional bulk water supply and source.
4. Upgrades needed to accommodate growth in greenfield areas.

## 3.3. Assumptions for assessing existing and future wastewater services

Wastewater in Wellington is treated at one of three treatment plants – Moa Point WWTP, Western WWTP or the Porirua WWTP.

Each of the WWTPs would need to be upgraded to accommodate 80,000 additional people distributed across the 22 growth areas. This may include upgrades in hydraulic capacity, treatment capacity, sludge management and effluent disposal outfall pipes. These potential plant upgrade costs are considered a 'system-wide' upgrade and the costs for the upgrade are shared proportionally among each relevant growth area based on projected population increases.

The hydraulic models specific to each of the three WWTP catchments were used in the same way to identify existing constraints in capacity and to identify potential upgrades needed to inform the WCC Spatial Plan. In general, the level of service for the wastewater system to accommodate urban growth was assessed based on the existing hydraulic capacity of the wastewater mains during a 1-year rainfall event. The models were not re-run with future population projections.

To inform the WCC Spatial Plan, where existing capacity constraints were identified, possible storage upgrades were proposed at a pre-feasibility level and included in the cost band to support growth. Allowances for the additional population at 220 litres per person per day was also made in sizing storage tanks based on 24-hour dry weather flow storage – assuming new development would be built to prevent inflow & infiltration. Storage was not considered as a viable option for Miramar because the ground conditions are too wet to be suitable for storage as a mitigation approach to manage the inflow & infiltration in that catchment.

Required storage tanks to alleviate capacity constraints for the existing and future populations were calculated as a nominal range from 0.5 ML to 11 ML or combinations of these sizes.

In particular, for the Moa Point WWTP network, the storage volume proposed for Ngaio Gorge is based on observed overflow volumes recorded by Mott McDonalds at Murphys Road. It was estimated that a storage volume of around 32.5ML between Ngaio Gorge and Mount Albert Tunnel would be needed to service the existing plus the future populations in all growth areas draining to Moa Point Treatment Plant. The distribution and location of this storage would require detailed investigations.

To inform the WCC Spatial Plan, the estimated cost for these 'system-wide' upgrades was shared proportionally based on projected population increases in all growth areas other than Miramar, Karori and Tawa. The Miramar growth area was excluded as wastewater from this area is conveyed via a separate rising and trunk main close to the treatment plant. Karori and Tawa were excluded as wastewater from these growth areas is not conveyed to the Moa Point WWTP.

The estimated costs for the system-wide upgrade of the Moa Point WWTP was shared proportionally based on population across all growth areas draining to Moa Point WWTP, including Miramar.

For the Karori growth area, which flows to the Western WWTP, an estimated 5.5 ML storage tank is required.

The Tawa growth area drains to Porirua WWTP and the WCC share of the cost is around 30 percent based on total population. The WCC share is partially allocated to Tawa growth area based on population growth.

Upgrades identified for conveyance (where existing pipes are under capacity) assumed that all undersized main trunks and local wastewater pipes will need to be upgraded to the next larger size.

In addition, poor structural-condition (grades 4 and 5) wastewater pipes are considered at or near the end of life. These pipes will need to be rehabilitated or renewed to alleviate adverse effects of wastewater leaks on environmental water quality. The replacement cost of these are included in the cost bands provided in this report.

Upgrades of all existing wastewater pump stations in the Central Business Area (CBD), even though upgrades will occur at renewal time are included as options and have been costed. Please note that one additional pump station at Taranaki Street with a separate rising main to the interceptor is also included.

To inform the WCC Spatial Plan, this report includes a number of upgrades identified for the Porirua Joint Venture trunk wastewater network (including conveyance, storage and the WWTP), of which 30 percent is assumed to be funded by WCC. This cost is shared proportionally between the northern greenfield areas and Tawa growth areas based on projected population growth.

In addition, an allowance is included for augmentation of Moa Point WWTP and an allowance is made for a major upgrade of the Western WWTP servicing Karori catchment. The Western WWTP outfall pipe will also require major upgrade. Separate and more detailed studies are recommended to confirm the upgrades and associated costs.

The wastewater options identified for this report specifically exclude the following:

1. Solutions do not look at upgrades to the WCC Interceptor.

2. Solutions do not include options to reduce inflow of stormwater and infiltration of groundwater (I&I), including options to upgrade private laterals.

3. Future populations were not hydraulically modelled for the identification of needed upgrades. Proposed upgrades and storage areas are based on locations of current deficiencies in the network capacity. Storage volumes were nominally increased to accommodate future populations, rather than analysed hydraulically.

4. Assessments of infrastructure requirements needed to service greenfield areas.

Other limitations associated with pre-feasibility level options include the lack of site investigation to confirm GIS data, optimisation of options, performance testing, and the timing or staging of options.

## 3.4. Assumptions for assessing existing and future stormwater services

Wellington's stormwater networks comprise both built assets such as pipes, inlets and outlets, as well as natural assets, such as overland flow paths and watercourses. These networks discharge stormwater into streams, the harbour and the ocean at many locations across the region. Land use and building restrictions that protect overland flow paths from being built over or blocked are also important for protecting people and property.

To inform the WCC Spatial Plan, the level of service for the stormwater network to accommodate urban growth was assessed based on the protection from flooding during a 100-year storm event plus climate change. This flood risk has been modelled within eight catchments that include the growth areas of: Tawa, Johnsonville, Newlands, Karori, Newtown, Berhampore, Te Aro, Wellington Central, Mount Victoria, Aro Valley, Pipitea, Thorndon, Brooklyn, Miramar, Kilbirnie, Island Bay and Lyall Bay. Where available, the stormwater models were validated against historical flood events.

No stormwater hydraulic models were available for Ngaio, Crofton Downs and Khandallah.

Previous studies to identify upgrades needed to protect people from flooding were completed for Tawa and for Aro Valley, Te Aro and parts of Newtown and Mount Cook[3]. This report, which informs the WCC Spatial Plan, includes these upgrades.

[3] Stantec. 2019. Wellington CBD Stormwater Master Planning, prepared for Wellington Water. Draft Report, July 2019.

In the other areas with hydraulic models, a high level assessment was carried out to identify potential options to provide stormwater protection. These options were based on capacity requirements to convey flows generated by the 100-year storm. Pipes to be upsized or duplicated were selected on the basis that they would reduce the flooding issues in areas where medium and high-density development is proposed to an acceptable level.

This pre-feasibility assessment generated options in some locations that will likely incur costs that could outweigh the benefits. However, as an information layer for the WCC Spatial Plan, these pre-feasibility level options will provide costs that are reflective of the likely costs of managing flood risks in these areas. Alternative options such as managed retreat or the use of open channel designs, similar to the integrated infrastructure options being discussed for Wellington CBD, could provide significantly higher benefits for similar costs.

**Figure 4- Concept for managing stormwater flooding.**

Therefore, for the purpose of the WCC Spatial Plan, we consider that including the costs for some of the stormwater options provides a mid- to upper cost range of the potential options for assessing and comparing the suitability and cost of growth across the 22 growth areas.

Similarly for the three growth areas where we do not have stormwater flooding models (Ngaio, Crofton Downs and Khandallah), needed upgrades were identified based on assuming that the main stormwater pipes would need to be duplicated.

For the stormwater catchments that drain into the Wellington CBD, we assumed the upgrades would be 'system-wide' for the contributing growth areas. The contributing growth areas in the CBD stormwater catchment include: Aro Valley, Kelburn, Mount Cook, Mount Victoria, Newtown, Pipitea, Te Aro, Thorndon and Wellington Central. The costs for these system-wide upgrades were included in the cost bands based proportionally on the projected population increases in these suburbs.

Two new stormwater pump stations are proposed to service the low lying areas of the Wellington CBD. The system-wide cost for these pump stations are also shared across each of the growth areas in the CBD stormwater catchment.

Where the flood risk for Ngaio, Crofton Downs and Khandallah was not quantified, it was assumed that the main stormwater pipes in the medium and high density areas would need to be upgraded by duplication.

An allowance has been made for required improvements to the management of stormwater quality, especially for the treatment of road runoff, across each of the growth areas. This acknowledges that new provisions in the Wellington Regional Plan and WWL's global stormwater consent conditions will require increased levels of service for the management of stormwater discharges and its effects on the water quality of receiving environments.

Options excluded from this report are:

1. Assessments of stormwater infrastructure required to service greenfield areas.
2. Purchase of land to construct any flood management or stormwater quality structures.

## 3.5. Cost Estimates and Cost Bands

A high-level procedure was used to estimate the cost of infrastructure upgrades identified in this report and to present the costs in a way that is useful for the WCC Spatial Plan.

The estimated costs of proposed solutions are summed across all three waters and presented as cost bands. These cost bands can be used as a layer in the WCC Spatial Plan to understand and compare the suitability and cost of growth across the 22 growth areas.

The costs are based on year-2019 costs, and do not make allowance for inflation. The costs are limited to capital expenditure for construction, generally referred to as Capex. Additional costs for operational expenditure, including on-going maintenance and operation, referred to as Opex are not included. Opex can include items such as, planned maintenance, condition assessment and performance monitoring, operations personnel, materials, fuel, chemicals and energy consumption.

Presenting the estimates in cost bands illustrates the scale of infrastructure upgrades needed to provide each of the three water services, rather than describing the specific cost of specific upgrades. The costs bands represent the sum of costs estimates for each pre-feasibility level infrastructure upgrade identified as needed to provide an adequate level of service and to provide for projected growth.

For most pre-feasibility level upgrades, a simplified method was used to estimate the cost of each option. This costing method was based, in part, on the WWL Costing Estimation Manual (Revision D) (2019). Costs were calculated using a base cost that includes costs for physical works associated with construction, council, legal and consultant fees and land purchase. This base cost is then subject to a contingency of 40 percent and a funding risk of 60 percent. On top of this a WWL management fee of 11 percent was added to make up the total cost.

We note that some upgrade options were based on more detailed optioneering, (i.e., flood protection projects for Tawa, Aro Valley, Te Aro and part of Newtown). For these options, costs were calculated using the base cost provided in those assessments and then adding in the above contingency, funding risk and management fees.

For the required upgrades to the Moa Point and Karori WWTPs and for the identified stormwater quality upgrades cost estimates were based on rough pre-feasibility estimates.

The costs of upgrading network assets that service more than one growth area (system-wide upgrades) are allocated proportionally based on the projected population increase in each growth area. Examples are the WWTPs, wastewater storage, stormwater upgrades in CBD catchment tanks and some water supply reservoirs.

The overall cost estimate of all upgrades summed for each growth area is presented as a cost band, as follows:

- Band A, $10 to $25M
- Band B, $25M to $50M
- Band C, $50M to $750M
- Band D, $75M to $100M
- Band E, $100M to $200M
- Band F, $200Mto $550M

The percent of the cost by water supply, wastewater and stormwater is illustrated within each cost band.

The growth related projects allowed for in the existing 2018-2028 LTP are:

- PCC JV wastewater network upgrade $9.6M of which WCC contributes around 30% ($2.9M).
- Miramar Peninsula Stormwater upgrades $3M.
- Miramar Peninsula Wastewater upgrades $8M.
- Miramar Peninsula Water Supply network upgrades $4M.
- CBD Wastewater pipe upgrades $8M.
- Taranaki Street Wastewater pumpstation and rising main $5.3M.
- Bell Road Reservoir inlet and outlet mains $11.6M

# 4. These cost are included within the cost bands provided in this report.Constraints and Options for Servicing the 22 Growth Areas

The predicted population growth over 30 years within each growth area are specified in the WCC Preferred Growth Scenario and summarised in Table 1 below.

**Table 1 - Growth Areas**

| Growth Area | Population Growth | Current Population | Future Suburb Population |
|---|---|---|---|
| Aro Valley | 1,100 | 3,300 | 4,400 |
| Berhampore | 1,600 | 4,000 | 5,600 |
| Brooklyn | 1,800 | 6,900 | 8,700 |
| Crofton Downs | 300 | 2,400 | 2,700 |

| | | | |
|---|---|---|---|
| **Island Bay** | 3,500 | 7,600 | 11,100 |
| **Johnsonville** | 5,700 | 11,800 | 17,500 |
| **Karori** | 6,600 | 16,400 | 23,000 |
| **Kelburn** | 1,900 | 4,900 | 6,800 |
| **Khandallah** | 2,800 | 9,300 | 12,100 |
| **Kilbirnie** | 1,300 | 4,100 | 5,400 |
| **Lyall Bay** | 500 | 4,100 | 4,600 |
| **Miramar** | 800 | 10,500 | 11,300 |
| **Mount Cook** | 2,500 | 8,000 | 10,500 |
| **Mount Victoria** | 200 | 6,000 | 6,200 |
| **Newlands** | 2,400 | 8,700 | 11,100 |
| **Newtown** | 2,900 | 9,900 | 12,800 |
| **Ngaio** | 1,300 | 5,800 | 7,100 |
| **Pipitea** | 2,100 | 1,000 | 3,100 |
| **Tawa** | 5,300 | 15,500 | 20,800 |
| **Te Aro** | 17,600 | 12,600 | 30,200 |
| **Thorndon** | 1,300 | 3,900 | 5,200 |
| **Wellington Central** | 2,900 | 4,000 | 6,900 |
| **Growth in Greenfields** | 11,000 | | |
| **Infill growth** | 2,600 | n/a | n/a |
| **Total Growth** | 80,000 | | |

## 4.1. Aro Valley

The estimated costing band of providing three waters at an adequate level of service to provide for projected growth in the Aro Valley growth area is Band C, $50 to $75M.

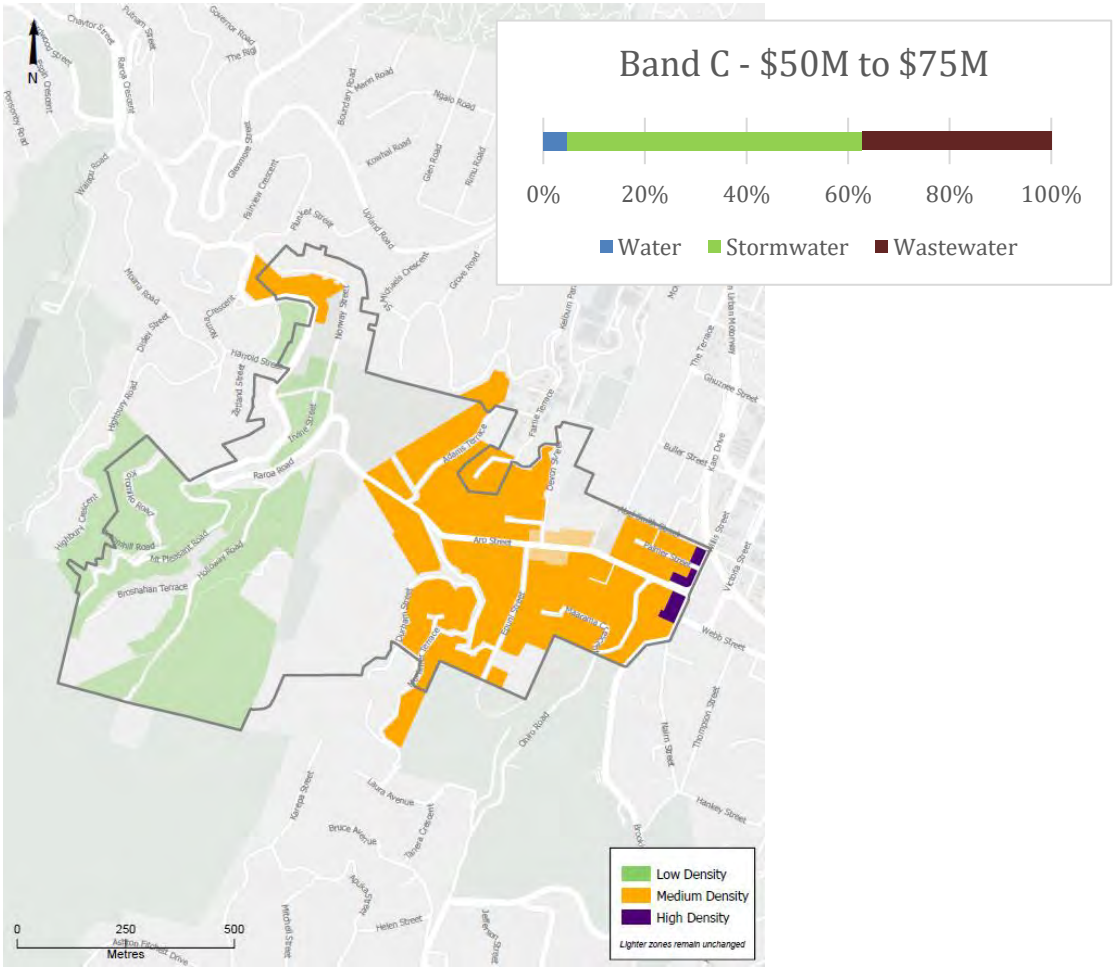


**Figure 5 - Aro Valley Preferred Growth Scenario for 1,100 additional people**[4]

| | Existing Constraints | Needed Infrastructure |
|---|---|---|
| **Water** | A few properties with low water pressure | The planned Moe-i-te-Ra Reservoir will cater for the additional storage required. Only mains upgrades to address low pressure areas are required. |
| **Wastewater** | The aging network and increased wet weather overflows | Renewal of poor condition pipes (3.4 km) and system-wide upgrades for conveyance, storage (0.63 ML) and contribution to WWTP upgrades |
| **Stormwater** | There is known deep flooding at the eastern end of Aro Street | Upgrade of trunk pipes leading to a new coastal outlet is required to reduce the risk of flooding and stormwater treatment devices |

[4] Image Source: BECA. 2019. Wellington City- Planning for Future Growth. Preferred Scenario Development. Prepared for Wellington City Council. July 2019

### 4.1.1. Water Supply

**Water supply zone**: The identified Aro Valley growth area is currently supplied with water from the Aro Valley reservoir with a top water level (TWL) of 136 m.

**Pressure**: Low water pressure is expected for approximately 10 properties at the Mortimer Terrace and the corner of Durham Street. 150 m of 100 mm main would be required to connect the two dead end 50 mm mains (one on Mortimer Terrace, and the other in the reserve to the east) together along Durham Street and re-zone these mains to Brooklyn Reservoir.

There are also few properties along the Fairlie Terrace and Kelburn Parade with low water pressure due to their high elevation compare to the Aro Reservoir.

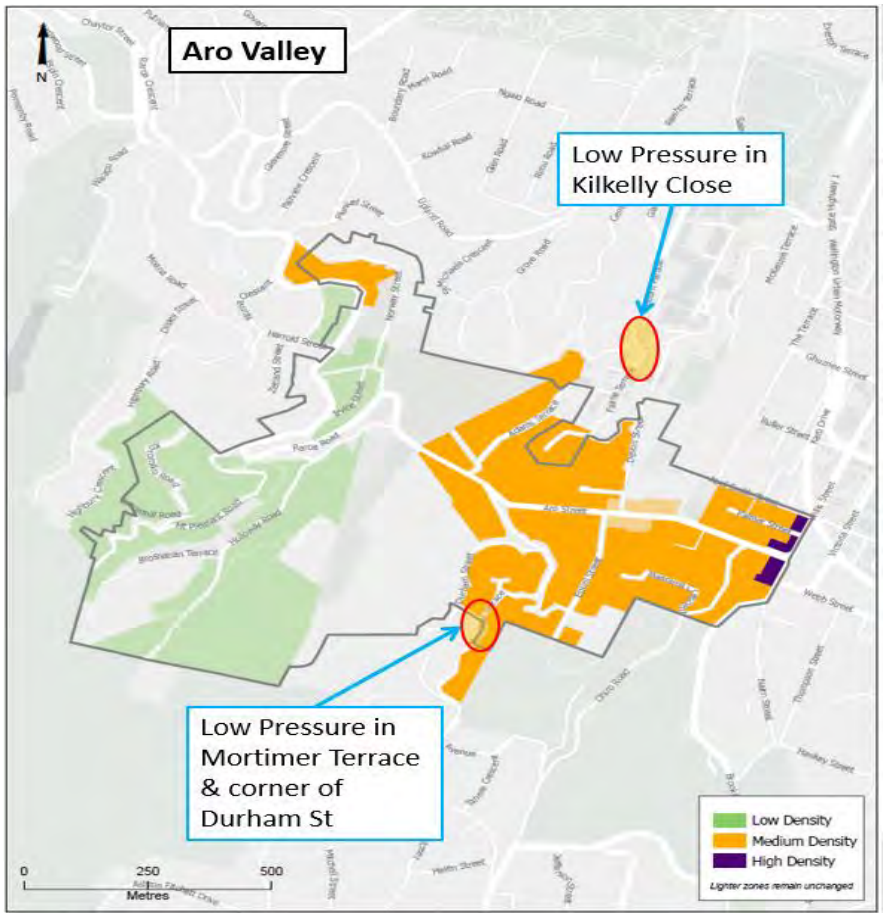


**Figure 6 – Predicted areas of existing low water pressure in Aro Valley.**

The proposed option is to install 200 m of 100 mm pipe and rezone the properties into the neighbouring Kelburn Zone. The supply is via a connection to the 100 mm main running along Kelburn Parade. In order to avoid very high pressure it is recommended to install a pressure reducing valve (PRV) and maintain maximum pressure in this area.

No other main upgrades have been identified as part of this high level analysis. However, further detailed investigations is needed to confirm this

**Mains**: To accommodate the proposed growth, only mains upgrades for low pressure areas would be required.

There are about 9 km of distribution network in Aro Valley suburb which of 0.5 km are asbestos cement (AC) pipes. It is recommended to replace the AC pipes over time. There are also about 6 km of pipes with other materials which have been installed more than 70 years

ago in this area. Those would be close to their end of life cycle when the proposed growth developments are fully implemented and are not included in estimates.

**Storage**: A preliminary analysis indicated that with the construction of the Moe-i-te-Ra Reservoir at Bell Road there would be enough storage capacity to cater for projected growth in this zone. The Moe-i-te-Ra Reservoir project is currently under review that may change the proposal to two separate replacement reservoirs for Bell Rd and Aro reservoirs. For this assessment it has been assumed that the Moe-i-te-Ra Reservoir will proceed as proposed.

### 4.1.2. Wastewater

Wastewater from the Aro Valley growth area is conveyed to the Moa Point WWTP for treatment and disposal.

Although there are no existing constraints in the local wastewater pipes in the Aro Valley growth area, additional wastewater flows from future populations will contribute to constraints in the downstream network and WWTP. In addition, there are approximately 3.4 km of poor or very poor condition (grade 4 and 5) wastewater pipes which will need to be renewed to alleviate adverse effects of wastewater leaks on water quality.

### 4.1.1. Stormwater

There is existing flooding in the area of Aro Valley where growth is proposed. In particular there is fast and dangerous flood flows down the steep sections of Aro Street. These flows pond in the low lying residential and commercial area.

To accommodate the proposed growth in Aro Valley, 300 m of stormwater trunk upgrade or an alternative solution would be required to address flood hazards.

Of note is that Aro Valley area relies on a single trunk pipe outlet spanning all the way out to Wellington Harbour (Port Nicholson), which also serves Te Aro area catchment. Much of this pipe is over 100 years old and lacks capacity. Therefore the Aro Valley flooding issues can only be resolved in conjunction with a wider CBD stormwater upgrade programme.

In addition to alleviating flood risks to growth, there are also water quality constraints that will require WWL to manage stormwater to address the outcomes of the Te Whanganui-o-Tara Whaitua, the NPS-FM and the global stormwater discharge consent conditions. It is anticipated that as a minimum, runoff from new growth will need to be treated so that the water quality of Wellington City's streams and coastal waters are maintained or improved. To account for this additional level of service, new stormwater treatment devices, such as rain gardens, were identified based on the catchment area of land proposed for medium and high density growth.

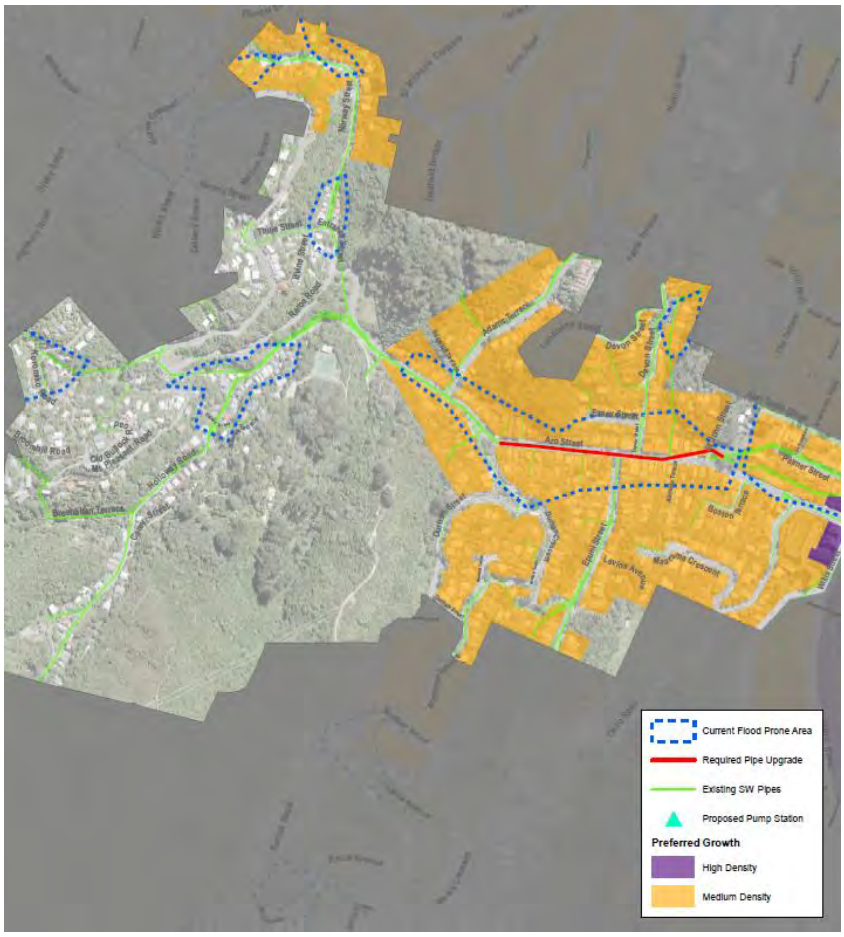


**Figure 7 – Predicted flooding and potential stormwater upgrades for Aro Valley.**

## 4.2. Berhampore

The estimated costing band of providing three waters at an adequate level of service to provide for projected growth in the Berhampore growth area is Band D, $75M to $100M.

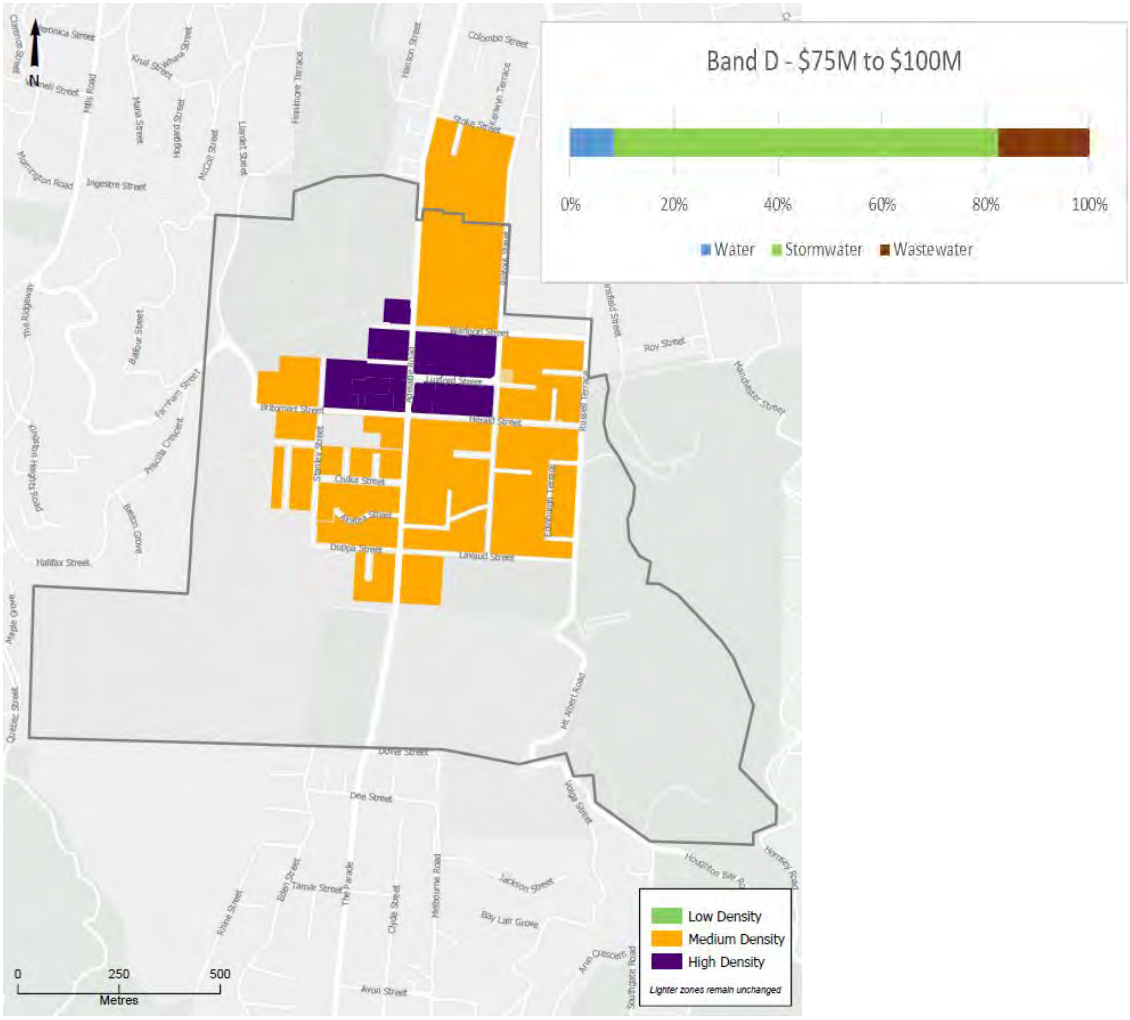


**Figure 8 - Berhampore Preferred Growth Scenario for 1,600 additional people**[5]

| | Existing Constraints | Needed Infrastructure |
|---|---|---|
| **Water** | A few properties with low water pressure | A Wellington central-wide additional 14 ML storage shared across Berhampore, Mount Victoria, Newtown, Pipitea, Te Aro, Wellington Central, Mount Cook and Thorndon growth areas is needed. Only mains upgrades to address low pressure areas are required. |
| **Wastewater** | Undersized and poor condition pipes and increased wet weather overflows | Upgrade of undersized and poor condition pipes (3.3 km) and system wide conveyance, storage (1 ML) and contribution to WWTP upgrade |
| **Stormwater** | Existing flooding in Luxford Street, Palm Grove and Adelaide Road | Approximately 2.6 km of new stormwater pipe and stormwater treatment devices |

[5] Image Source BECA. Name of Map: Preferred Growth Scenario. Date: 12/07/2019

### 4.2.1. Water supply

**Water supply zone**: The Berhampore growth area is supplied from Newtown West DMA and is fed from the Carmichael Reservoir and the Macalister Reservoirs with the TWL of 92 m.

**Pressure**: Low water pressure is expected for the following locations in this suburb:

- approximately 10 properties in Rintoul Street and Edinburgh Terrace
- approximately 10 properties in Britomart Street

These properties are located at a relatively high altitude (approx. 65 m) compared to the other properties in the zone. The TWL of 92 m of Carmichael reservoir is not high enough to supply these properties with minimum pressure of 25 m. It is not expected that the situation will get significantly worse in the future as the low pressure is not generally caused by demand-related head loss.

A possible solution for the low pressure in Britomart Street is re-zoning those properties into Brooklyn zone with supply from Brooklyn reservoirs (TWL 224 m). It would require laying of a new 260 m 100 mm main connecting to 100 mm main along Farnham Street and 100 mm main at Britomart Street along with a PRV.

**Mains**: To accommodate the proposed growth, only mains upgrades to address low pressure areas are required.

This area is part of the very large Low Level Water Supply Zone for which a draft hydraulic model was recently completed. The Low Level zone includes the growth areas of Newtown, Pipitea, Thorndon, Wellington Central, Te Aro, Lyall Bay, Berhampore, Kilbirnie, Mount Cook, Miramar and Mount Victoria. While not necessarily aligning spatially with the growth areas it does not indicate the need for any major mains upgrades. This would be subject to further assessment and confirmation.

There are about 12 km of distribution network in Berhampore suburb which of 2 km are AC pipes. It is recommended to replace the AC pipes over time. There are also about 7 km of pipes with other materials which have been installed more than 70 years ago in this area. Those would be close to their end of life cycle when the proposed growth developments are fully implemented and are not included in estimates.

**Storage**: Please refer to the storage requirement for Wellington Central growth area (section 4.22.1) as this area is supplied from the same reservoirs.

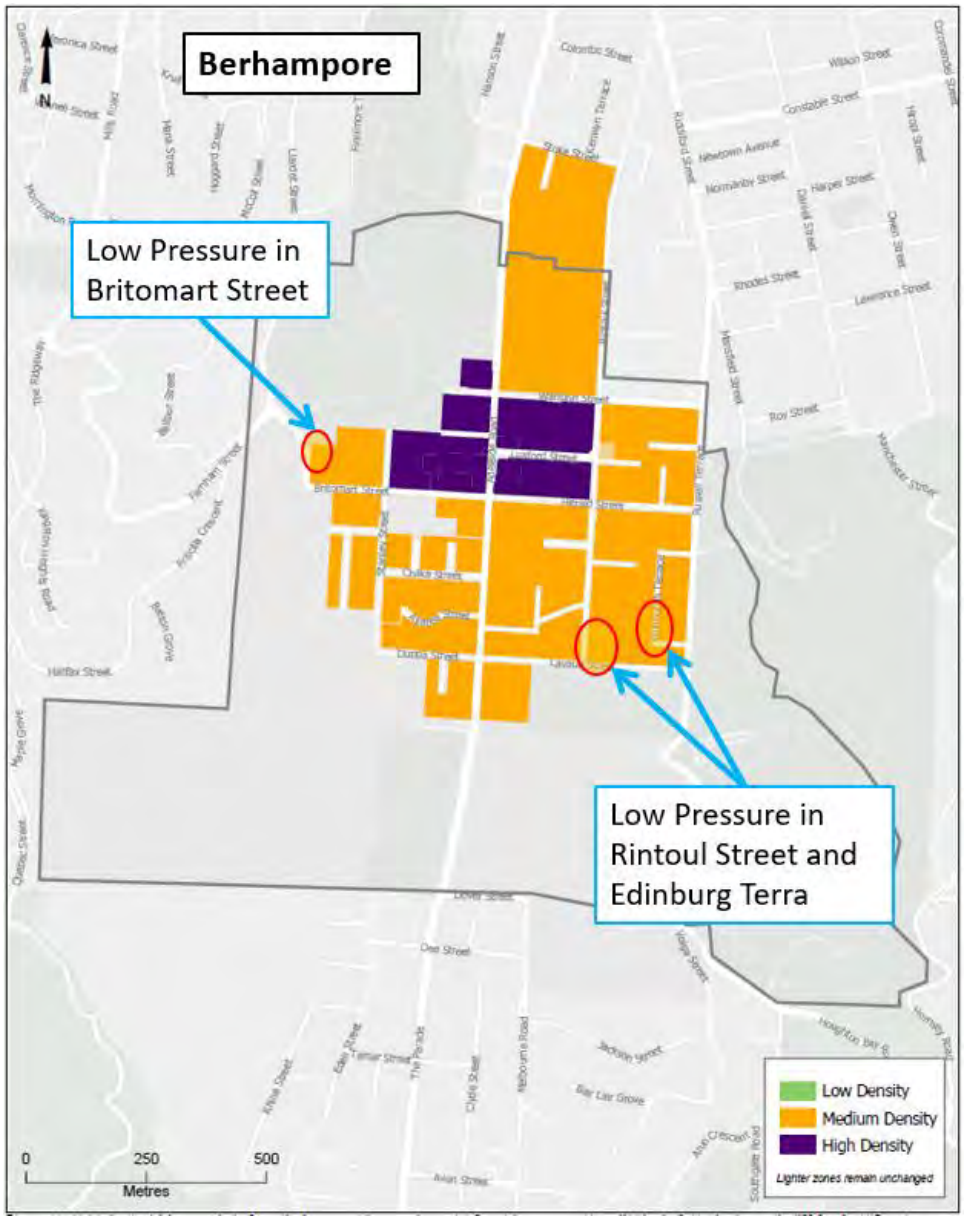


**Figure 9 – Predicted areas of existing low water pressure in Berhampore**

### 4.2.2. Wastewater

Wastewater from the Berhampore growth area is conveyed to the Moa Point WWTP for treatment and disposal.

Additional wastewater flows from future populations will contribute to constraints in the downstream network and WWTP.

To service for growth around 2.1 km of local wastewater pipe were identified for upgrades. Another 1.2 km of pipes were identified as structural condition grades 4 and 5 and included for replacement.

### 4.2.3. Stormwater

The area of Berhampore where growth is proposed including high density, is predicted to experience flooding problems during significant storm events. In particular on Luxford Street, Palm Grove, and Adelaide Road.

In order to reduce these flooding problems and accommodate growth, 2.6 km of stormwater network will need to be upgraded. Alternatives to this that could reduce the length of pipe upgrades includes construction of flood detention wetlands and open channels.

Of note is that Berhampore area relies on a single stormwater trunk pipe outlet spanning all the way out to Island Bay, which also serves the Island Bay growth area. It is likely that Berhampore flooding issues can be addressed only if downstream network capacity constraints were removed, such as network capacity constraints in Island Bay.

It is anticipated that as a minimum runoff from new growth will need to be treated so that the water quality of Wellington City's streams and coastal waters are maintained or improved. The likely costs associated with this have also been factored into our cost band.

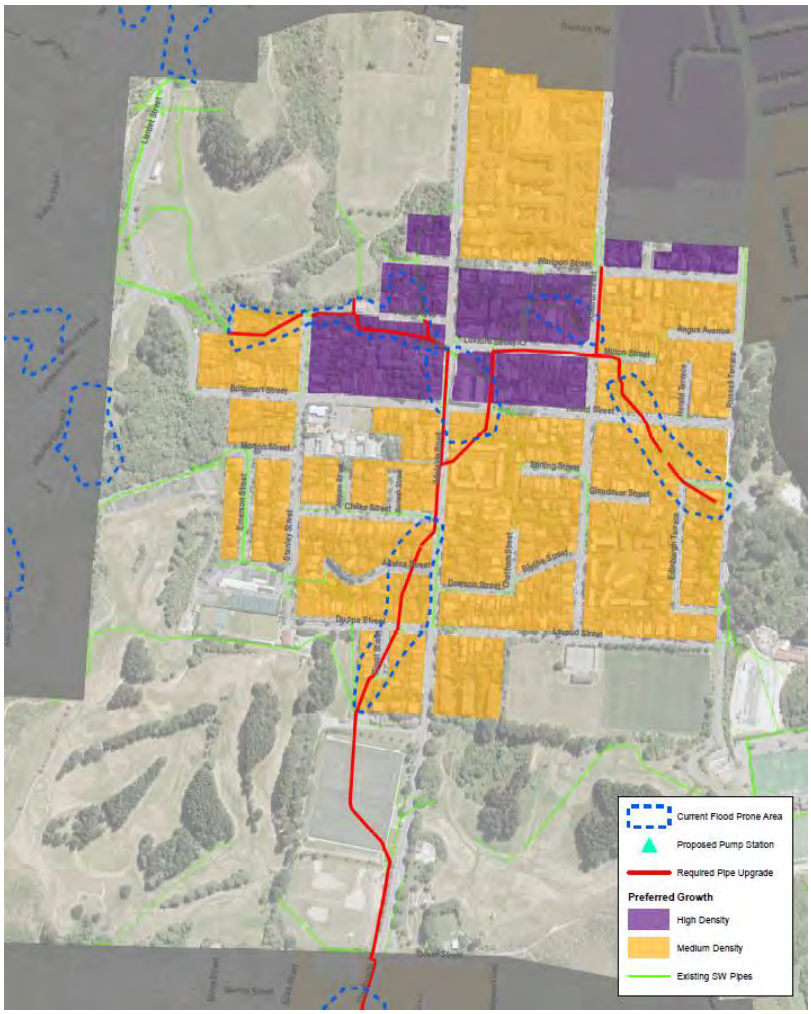


**Figure 10 – Predicted flooding and potential stormwater upgrades for Berhampore.**

## 4.3. Brooklyn

The estimated costing band of providing three waters at an adequate level of service to provide for projected growth in the Brooklyn growth area is Band D, $75M to $100M.

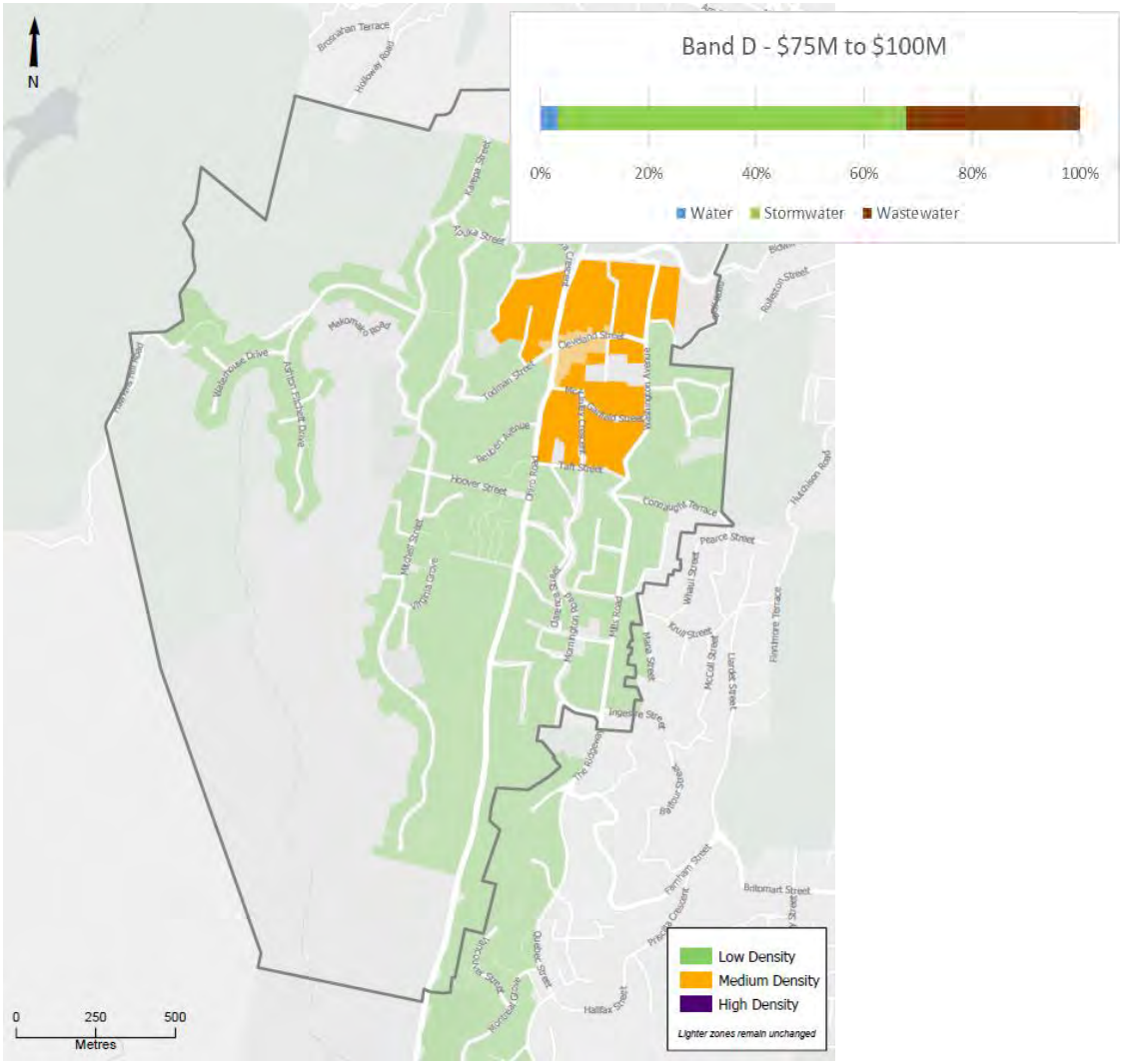


**Figure 11 - Brooklyn Preferred Growth Scenario for 1,800 additional people**[6]

| | Existing Constraints | Needed Infrastructure |
|---|---|---|
| **Water** | Numerous properties with low water pressure | Construction of the planned replacement Brooklyn No. 2 reservoir will cater for the projected growth. Only mains upgrades to address low pressure areas are required. |
| **Wastewater** | Undersized and poor condition pipes and increased wet weather overflows | Renewal of poor condition pipes (5.4 km) and system wide conveyance, storage (1 ML) and contribution to WWTP upgrade |
| **Stormwater** | Existing flooding in Cleveland Street, Todman Street and Ohiro Road | Approximately 1.5 km of upgraded stormwater pipes and stormwater treatment devices |

[6] Image Source BECA. Name of Map: Preferred Growth Scenario. Date: 12/07/2019

### 4.3.1. Water supply

**Water supply zone**: The Brooklyn zone is supplied from the Epuni Street pump station which directly feed into Brooklyn Reservoirs No 1 and No 2 with a TWL of 224 m.

The higher elevated areas in Brooklyn sit within the Brooklyn West DMA. That DMA is supplied by the Brooklyn West Reservoir (TWL 294 m). Water is supplied to the reservoir via the Karepa Street pump station which operates on level control of Brooklyn West Reservoir, drawing from both Brooklyn reservoirs. The identified medium density area in Brooklyn suburb is located within the Brooklyn DMA which is supplied by gravity from the Brooklyn Reservoirs.

**Pressure**: Approximately 130 properties located around Mitchell Street are predicted to have low pressures about 20 m. This is due to being located on the ridge line having similar elevations to the Brooklyn reservoir TWL. Those are not expected to be significantly impacted significantly by the proposed growth.

There are also about 30 properties with low pressure on Mitchell Street which they are very close proximity to the Brooklyn Reservoirs. They can be rezoned to the Brooklyn West Reservoir.

There are other areas with low pressure issues in the Brooklyn suburb, however they are outside the identified medium density growth area. Those areas are currently supplied from the Brooklyn West Reservoir and are not expected to be significantly impacted by the proposed growth.

**Mains**: To accommodate the proposed growth only mains upgrades to address low pressure areas are required.

In order to improve the security of supply to the Brooklyn zone network, a number of options were considered in a recent study (Connect Water 2019) to provide an alternative/additional supply point to the zone. That study suggested a new 1.5 km of DN300 main and a new pump station (approximately 70 L/s flow and 95 m lift) could be built to transfer water from the proposed Moe-i-te-Ra Reservoir to the Brooklyn zone. This is flagged as a level of service improvement and not included in the estimates.

There are about 27 km of distribution network in Brooklyn suburb which of 3 km are AC pipes. It is recommended to replace the AC pipes over time. There are also about 8 km of pipes with other materials which have been installed more than 70 years ago in this area. Those would be close to their end of life cycle when the proposed growth developments are fully implemented and have not been included in the estimates.

**Storage**: A preliminary analysis indicated that with the construction of the planned replacement Brooklyn No 2 Reservoir there will be enough water storage capacity to cater for the projected growth up to 2047 in this zone.

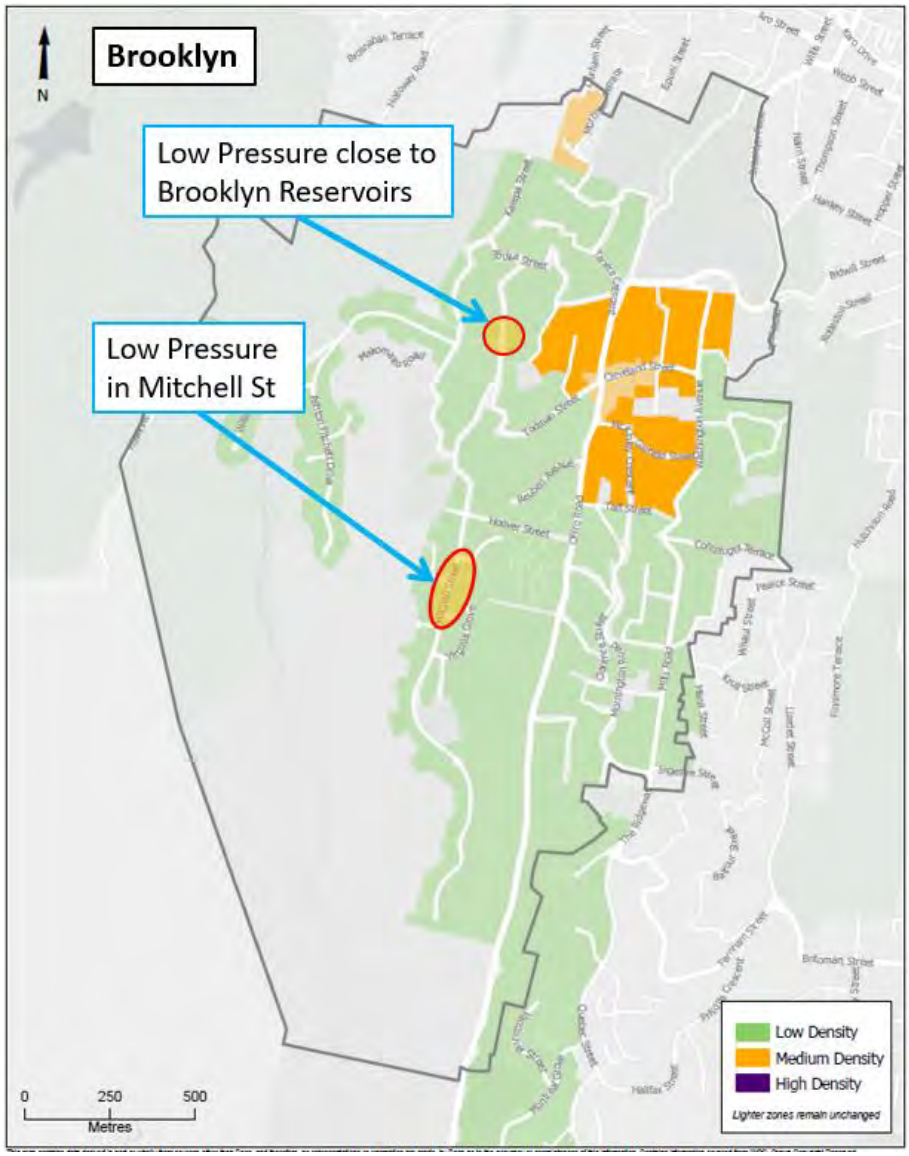


**Figure 12 – Predicted areas of existing low water pressure in Brooklyn.**

### 4.3.2. Wastewater

Wastewater from the Brooklyn growth area is conveyed to the Moa Point WWTP for treatment and disposal.

Based on proposed growth in the Preferred Growth Scenario, additional pipe capacity is required to reduce overflows at the constructed wastewater overflow at 279 Ohiro Road. In the Brooklyn growth area, there are required upgrades to 185m of local wastewater pipes to support urban growth.

In addition, 5.2 km of structural condition grades 4 and 5 pipes are proposed for replacement to meet future levels of service for managing the water quality of fresh waters.

### 4.3.3. Stormwater

The medium density areas identified for Brooklyn in the Preferred Growth Scenario are predicted to experience flooding during significant storm events. In particular, flood risks are identified on Cleveland Street, Todman Street, and Ohiro Road. Furthermore there are downstream flooding risks that could be exacerbated by intensification in this area.

In order to manage these flooding risks and accommodate growth, approximately 1.5 km of stormwater network could be upgraded. The topography and land use in this area makes alternatives to this difficult.

As a minimum runoff from new growth will need to be treated so that the water quality of Wellington City's streams and coastal waters are maintained or improved. The likely costs associated with this have also been factored into our cost band.

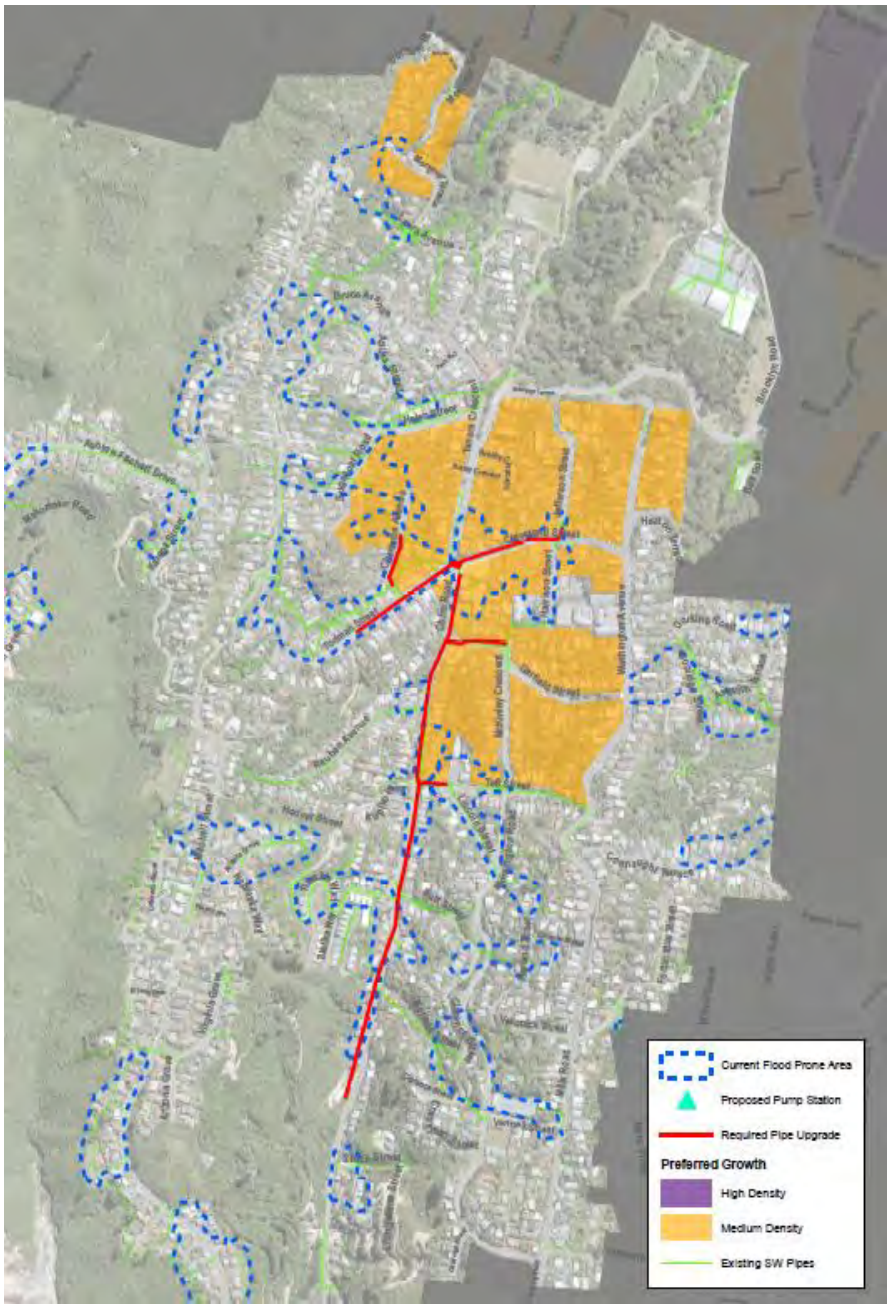


**Figure 13 – Predicted flooding and potential stormwater upgrades for Brooklyn.**

## 4.4. Crofton Downs

The estimated costing band of providing three waters at an adequate level of service to provide for projected growth in the Crofton Downs growth area is Band A, $10M to $25M.


**Figure 14 – Crofton Downs Preferred Growth Scenario for 300 additional people**[7]

| | Existing Constraints | Needed Infrastructure |
|---|---|---|
| **Water** | No current constraints | To accommodate projected growth in Ngaio and Crofton Downs, approximately 1.3 ML additional water storage is required. Only mains upgrades to maintain existing pressures are required |
| **Wastewater** | Poor condition pipes and increased wet weather overflows | Renewal of poor condition pipes (1.5 km) and system wide conveyance, storage (0.2 ML) and contribution to WWTP upgrade |
| **Stormwater** | Unknown as modelling is not complete | Approximately 300 m of upgraded pipe and stormwater treatment devices |

[7] Image Source BECA. Name of Map: Preferred Growth Scenario. Date: 12/07/2019

### 4.4.1. Water supply

**Water supply zone:** Water for the specified growth area in Crofton Downs is mostly supplied from the Ngaio DMA. However a small section of designated Medium Density area (in the Winston Street) is connected to the Wadestown DMA. The Wadestown DMA supply is pumped directly from Pembroke Reservoir via Warwick Street pump station. The DMA is balanced against Wadestown Reservoir with a TWL of 242 m. Ngaio Reservoir operates on the TWL of 171 m.

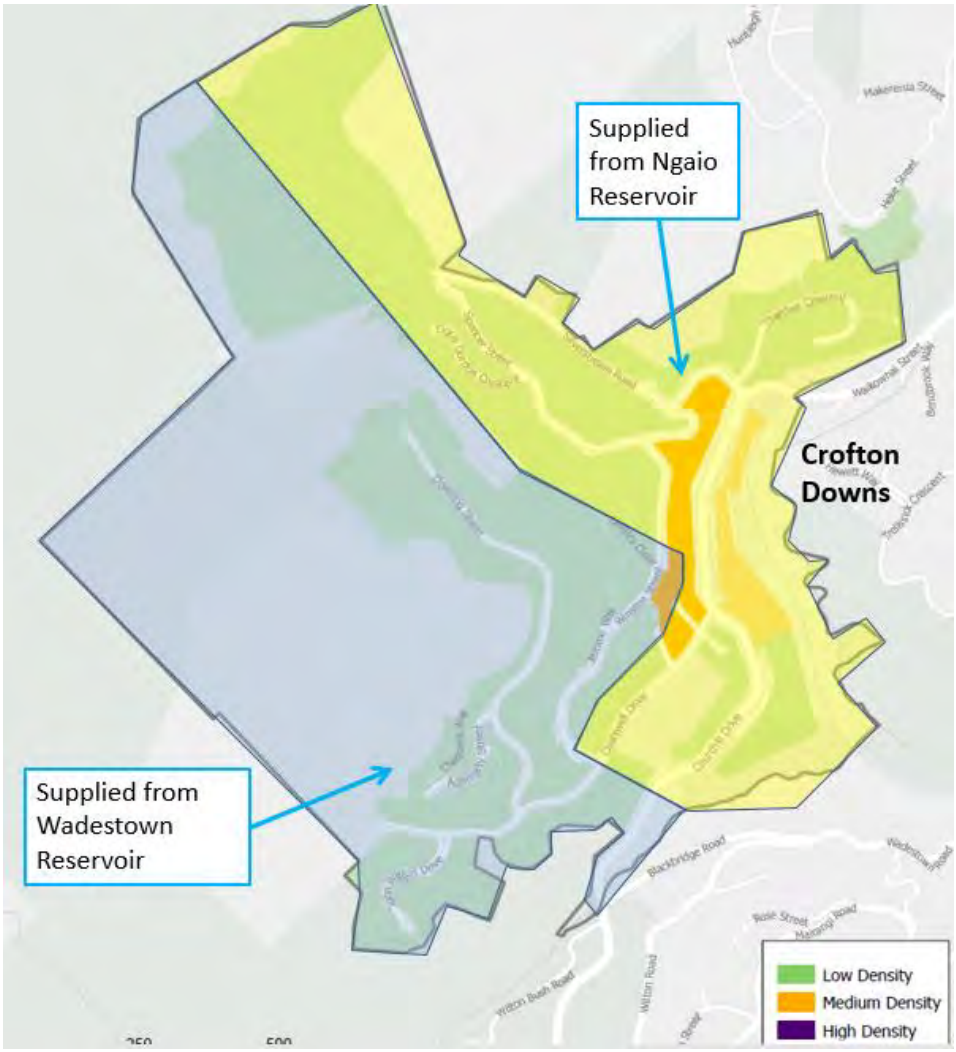


**Figure 15 – Water supply in Crofton Downs**

**Pressure:** Available water pressure in Crofton Downs is well above the minimum criteria. Minimum pressures range from 60 m to 90 m on public mains in areas connected to the Ngaio Reservoir. The pressure range for the few properties connected to the Wadestown Reservoir is from 100 m to 115 m.

**Mains**: To accommodate the proposed growth only mains upgrades to maintain existing pressures are required. There are about 8 km of distribution network in the Crofton Downs zone, and about 4 km are AC pipes. It is recommended to replace the AC pipes over time.

**Storage**: Ngaio Reservoir supplies both medium density growth areas in Ngaio and Crofton Downs suburbs. A preliminary analysis indicated that in order to accommodate for projected growth in Ngaio and Crofton Downs, and additional 1.3 ML (0.6 ML for Ngaio and 0.6 ML for

Crofton Downs) is required, of which 0.3 ML is required for the existing deficit. Further investigations are needed to confirm the actual capacity and location of this future reservoir.

### 4.4.2. Wastewater

Wastewater from the Crofton Downs growth area is conveyed to the Moa Point WWTP for treatment and disposal.

This catchment generally has good drainage grades and is in close proximity to the wastewater interceptor. To support growth, identified requirements include 1.1 km of pipe upgrades and the replacement of 0.4 km of poor condition pipes to meet future levels of service for water quality.

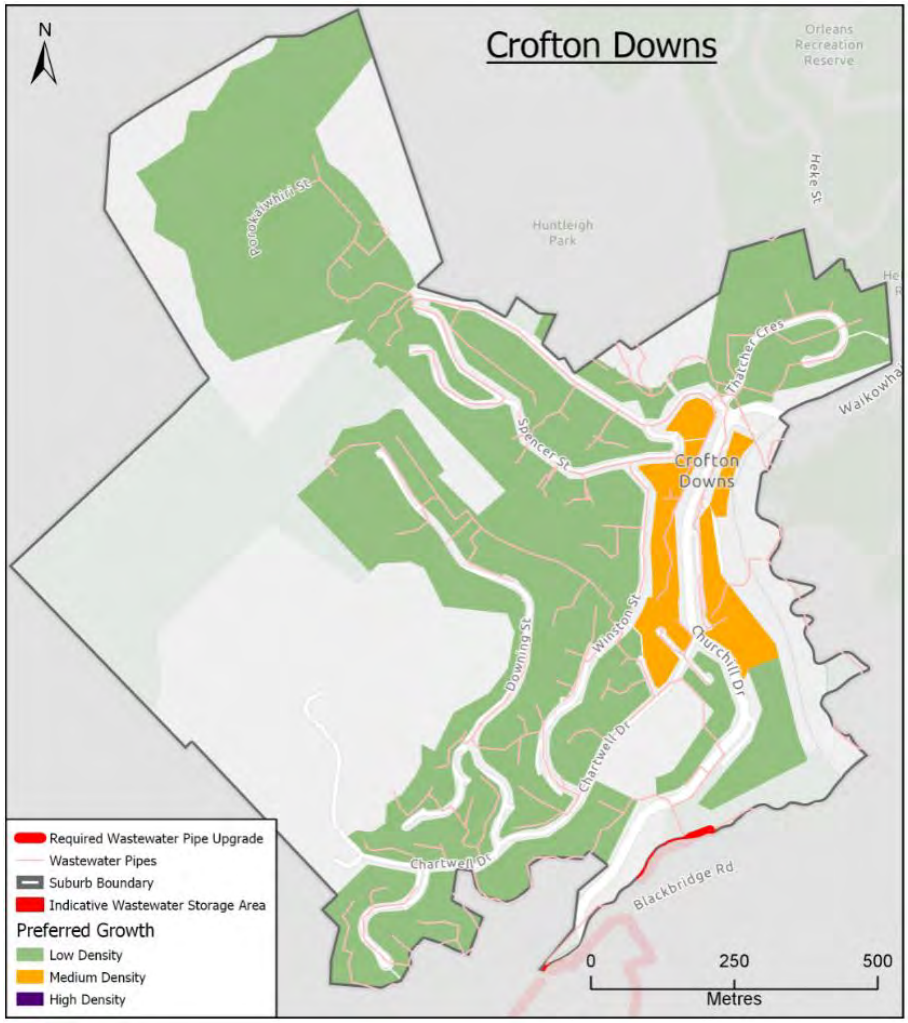


**Figure 16 – Proposed wastewater upgrades in Crofton Downs.**

### 4.4.3. Stormwater

The Crofton Downs area has not been modelled for flooding risks and therefore the likelihood of major flooding problems is unknown. However, like many other areas in Wellington, it is likely that this area would experience some flooding. Therefore it is assumed that 300 m of main stormwater pipes servicing the area identified for medium growth will be required to be upgraded.

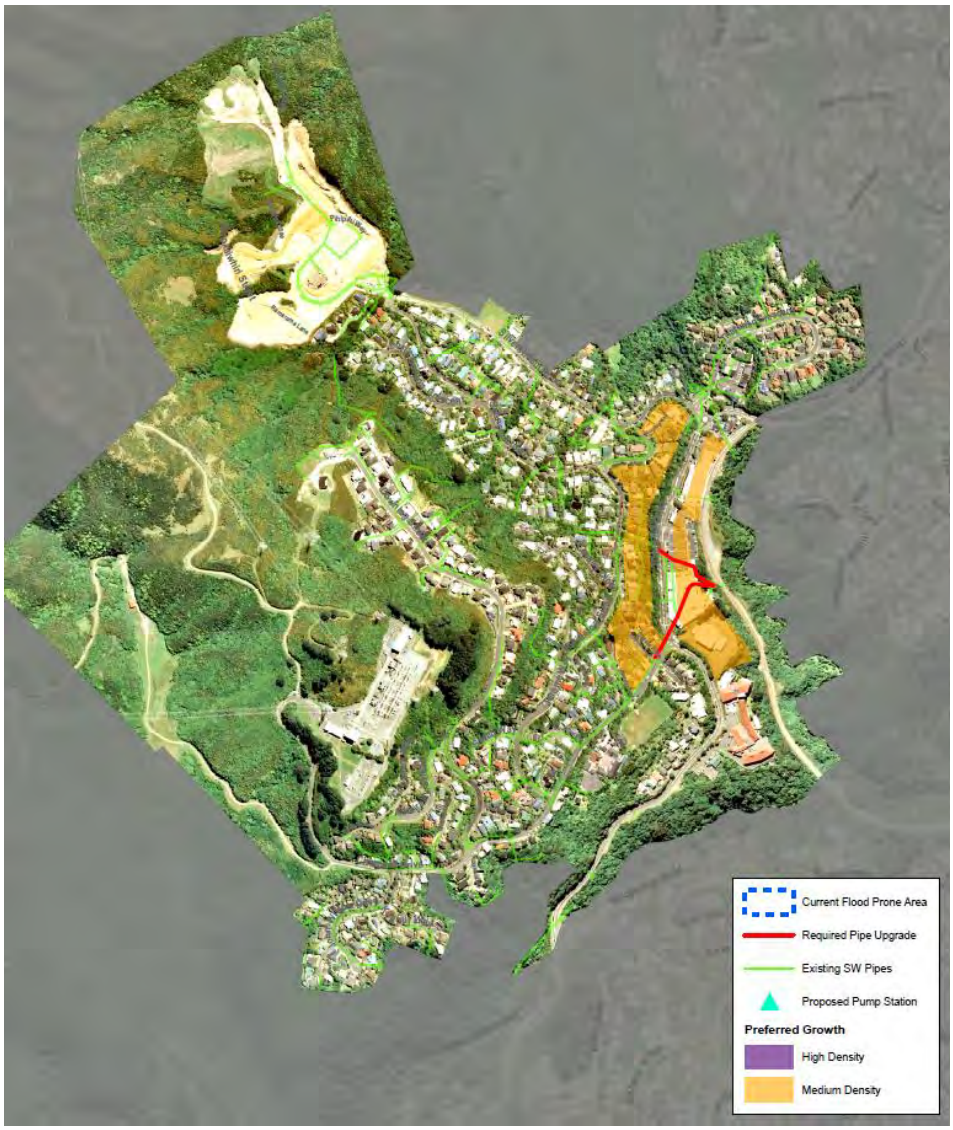


**Figure 17 –Potential stormwater upgrades for Crofton Downs**

## 4.5. Island Bay

The estimated costing band of providing three waters at an adequate level of service to provide for projected growth in the Island Bay growth area is Band F, $200M to $550M.

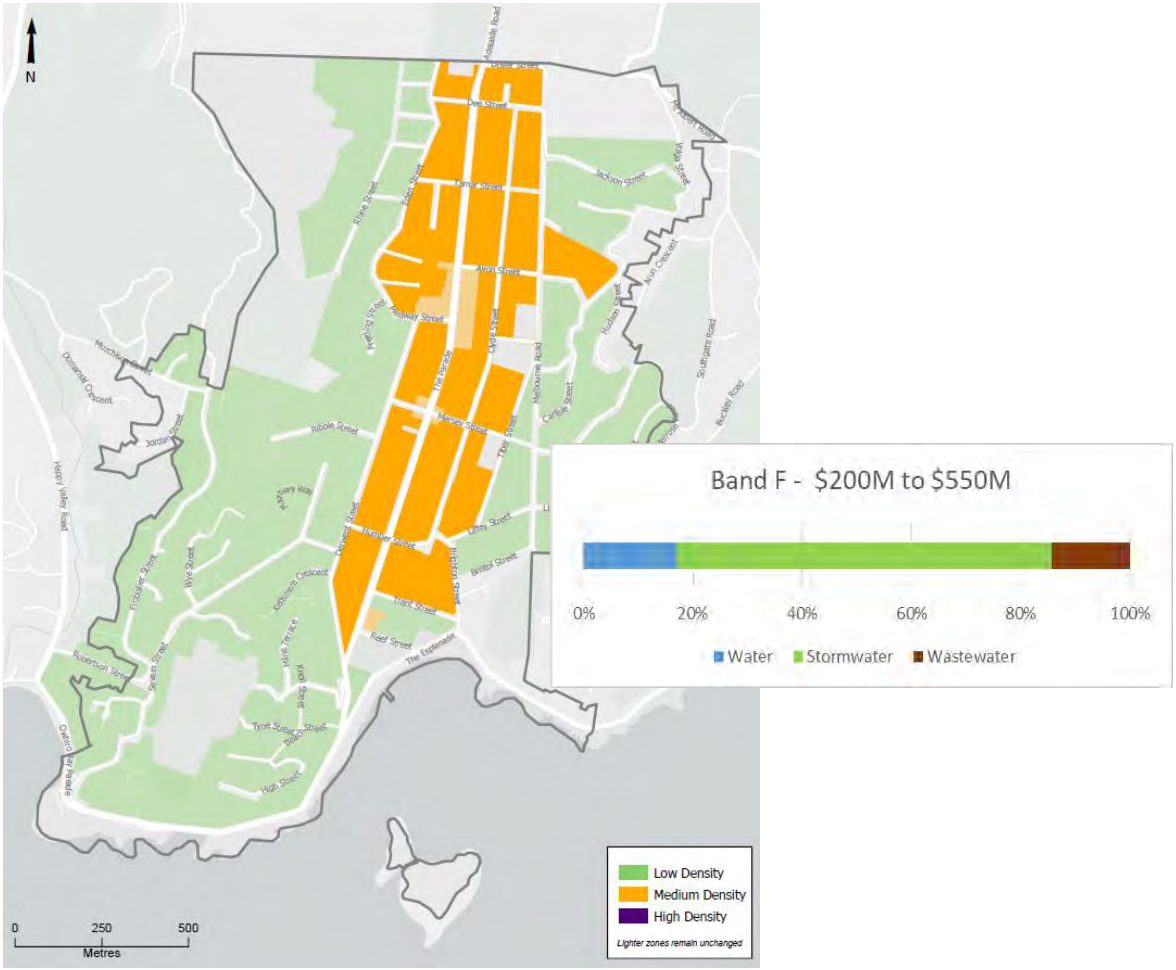


**Figure 18 – Island Bay Preferred Growth Scenario for 3,500 additional people**[8]

| | Existing Constraints | Needed Infrastructure |
|---|---|---|
| **Water** | A few properties with low water pressure | Mains upgrades and 4.5 ML additional water storage required |
| **Wastewater** | Poor condition pipes and Main trunk is under capacity during wet weather events | Renewal of poor condition pipe (6.1 km), main trunk upgrade and system wide storage (2 ML) and contribution to WWTP upgrade |
| **Stormwater** | Extensive areas of flooding and lack of overland paths | Approximately 8 km of upgrades with a new or upgraded stormwater discharge point to the coastline and stormwater treatment devices |

[8] Image Source BECA. Name of Map: Preferred Growth Scenario. Date: 12/07/2019

### 4.5.1. Water supply

**Water supply zone:** The water supply zone in Island Bay is comprised of two main DMAs - Southern suburbs DMA (aka Island Bay DMA) and Frobisher DMA. The zone is fed from the Wellington Central system through a flow meter into the Mount Albert Reservoir (3.5 ML, TWL 89 m). Water then gravitates to Southern Suburbs DMA.

The Southern Suburbs DMA supplies the Frobisher DMA via the Rhine Street pump station.

The hydraulic model for this area has not been developed yet so all current issues may have not been captured here.

**Pressure:** There are few areas where low pressures are expected based on the reservoir level and properties located at a relatively high altitude in the zone. They have been roughly marked in the plan below.

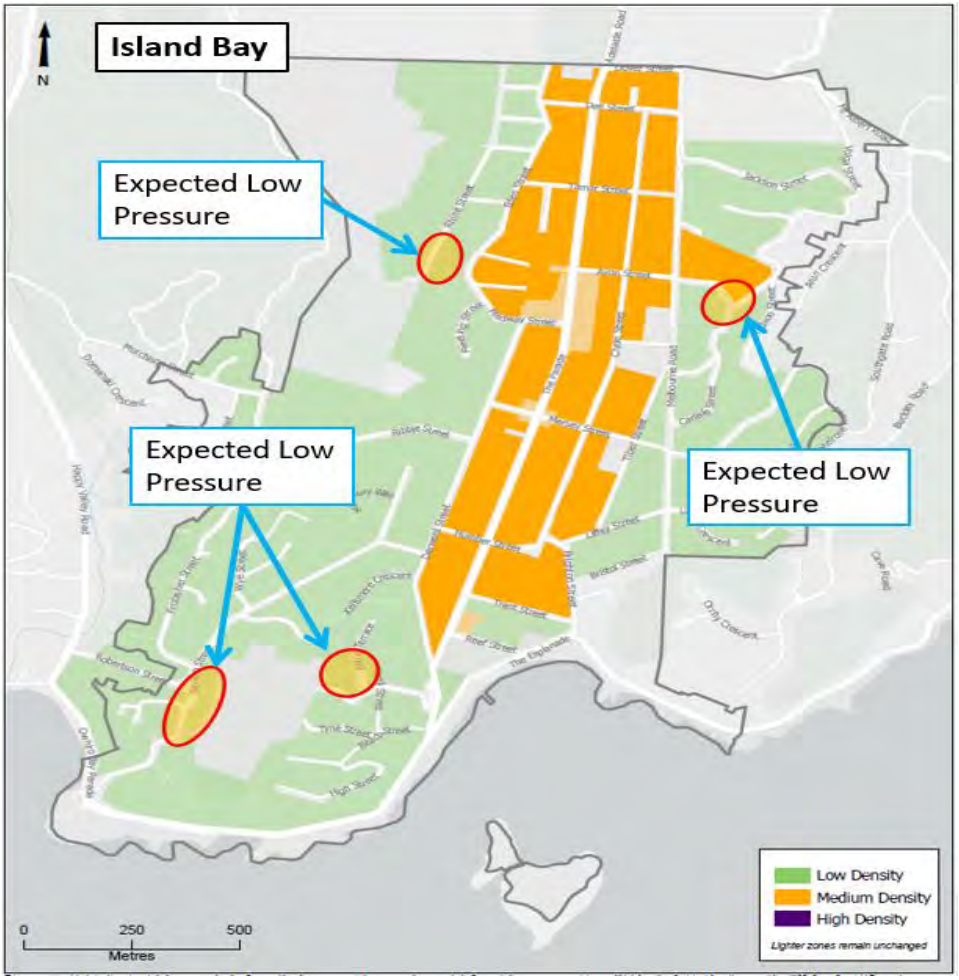


**Figure 19 – Predicted areas of existing low pressure in Island Bay**

**Mains:** To accommodate the proposed growth, 1.8 km mains would need to be upgraded to 300 mm diameter; 1.1 km on The Parade from Dover Street to the intersection of Mersey Street and 0.7 km on Clyde Street from Tamar Street to Mersey Street. Mains upgrades to address low pressure areas are also required. There are about 50 km of distribution network in Island Bay suburb, and about 11 km are AC pipes. It is recommended to replace the AC pipes over time.

**Storage:** A preliminary analysis indicated that in order to accommodate the projected growth in Island Bay suburb, there would be around 4.5 ML additional water storage required of which about 2 ML is to cover for the existing shortfall.

### 4.5.2. Wastewater

Wastewater from the Island Bay growth area is conveyed to the Moa Point WWTP for treatment and disposal.

The trunk wastewater was duplicated along the lower half of The Parade in 2004. A number of constructed wastewater overflows are positioned in the side streets entering The Parade. Duplication is likely to have reduced the occurrence of overflows at these sites by passing more flow forward. At the same time the capacity of the terminal pump station PS38 was increased.

During a 1-year ARI the duplicated trunk wastewater pipes run full. It is expected that with additional growth overflows at the constructed wastewater overflows will start to spill more frequently.

The renewal of the 1930 line along The Parade to a larger pipe has been identified as a pre-feasibility option to increase the capacity and reduce the frequency and volume of wastewater overflows at this location.

The additional capacity required in the Island Bay trunk wastewater main for the proposed population growth will need to be confirmed in detail. To support growth in Island Bay 0.8 km of local wastewater pipe upgrades are needed. Any development in this catchment needs to be considered together with the possible upgrades required in the Interceptor.

In addition, to meet future levels of service for water quality from the wastewater network in the Island Bay growth area, approximately 5.3 km of wastewater poor condition pipes have been identified for renewal.

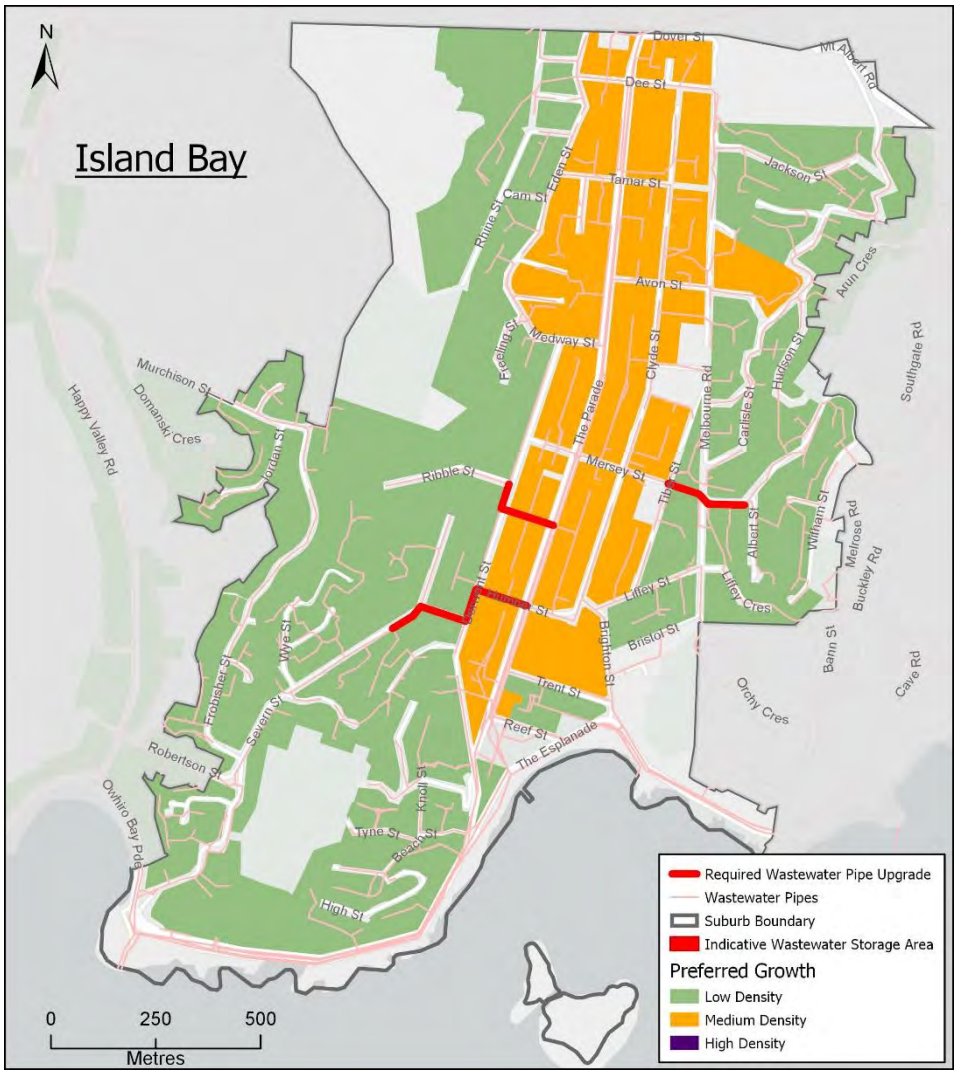


**Figure 20 – Proposed wastewater upgrades in Island Bay.**

### 4.5.3. Stormwater

The medium density growth areas for Island Bay are predicted to experience flooding problems during significant storm events. In particular flood risks are predicted in the historical swamp area at either side of The Parade, between Tamar Street and Humber Street, as well as along the low-lying areas of Reef and Trent streets. This area experienced extensive flooding in 1995 and continues to have the potential for deep and life threatening floods. In addition, there are a number of overland flow paths that should be protected from new development. These are found near Melrose Road and Mersey, Severn, Avon streets and at the back of properties along Jackson Street.

A potential measure to manage flood risks in Island Bay and accommodate growth could include upgrading of the trunk network down Parade.

Of note is that the trunk upgrades could also be used to address flooding problems in Berhampore.

Island bay coast is a highly valued environment and that will be a focus area for improved water quality. To account for this additional level of service, new stormwater treatment devices, such as rain gardens, were identified based on the catchment area of land proposed for growth.

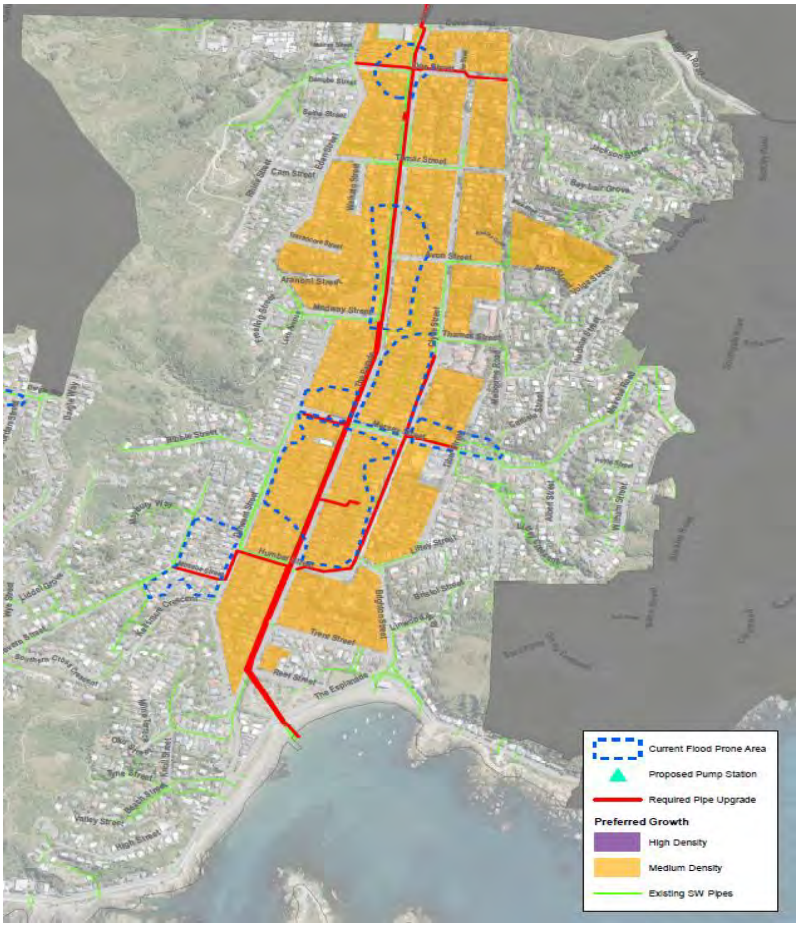


**Figure 21 – Predicted flooding and potential stormwater upgrades for Island Bay.**

## 4.6. Johnsonville

The estimated costing band of providing three waters at an adequate level of service to provide for projected growth in the Johnsonville growth area is Band F, $200M to $5500M.

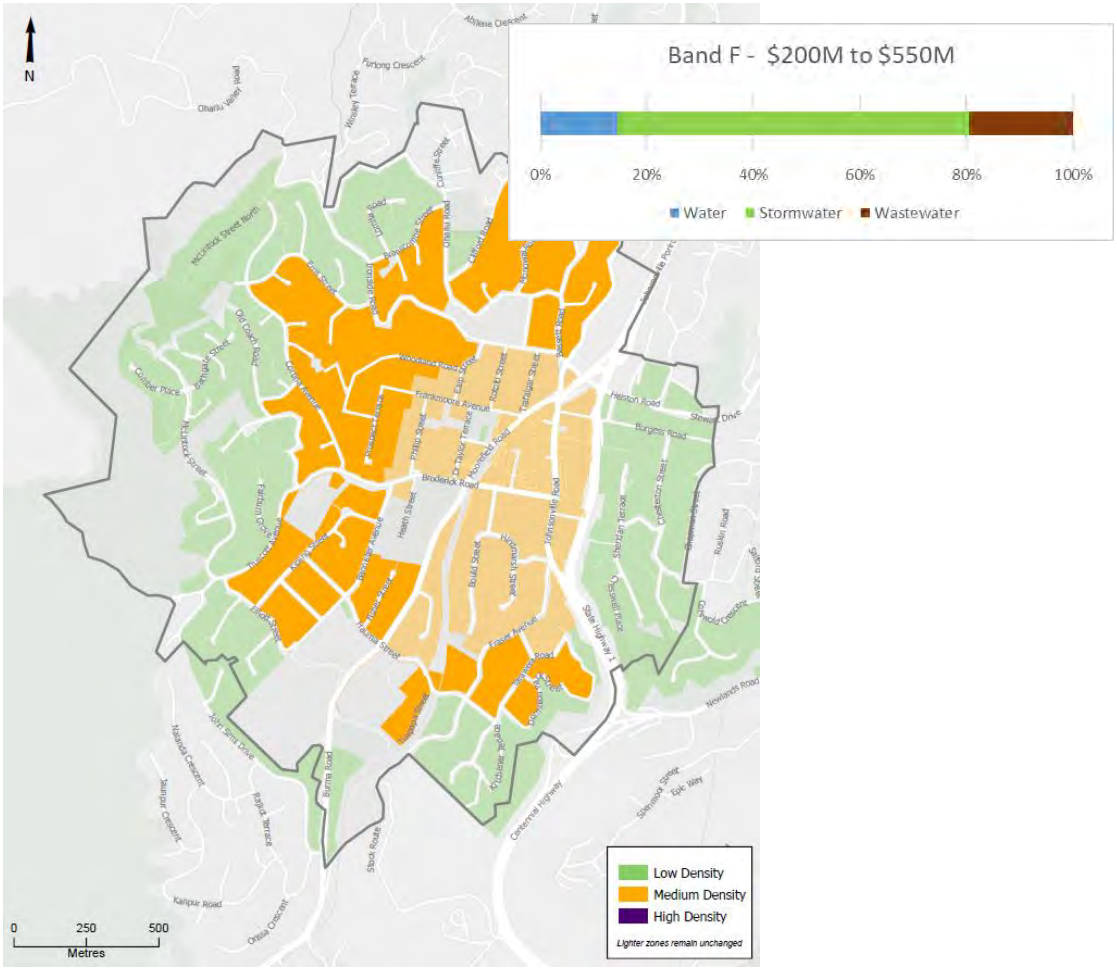


**Figure 22 – Johnsonville Preferred Growth Scenario for 5,700 additional people**[9]

| | Existing Constraints | Needed Infrastructure |
|---|---|---|
| **Water** | A few properties with low water pressure | Mains upgrades and around 6 ML additional water storage required |
| **Wastewater** | Under capacity and poor condition pipes and increased wet weather overflows | Renewal of poor quality pipes (4.1km) and upgrades for capacity with storage (3.3 ML) and contribution to WWTP upgrade |
| **Stormwater** | Extensive flooding due to topography and undersized pipes and lack of protected overland flow paths | The pipe upgrades identified are assumed to be indicative of the scale of investment needed to manage flooding. The actual solution is likely to be a mix of pipes, pumps and building control measures and stormwater treatment devices |

[9] Image Source BECA. Name of Map: Preferred Growth Scenario. Date: 12/07/2019

### 4.6.1. Water supply

**Water supply zone**: The preferred growth area in Johnsonville is supplied from four DMAs - Johnsonville South, Johnsonville West, Johnsonville West PRV and Johnsonville North. Johnsonville South zone is fed under gravity from the Johnsonville Reservoirs (TWL 222m); however, it also exports flow to all the other subzones operating in the Johnsonville Supply Zone.

**Pressure**: Johnsonville West is fed through the Broderick Road Pumping Station which is supplied through a 200 mm main running along Broderick Road. The losses along this main, caused by the suction pressure associated the pumping station, result in low pressure currently affecting around 60 customers in the Johnsonville South DMA. This occurs at Arapiko Street, Hollies Crescent, Elliot Street and Sheridan Terrace.

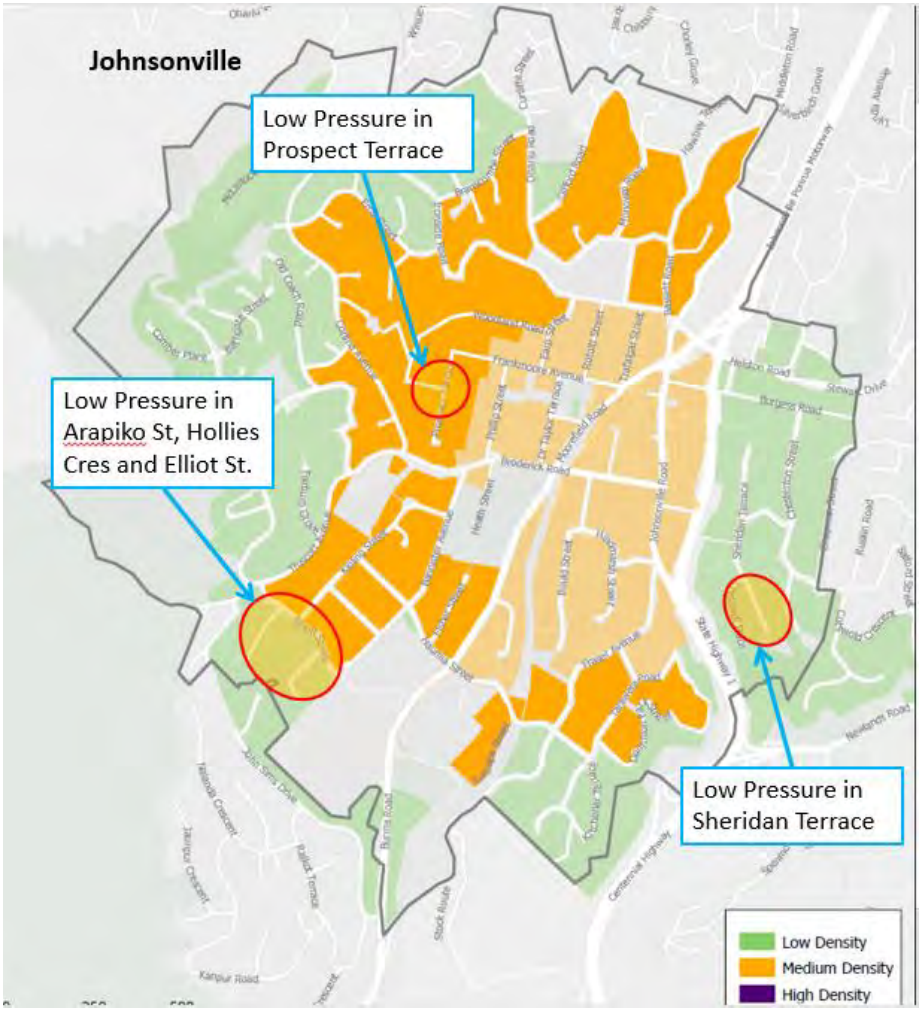


**Figure 23– Existing areas of low pressure in Johnsonville.**

No significant low pressure issues were identified in the Johnsonville West and Johnsonville West PRV zones under current peak demand. Within the Johnsonville North zone, there is high elevation area in Prospect Terrace where the network pressure drops below 25 m while Broderick Road pumping station is operating. Future growth will likely exacerbate this issue, and it is predicted that network pressures around this area could drop below 20 m, affecting up to 30 customers.

**Mains**: To accommodate the proposed growth, 2.2 km of main would need to be upgraded to 375 mm diameter from the Johnsonville reservoirs on Burgess Road from Chesterton Street to Johnsonville Road, on Johnsonville Road from Broderick Road to Ironside Road, on Ironside

Road from Johnsonville Road and on Broderick Road from Johnsonville Road to Cortina Avenue. An identified 0.5 km of main is identified to be upgraded to 300 mm diameter from Chesterton Street to Johnsonville Road cross Sheridan Terrace and 0.4 km of main would be upgraded to 450 mm diameter on Chesterton Street from Burgess Road, and the intersection of Broderick Road/Cortina Avenue , Ironside Road/Erris Street and Johnsonville Road.

There are about 43 km of distribution network in Johnsonville suburb, and about 9 km are AC pipes. It is recommended to replace the AC pipes over time. There are also about 1 km of pipes with other materials which have been installed more than 70 years ago in this area. Those would be close to their end of life cycle when the proposed growth developments are fully implemented and are not included in estimates.

**Storage**: Existing water reservoirs in Johnsonville and Khandallah suburbs can interchangeably be used to supply water especially during a seismic event. A preliminary analysis indicated that in order to accommodate the projected growth in Johnsonville and Khandallah suburbs, there would be around 9 ML additional water storage required of which 3 ML is to cover for current shortfall. At least two reservoirs with the total capacity of 9 ML (6 ML for Johnsonville and 3 ML for Khandallah) would be required to supply these two suburbs. Further investigations are needed to confirm the actual capacity, number and location of those required reservoirs (please refer to storage requirements in Khandallah, section 4.9.1).

### 4.6.2. Wastewater

Wastewater from the Johnsonville growth area is largely conveyed to the Moa Point WWTP for treatment and disposal. The northern end of Johnsonville is conveyed to the Porirua WWTP.

A number of upgrade options are identified to alleviate current capacity constraints in the local wastewater network.

The options include extending the trunk wastewater network with approximately 2.5 km of trunk main. In addition, to meet the future water quality requirements approximately 1.6 km of poor condition pipes need to be renewed.

Any development in this catchment will need to be considered together with wastewater storage requirements along the interceptor between Ngaio Gorge and before Mount Albert Tunnel.

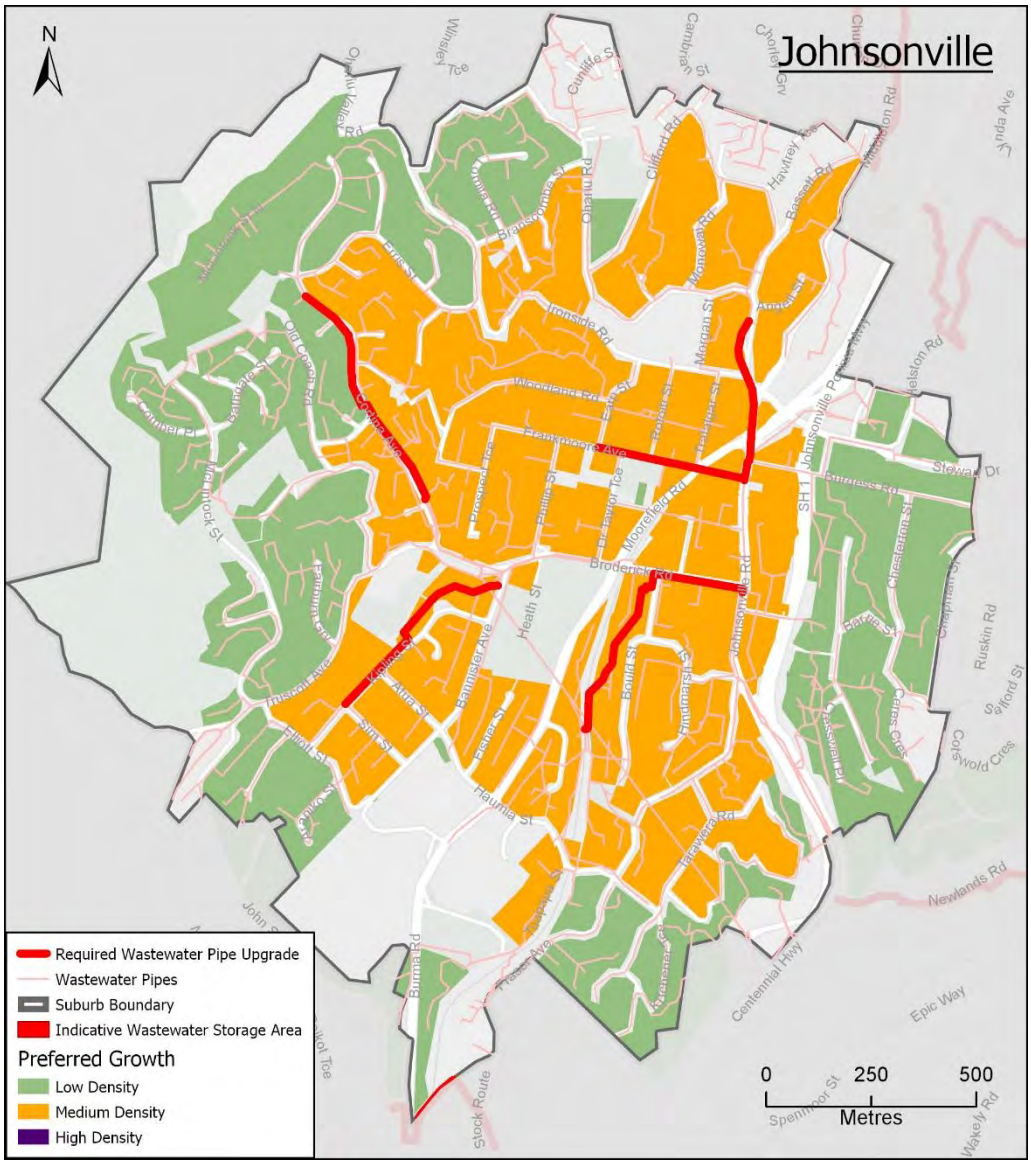


**Figure 24 – Proposed wastewater upgrades for Johnsonville**

### 4.6.3. Stormwater

The area of Johnsonville, especially the low-lying portion where the bulk of growth is proposed has historically suffered from flooding problems due to lack of natural drainage. Following the 1976 flood, a major stormwater construction project created a tunnel to intercept flood flows down Broderick Road and convey them to Ngauranga Gorge. For many years this tunnel has provided a reasonable base level of protection to the low-lying valley floor surrounding the Johnsonville shopping and business area. However development on the surrounding hillsides has reduced the effectiveness of the tunnel and moderate flooding is now expected to occur in a 1 in 10-year rainfall event.

Johnsonville is already experiencing intense interest from developers who have frequently expressed concern at the lack of council action to address the current flood risks and the restriction that flooding already is on development.

In order to mitigate Johnsonville main flooding problems and accommodate growth, around 9 km of stormwater network would require upgrading. This would include another major trunk similar to that constructed after 1976 flood. The high cost of such a solution is assumed to be indicative of the potential cost of managing flooding risks in this area.

As an alternative to another major stormwater trunk, a pump station that would allow greater utilisation of the existing trunk main can be considered during more detailed optioneering.

In addition to alleviating flood risks to growth, there are also water quality constraints that will require WWL to manage stormwater to address the outcomes of the Te Whanganui-o-Tara Whaitua, the NPS-FM and the global stormwater discharge consent conditions. While Ngauranga Stream has low public interaction there is likely to be some demand for improvements and these have also been factored into our cost band.

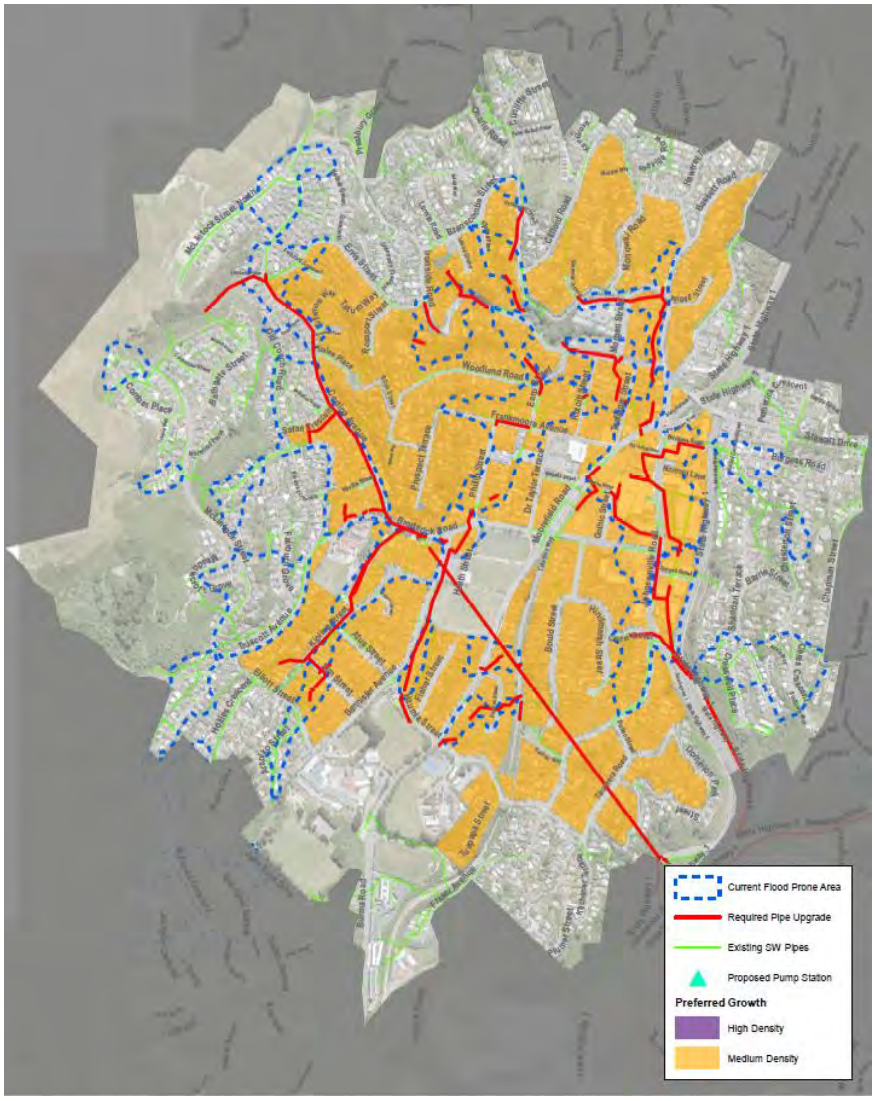


**Figure 25 – Predicted flooding and potential stormwater upgrades for Johnsonville.**

## 4.7. Karori

The estimated costing band of providing three waters at an adequate level of service to provide for projected growth in the Karori growth area is Band F, $200M to $550M.

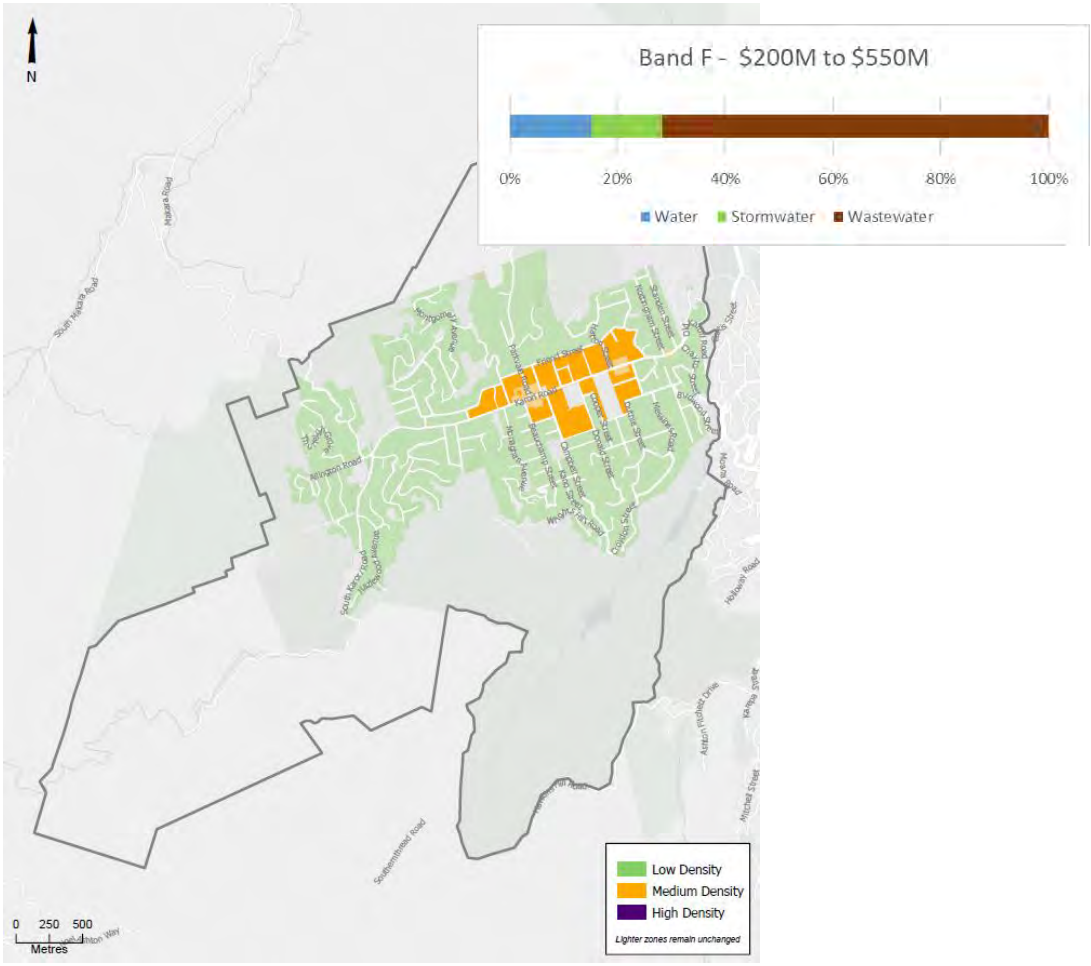


**Figure 26 – Karori Preferred Growth Scenario for 6,600 additional people[10]**

| | Existing Constraints | Needed Infrastructure |
|---|---|---|
| **Water** | A number of properties with low water pressure | Mains upgrades and around 5.5 ML additional water storage is required |
| **Wastewater** | Poor and under capacity condition pipes, wet weather related overflows and treatment plant and outfall capacities | Local pipe renewals (12.3 km) to meet capacity and water quality needs and 5.5 ML storage tank, new WWTP and outfall replacement |
| **Stormwater** | Areas of surface flooding and overland flows | Approximately 3 km of stormwater network needs upgrading and stormwater treatment devices |

[10] Image Source BECA. Name of Map: Preferred Growth Scenario. Date: 12/07/2019

### 4.7.1. Water supply

**Water supply zone**: Water in Karori is supplied from the Messines Reservoir (TWL 221 m). A number of other higher-elevation pressure zones are supplied through booster pump stations from the main Karori pressure zone including:

- Croydon (TWL 257 m)
- Wrights Hill (TWL 293 m)
- Makara (TWL 243 m)
- Karori West (TWL 274 m)
- Karori West High Level (TWL 312 m)

The preferred growth area in Karori is located within the Messines DMA and Karori East DMA which are both supplied from the Messines Reservoir.

**Pressure**: There are a number of areas where low pressures currently exist for properties located at a relatively high altitude in the vicinity of reservoirs. These low pressures are not expected to worsen significantly by intensification. These areas are as follows:

- approximately 90 properties in Versailles Street (all above 225 m elevation) in the vicinity of Croydon Reservoir.
- approximately 25 properties in Messines Road (all above 190 m elevation) in the vicinity of Messines Reservoir.
- approximately 25 properties in Montgomery Avenue; 10 properties are above 285 m elevation in the vicinity of Karori West High Level Reservoir, and the other 15 properties are above 250 m in the vicinity of Karori West Reservoir.
- approximately 10 properties in Makara Road (all above 220 m elevation) in the vicinity of Makara reservoir.
- approximately 20 properties in Shooter Street and Baxter Way (all above 265 m elevation) in the vicinity of Wrights Hill Reservoir.

There are also a number of locations where low pressures exist, where network head losses are not currently excessive but could be made worse by intensification. These areas are as follows:

- approximately 35 properties in Hatton Street
- approximately 10 properties in David Crescent
- approximately 10 properties in Beatty Avenue.

These properties are all above 190 m elevation and are supplied by Messines Reservoir.

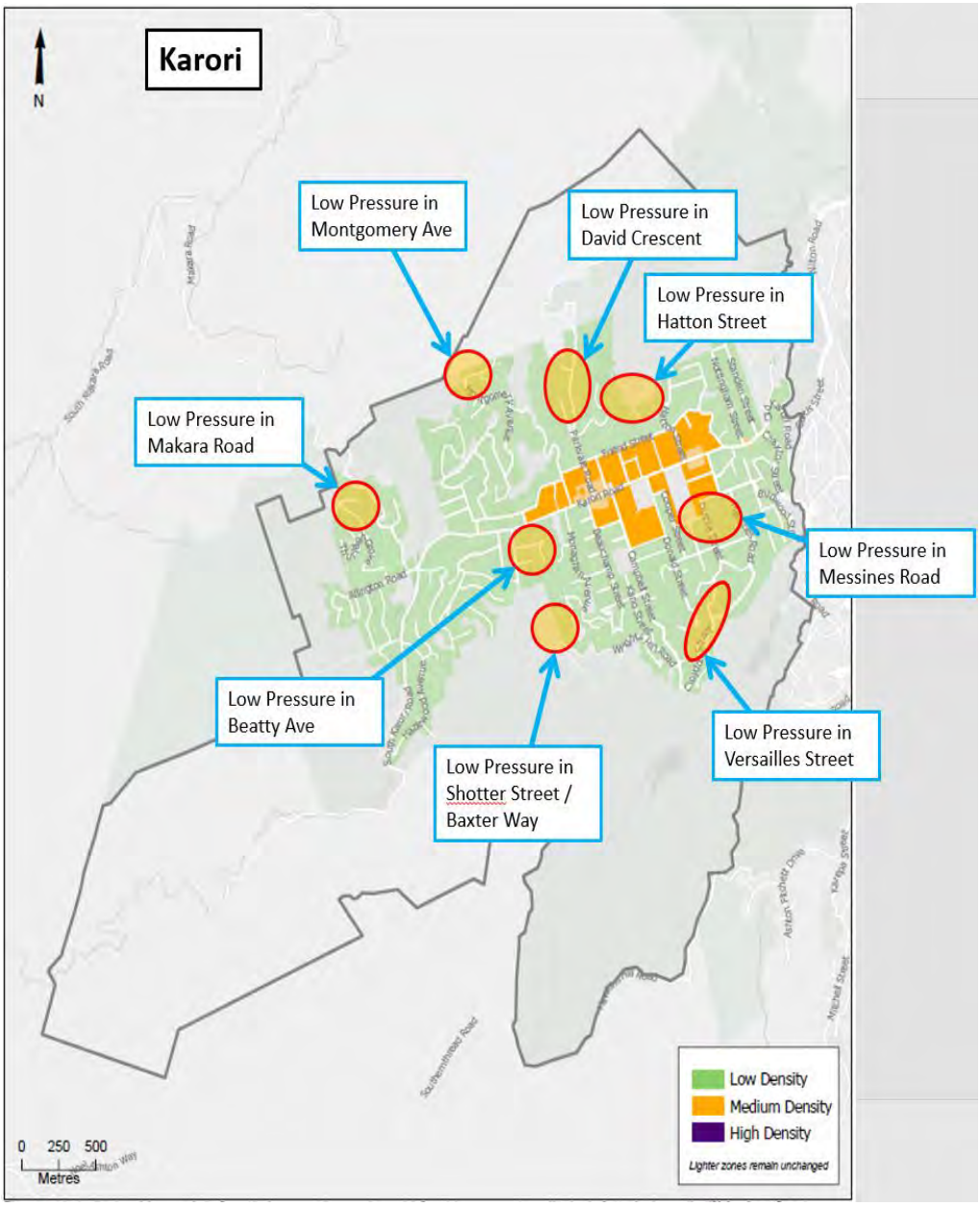


**Figure 27 – Predicted areas of existing low water pressure in Karori**

**Mains**: To accommodate the proposed growth, 2.5 km of trunk mains are to be upgraded to 300 mm diameter forming trunk mains down from the reservoir.

There are about 72 km of distribution network in Karori, and 24 km are AC pipes. It is recommended to replace the AC pipes over time. There are also about 12 km of pipes with other materials which have been installed more than 70 years ago in this area. Those would be close to their end of life cycle when the proposed growth developments are fully implemented and are not included in estimates.

**Storage**: A preliminary analysis indicated that in order to accommodate the projected growth in Karori, there would be around 5.5 ML additional water storage required of which about 1 ML is needed for the existing deficit.

### 4.7.2. Wastewater

Wastewater from the Karori growth area is conveyed to the Western WWTP for treatment and disposal. The Western WWTP is at capacity with the current population and additional growth

of around 5,000 people as proposed will trigger a major upgrade of the plant at Karori. It is likely that an additional plant such as membrane bioreactor (MBR) technology would be required if treated wastewater were discharged to Karori Stream. The outfall pipe to the ocean also needs to be replaced.

In addition to the upgrades needed to the WWTP and outfall pipe, the Karori wastewater network has major constraints due to under-capacity of the main trunk, excessive inflow and infiltration, and several locations that overflow untreated wastewater to the Karori Stream.

To meet future water quality requirements renewal of 12.3 km of poor condition pipe is required.

The Karori catchment has 11 constructed overflows and 2 of these overflow at the 1 -year ARI with the current population. The main trunk running through the middle of the catchment is under capacity for the future population[11].

The option identified to reduce overflows from the network is a 5.5 ML storage tank before the flows enter the treatment plant.

[11] Wellington Water Ltd. 2019. NPS-UDC Three Waters Infrastructure Enabled Development Capacity Wellington City Council. May 2019

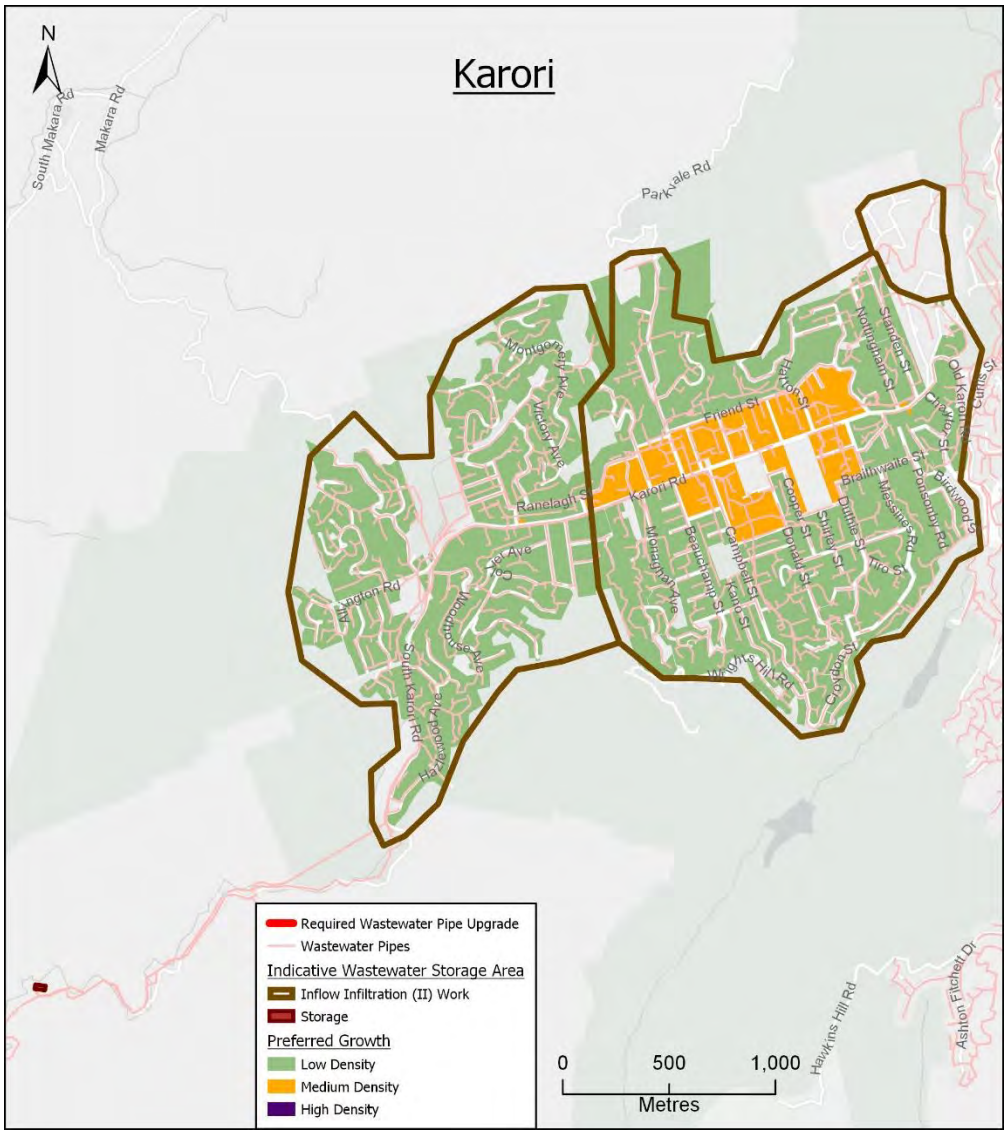


**Figure 28 – Proposed wastewater upgrades for Karori.**

### 4.7.3. Stormwater

Much of the Karori stormwater network does not have capacity to carry even common flood flows. The catchment has a history of surface flooding associated with overland flow paths and the Karori Stream. Of particular note is the large flood-prone area along Ranelagh Street/Ranelagh Terrace. There is also overland flow along South Karori Road and Allington Road which contributes to extensive flooding in Hildreth Street, Fernlea Avenue and Ranelagh Street[12].

In order to manage existing flooding problems in Karori where medium density growth is proposed, 3 km of stormwater network needs upgrading. Much of this will require large diameter pipes.

For the WCC Spatial Plan, Council should considered that Karori stream has limited capacity and surrounding land use has heavily constrained the channel and its flood conveyance. While the upgrades identified would reduce the flooding issues in the growth area, more flow would

[12] Wellington Water Ltd. 2019. NPS-UDC Three Waters Infrastructure Enabled Development Capacity Wellington City Council. May 2019.

make its way into Karori stream and this could exacerbate flooding problems in the areas adjacent to the stream. Currently WWL and WCC are investigating options to improve capacity of the Karori Stream by upgrading the culvert under Allington Road. The future performance of Karori Stream and potential impact from intensification on the properties along the banks of the stream will need to be assessed.

Water quality is already a vocal public concern in the catchment. Water quality constraints that will require WWL to manage stormwater to address the outcomes of the Te Whanganui-o-Tara Whaitua, the NPS-FM and the global stormwater discharge consent conditions. It is anticipated that as a minimum, runoff from new growth will need to be treated so that the water quality of Wellington City's streams and coastal waters are maintained or improved. To account for this additional level of service, new stormwater treatment devices, such as rain gardens, were identified based on the catchment area of land proposed for medium and high density growth.

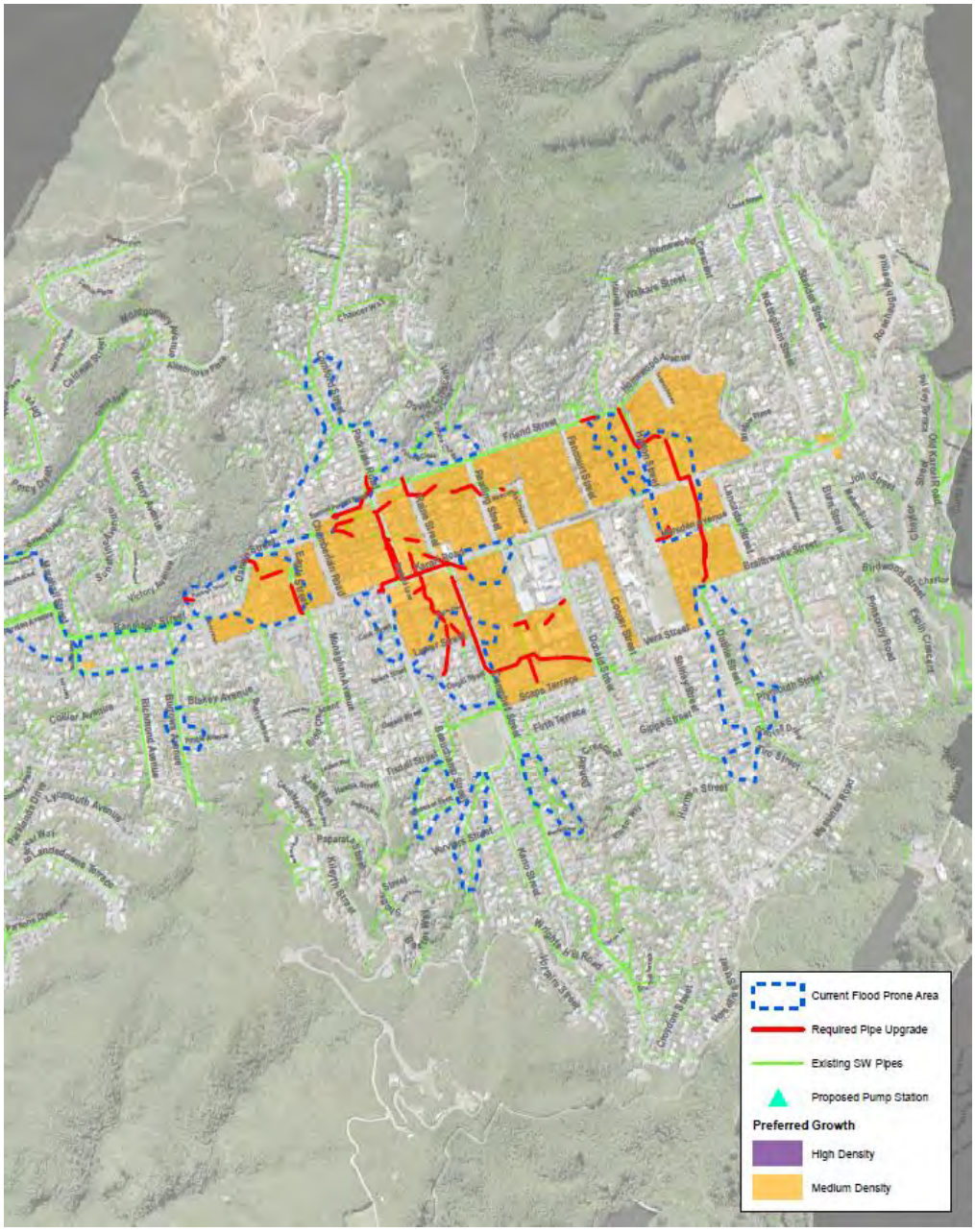


**Figure 29 – Predicted flooding and potential stormwater upgrades for Karori.**

## 4.8. Kelburn

The estimated costing band of providing three waters at an adequate level of service to provide for projected growth in the Kelburn growth area is Band E, $100M to $200M.

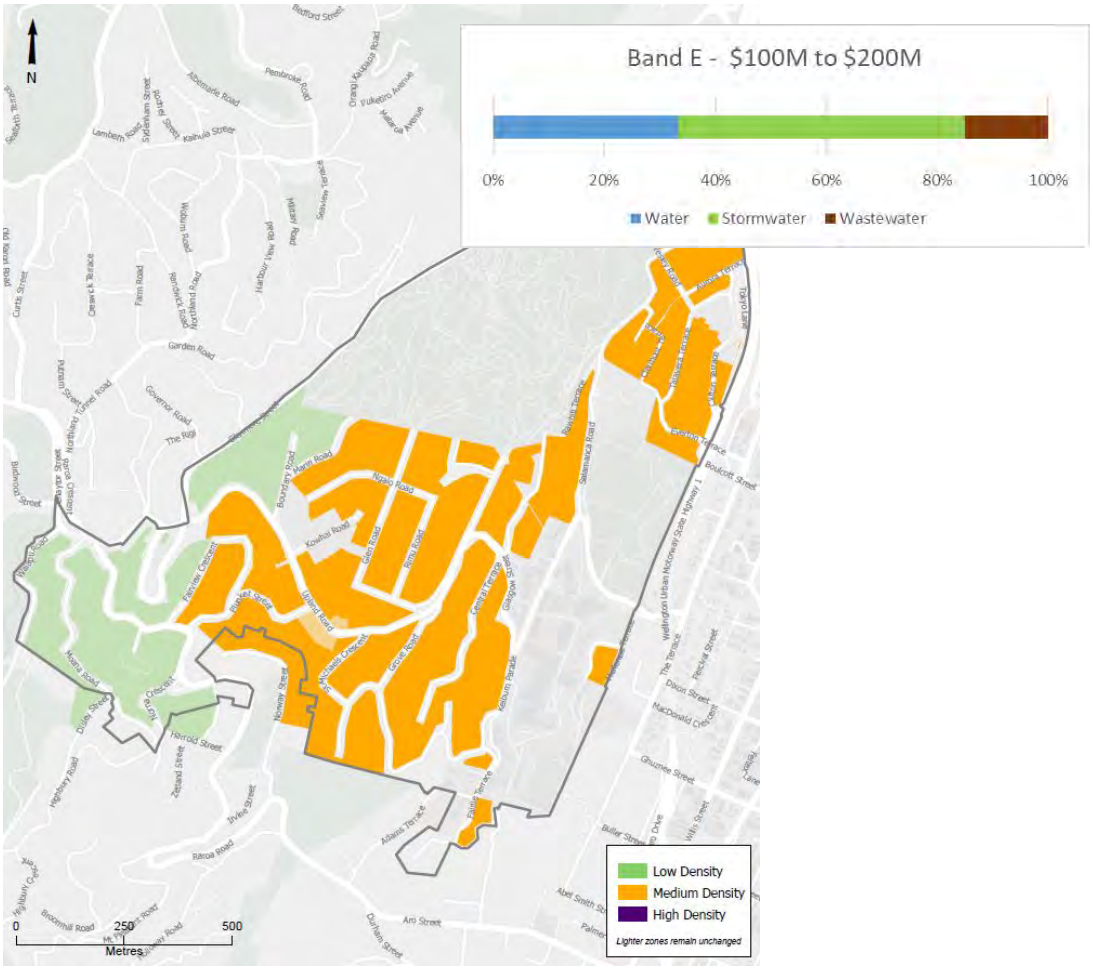


**Figure 30 – Kelburn Preferred Growth Scenario for 1,900 additional people**[13]

| | Existing Constraints | Needed Infrastructure |
|---|---|---|
| **Water** | Numerous properties with low water pressure | Pipe upgrades and around 2.2 ML additional water storage required |
| **Wastewater** | Poor condition pipes and increased wet weather overflows | Renewal of poor quality pipes (1.7 km) and storage (1.1 ML) to manage wet weather overflows and contribution to WWTP upgrade |
| **Stormwater** | Flooding on Kelburn Parade | Approximately 260m of pipe upgrades and stormwater treatment devices |

[13] Image Source BECA. Name of Map: Preferred Growth Scenario. Date: 12/07/2019

### 4.8.1. Water supply

**Water supply zone**: Kelburn is fed from the Kelburn Reservoir (TWL 207 m). Most of the network is fed from Kelburn Reservoir by gravity, but a small area in Highbury is boosted out of the Kelburn network to a TWL of 238 m. Note that Northland is also largely supplied by the Kelburn Reservoir, although it is not included in the Kelburn intensification area.

**Pressure**: No significant low pressure issue has been spotted as part of this high level analysis for the identified area in Kelburn (including Northland).

There are two areas in Northland (Albemarle Road and Putnam Street) where increased demand in the Kelburn intensification area might affect pressures for small numbers of higher elevation properties:

- pressures in Albemarle Road currently drop to around 25 m, but this area could potentially be rezoned onto Wadestown, if required.
- pressures in Putnam Street currently drop to just below 30 m for 3 properties. There are no rezoning options for this location.

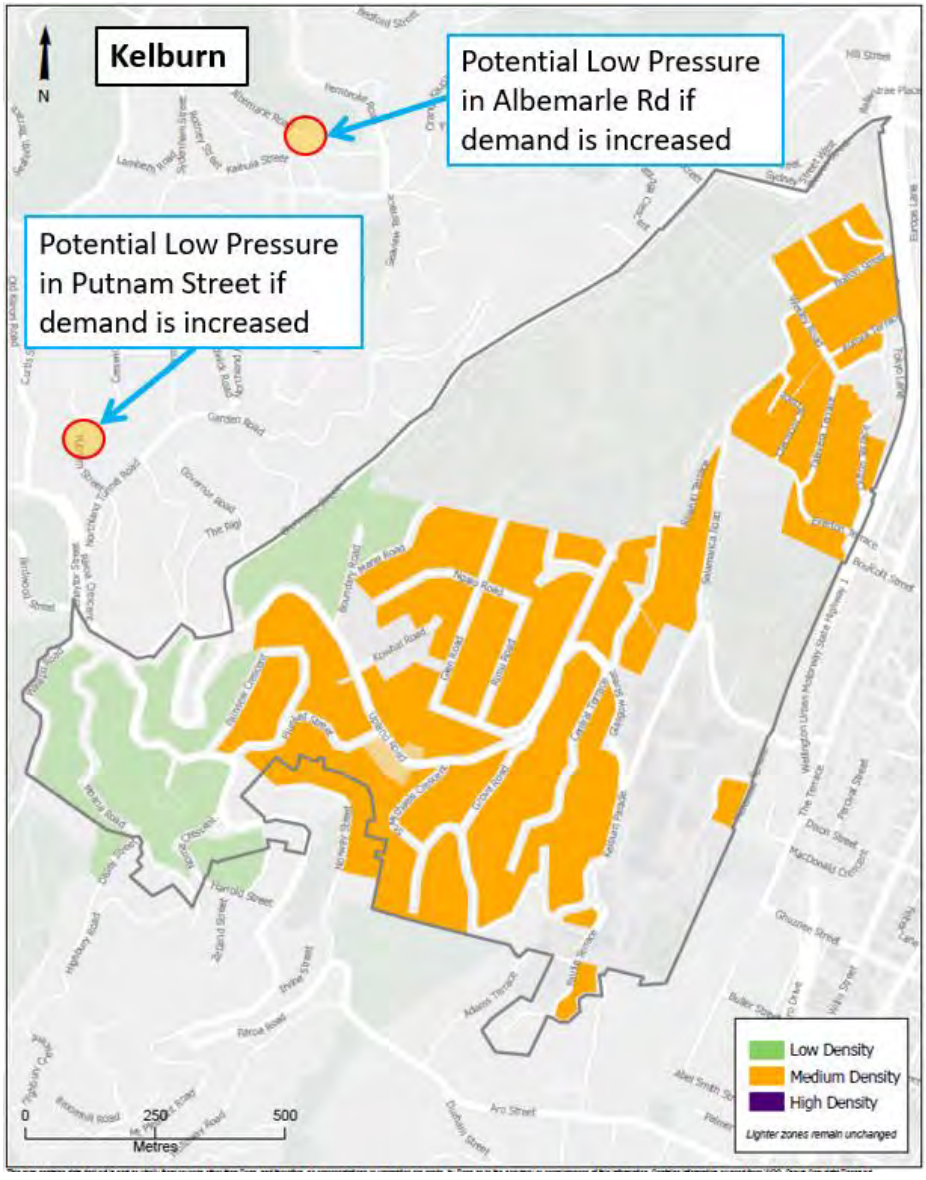


**Figure 31 – Potential future areas of low pressure in Kelburn.**

**Mains**: To accommodate the proposed growth, 1.2 km of main would need to be upgraded to 300mm diameter from the Kelburn reservoir and Disley Street, Raroa Rd, Moana Road, Nora Crescent and Plunket Street to Upland Road. Also Glenmore Street to Plunket Street on Raroa Road. As well some mains upgrades to address low pressure areas are required.

There are about 11 km of distribution network in Kelburn suburb, and 1 km are AC pipes. It is recommended to replace the AC pipes over time. There are also about 4 km of pipes with other materials which have been installed more than 70 years ago in this area. Those would be close to their end of life cycle when the proposed growth developments are fully implemented and are not included in estimates.

**Storage**: A preliminary analysis indicated that in order to accommodate the projected growth in Kelburn, around 2.2 ML additional water storage is required of which about 0.8 ML is needed for the existing shortfall.

### 4.8.2. Wastewater

Wastewater from the Kelburn growth area is conveyed to the Moa Point WWTP for treatment and disposal.

Although there are no existing constraints in the local wastewater pipes in the Kelburn growth area, additional wastewater flows from future populations will contribute to constraints in the downstream network and WWTP. In addition, there are approximately 1.7 km of poor or very poor condition (grade 4 and 5) wastewater pipes which will need to be renewed to alleviate adverse effects of wastewater leaks on water quality.

### 4.8.3. Stormwater

The Kelburn growth area is subject to some minor flooding and the low-laying area along Kelburn Parade is subject to significant flooding.

To manage the flood risks along Kelburn Parade, which effects the university and some of the proposed growth area, 250 m of stormwater network would require upgrading. Alternative options could include storage. These proposed upgrades are preliminary and are subject to further assessment and optioneering.

This area could also be subject to water quality enhancement and opportunities have been included in the costs.

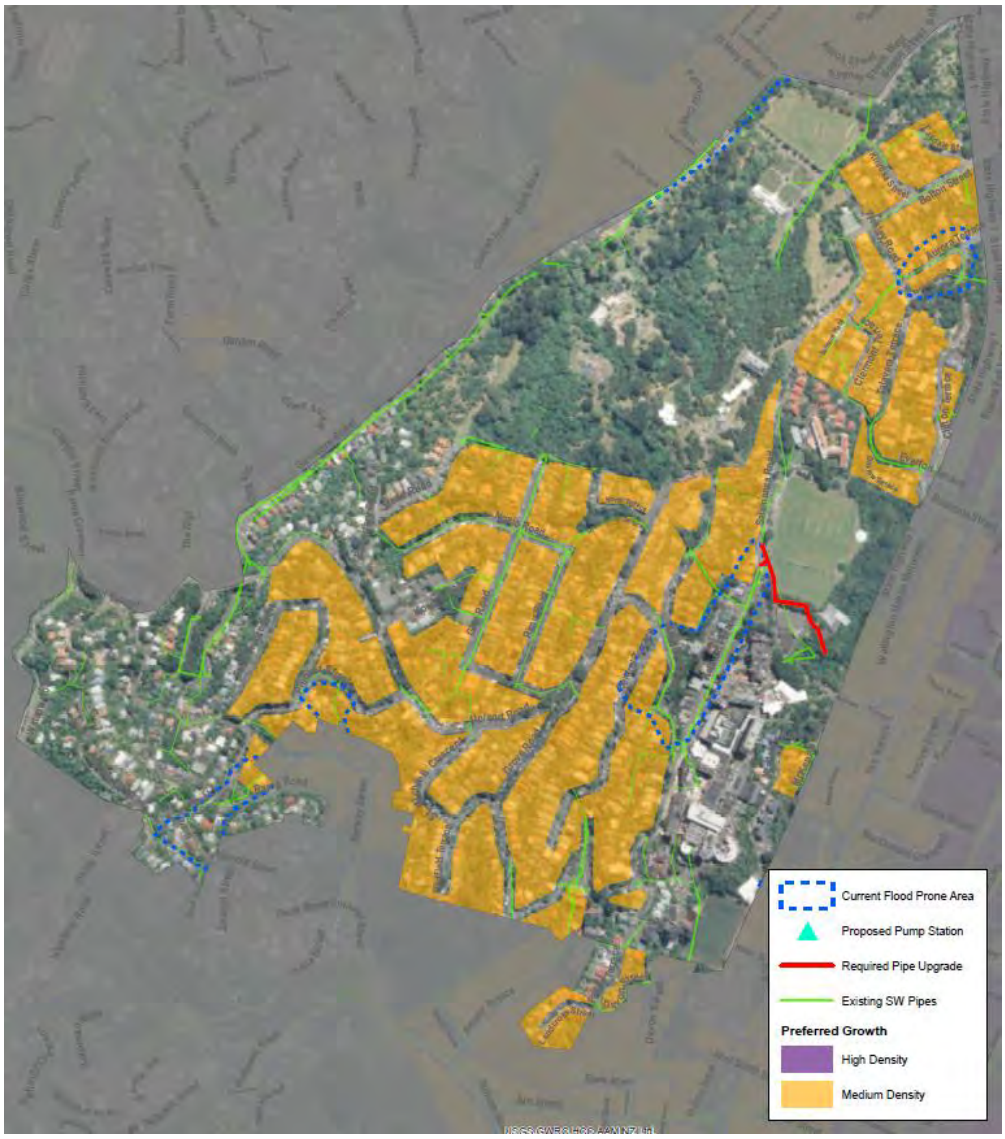


**Figure 32 – Predicted flooding and potential stormwater upgrades for Kelburn.**

## 4.9. Khandallah

The estimated costing band of providing three waters at an adequate level of service to provide for projected growth in the Khandallah growth area is Band E, $100M to $200M].

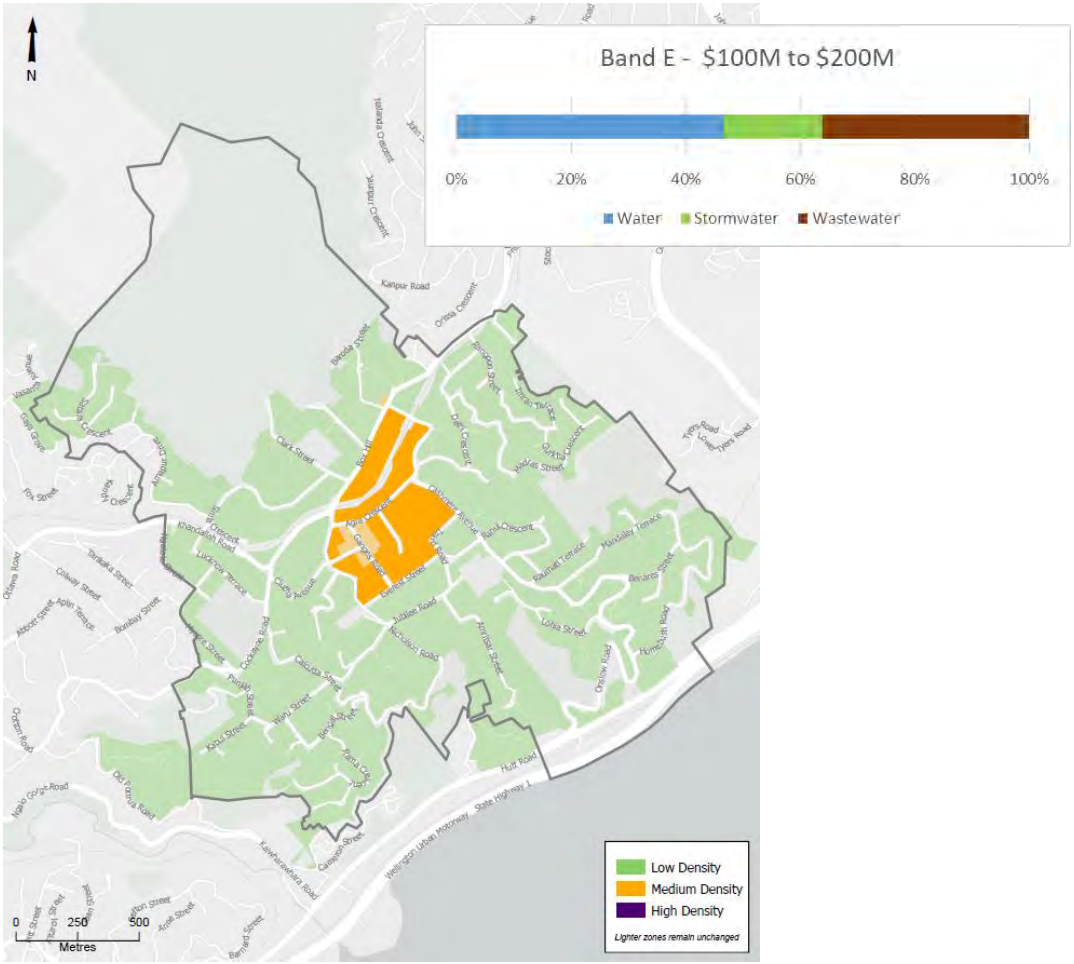


**Figure 33 – Khandallah Preferred Growth Scenario for 2,800 additional people**[14]

| C | Existing Constraints | Needed Infrastructure |
|---|---|---|
| **Water** | A few properties with low water pressure | Mains upgrades, booster pump station and around 3 ML additional water storage required |
| **Wastewater** | Under capacity and poor condition pipes and increased wet weather overflows from interceptor. | Renewal and upgrade of pipes (4.9 km) and storage (1.6 ML) to manage wet weather overflows and contribution to WWTP upgrade. |
| **Stormwater** | Unknown as flood modelling is incomplete | 800 m of pipe upgrade, overland flow path protection and stormwater treatment devices. |

[14] Image Source BECA. Name of Map: Preferred Growth Scenario. Date: 12/07/2019

### 4.9.1. Water supply

**Water supply zone:** The preferred growth area in Khandallah is part of the Onslow DMA, which is fed directly from Onslow Reservoirs No 1 and No 2 with a TWL of 220 m.

**Pressure**: There is an isolated area of low pressure at the corner of Bengal and Kabul streets affecting approximately 25 customers, though currently pressure does not fall below 22 m. This is a high elevation area on the border of Ngaio and Onslow. In this area, there is almost no demand-based head loss and residents are lower than street level, so they likely receive better pressure than 22 m. This issue is not predicted to be significantly exacerbated by growth.

Low pressures were also identified at the corner of Himalaya Crescent and Jubilee Road with approximately 28 customers currently having pressures between 21 and 25 m. The issue results from the high elevation properties combined with some demand-related head losses which may be pronounced with the proposed Medium Density growth.

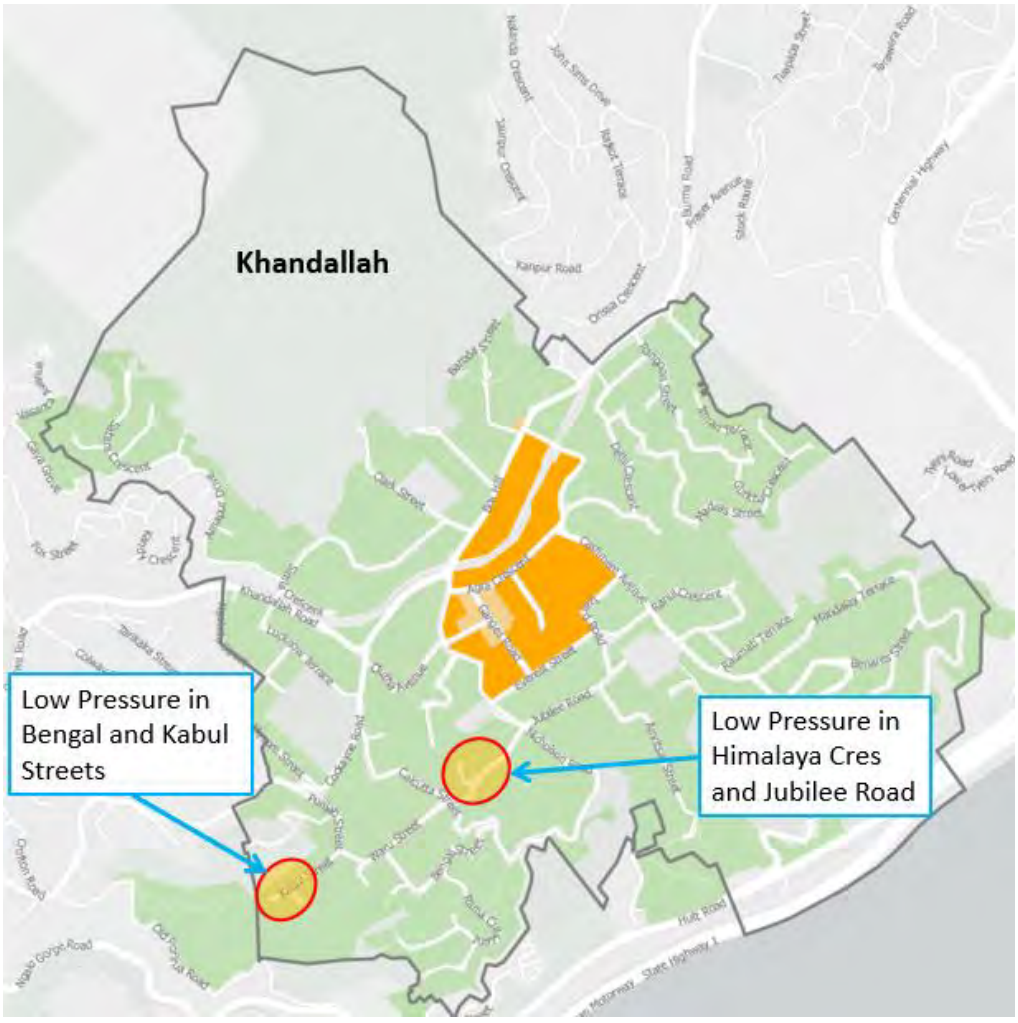


**Figure 34 – Existing areas of low pressure in Khandallah.**

To address the issue in Himalaya Crescent and Jubilee Road, a booster pumping station at the corner of Himalaya and Jubilee which creates a small pressure managed area would be required. This zone would also require approximately 140 m of new 100 mm main, running between the booster station and Clive Road.

**Mains**: To accommodate the proposed growth, 0.8 km of main needs to be upgraded to 300 mm diameter on Cockayne Road from the intersection of Punjab Street to Clutha Avenue and 1.3 km of main needs to be upgraded to 200 mm diameter from Clutha Avenue, Agra Crescent,

and Cashmere Avenue to the end at Ranui Crescent. Some other minor mains upgrades are also required.

There are about 37 km of distribution network in the Khandallah suburb, which 13 km are AC pipes. It is recommended to replace the AC pipes over time. There are also about 10 km of pipes with other materials which have been installed more than 70 years ago and would be close to their end of life cycle when the proposed growth developments are fully implemented and are not included in estimates.

**Storage**: Existing water reservoirs in Johnsonville and Khandallah suburbs can interchangeably be used to supply water especially during a seismic event. A preliminary analysis indicated that in order to accommodate the projected growth in Johnsonville and Khandallah suburbs, there would be around 9 ML additional water storage required (6 ML for Johnsonville and 3 ML for Khandallah) of which 3 ML is to cover for current shortfall. At least two reservoirs with the total capacity of 9 ML would be required to supply these two suburbs. Further investigations are needed to confirm the actual capacity, number and location of those required reservoirs.

### 4.9.2. Wastewater

Wastewater from the Khandallah growth area is conveyed to the Moa Point WWTP for treatment and disposal

Around 3.1 km of pipe upgrade have been proposed for current deficiencies. In general there is lack of capacity in the local wastewater network in and around the constructed wastewater overflow at Khandallah Tennis Club. High levels of inflow & infiltration also exist in this catchment and as such the trunk wastewater from Khandallah to Ngauranga Gorge is under-capacity. Renewal of 1.8 km of poor condition wastewater pipes are needed to address water quality.

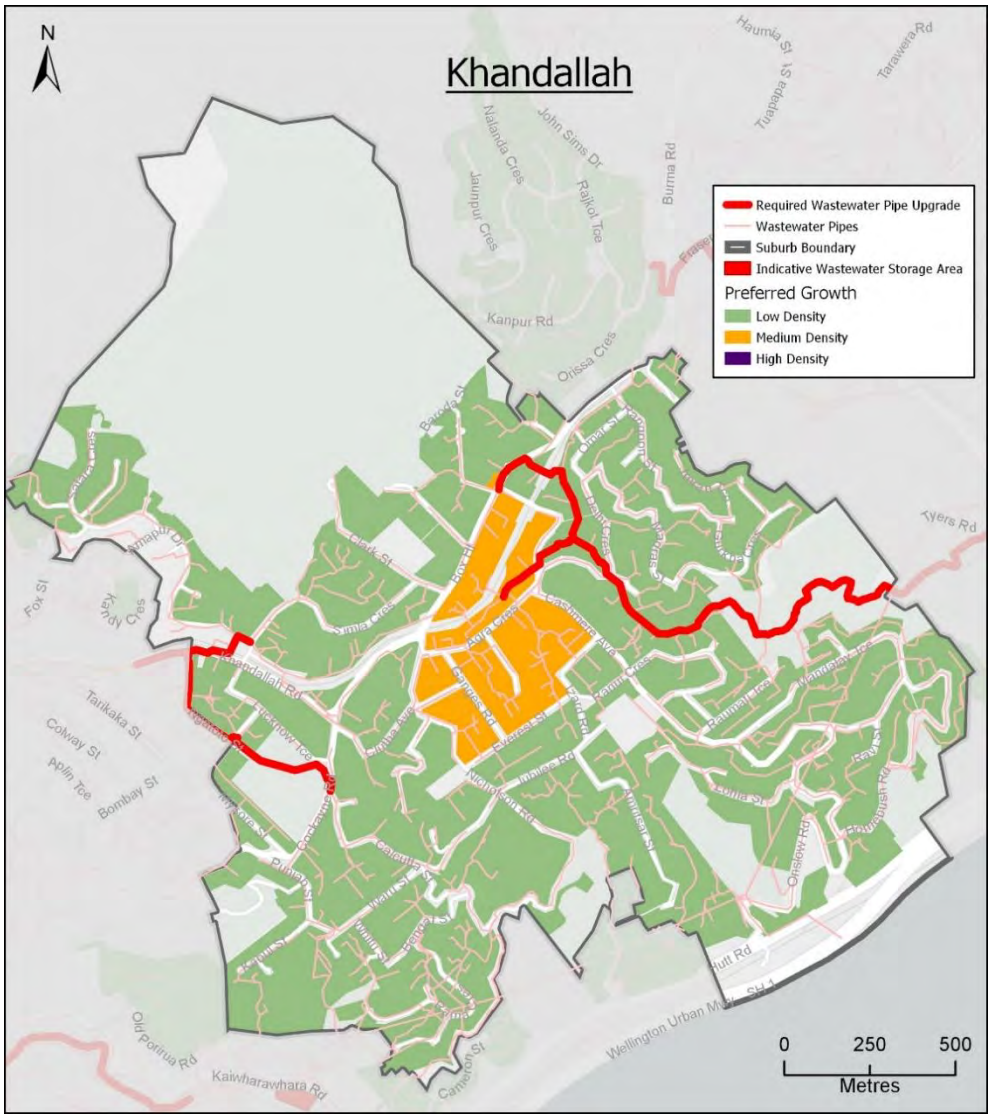


**Figure 35 – Proposed wastewater upgrades to allow for growth in Khandallah.**

### 4.9.3. Stormwater

The Khandallah area has not been modelled and likelihood of major flooding problems is unknown. However, like many other areas around Wellington Region, it is likely that this area would experience some flooding. It is assumed 800m of main stormwater pipes would require upgrading.

There are opportunities for water quality improvements in this area within the medium density locations and these costs have been included.


**Figure 36 – Predicted flooding and potential stormwater upgrades for Khandallah**

## 4.10. Kilbirnie

The estimated costing band of providing three waters at an adequate level of service to provide for projected growth in the Kilbirnie growth area is Band E, $100M to $200M.

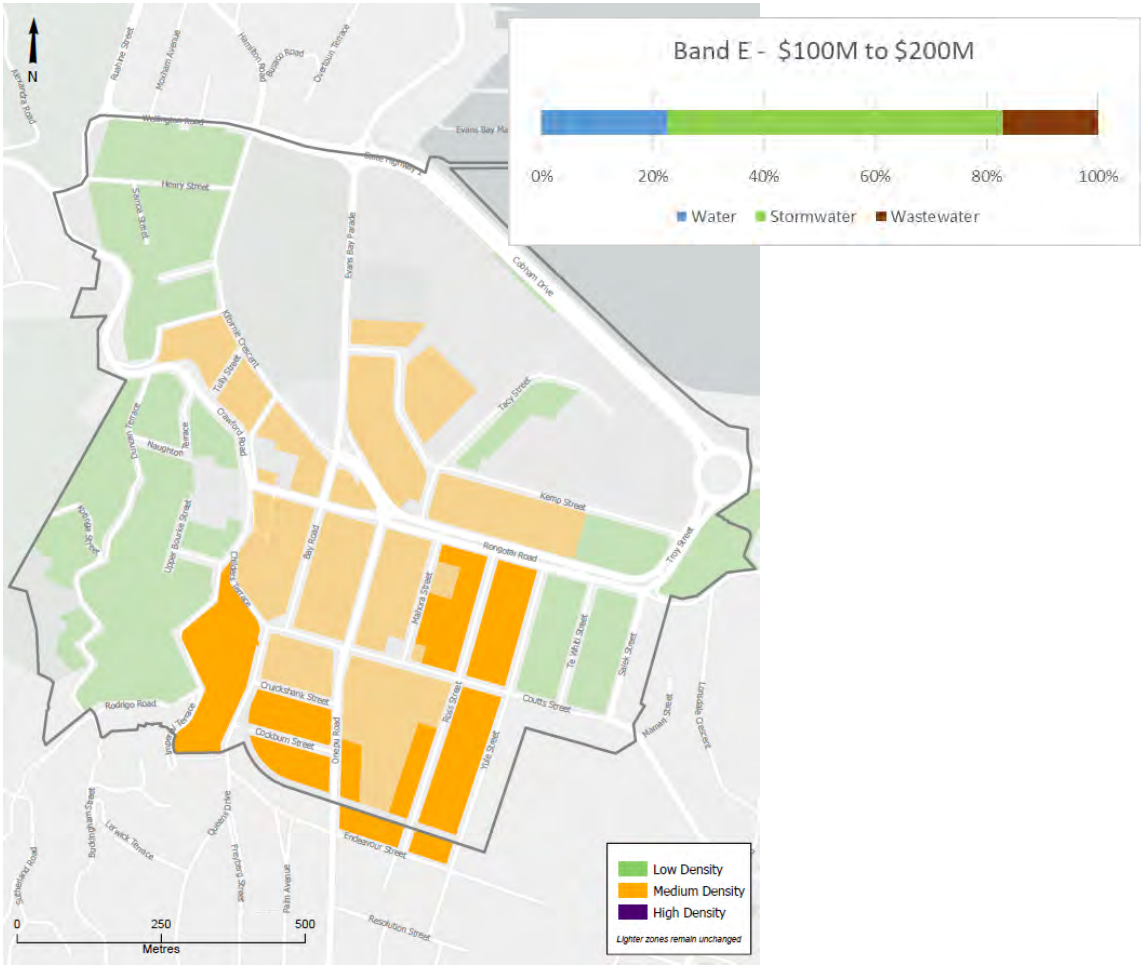


**Figure 37 – Kilbirnie Preferred Growth Scenario for 1,300 additional people**[15]

| C | Existing Constraints | Needed Infrastructure |
|---|---|---|
| **Water** | No major existing constraints | Mains upgrades to maintain existing pressures are required. Storage upgrades have been applied to the Miramar growth zone. |
| **Wastewater** | Pipe capacity and poor condition and treatment plant capacity | Upgrade and replacement of pipes (3 km), storage (0.8 ML) and contribution to WWTP upgrades |
| **Stormwater** | Extensive flooding likely to be compounded by high tide and sea level rise | 3 km of stormwater pipe upgrades and a pump station with at least 5 $m^3/s$ capacity and stormwater treatment devices |

[15] Image Source BECA. Name of Map: Preferred Growth Scenario. Date: 12/07/2019

### 4.10.1. Water supply

**Water supply zone:** The preferred growth area in Kilbirnie is connected to the Kilbirnie DMA and is fed from the Carmichael Reservoir and with the TWL of 92 m.

**Pressure**: A draft hydraulic model was recently completed for this area. That work is subject to review and assessed growth implications in excess of the proposed growth. While not necessarily aligning spatially with the growth areas it does not indicate any major mains upgrades. This would be subject to further assessment. Some mains upgrades maybe required to maintain existing pressures.

**Mains**. Only mains upgrades to maintain existing pressures are required.

There are about 17 km of distribution network in Kilbirnie, and 2 km are AC pipes. It is recommended to replace the AC pipes over time. There are also about 9 km of pipes with other materials which have been installed more than 70 years ago in this area. Those would be close to their end of life cycle when the proposed growth developments are fully implemented and are not included in estimates.

**Storage**: A preliminary analysis indicated that in order to accommodate the projected growth in both Kilbirnie and Miramar suburbs, around 12 ML combined additional water storage would be required, of which 10 ML is required for the existing shortfall. The additional storage has been assigned to the Miramar growth zone for this assessment (please refer to section 4.12.1 for more information on storage).

It should be noted that if the Kilbirnie and Miramar zones are considered to be supplied from Wellington Central system in a seismic event, some of this shortfall is likely to be covered by the construction of Omāroro Reservoir. Further detailed investigations are needed to refine these initial findings.

### 4.10.2. Wastewater

Wastewater from the Kilbirnie growth area is conveyed to the Moa Point WWTP for treatment and disposal

To service for growth in Kilbirnie 650 m of wastewater pipe has been identified for upgrade. Another 2.3 km of poor condition pipes need to be renewed to meet water quality requirements.

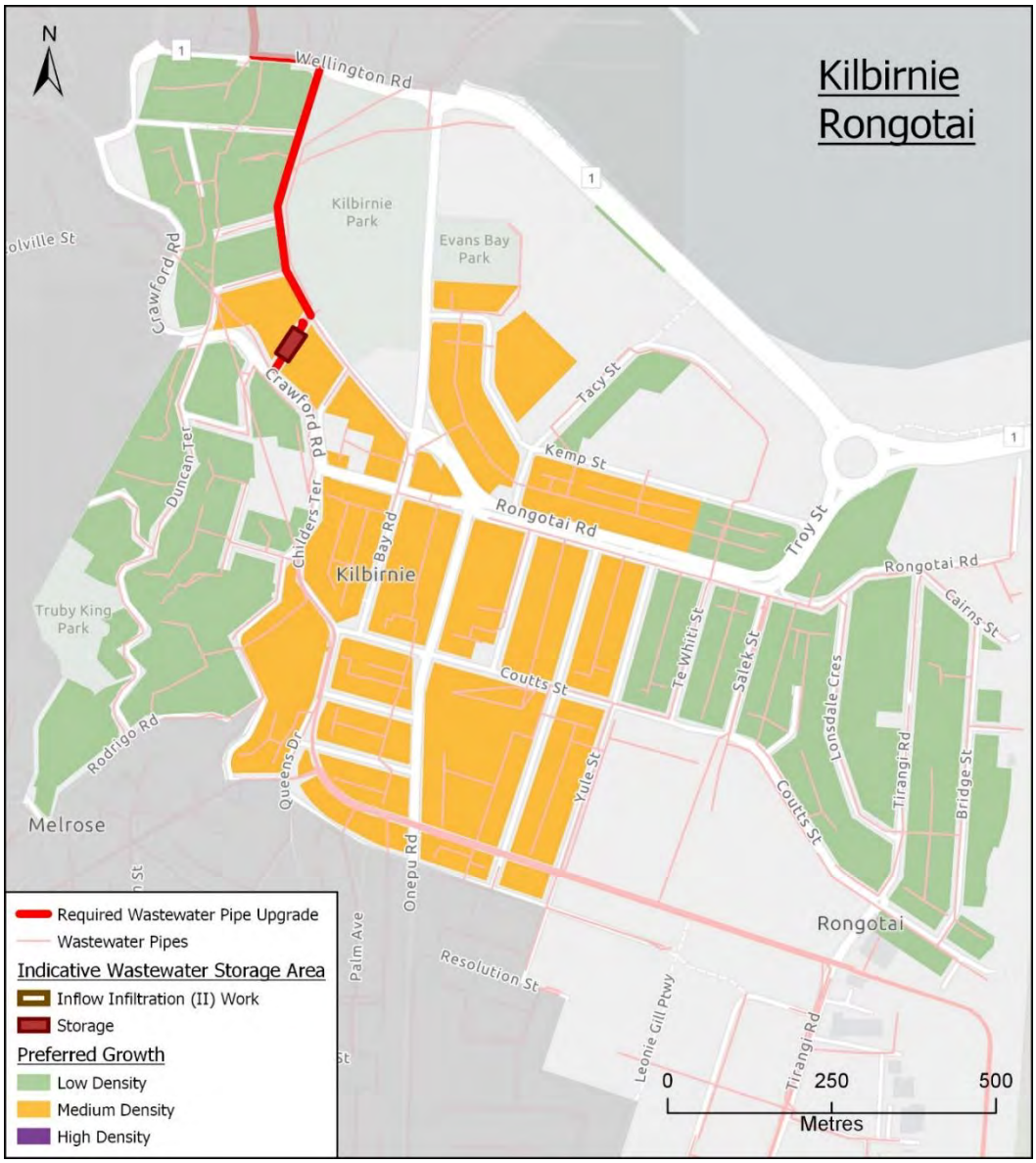


**Figure 38 – Proposed wastewater upgrades for Kilbirnie.**

Options to address capacity and overflow issues in Hataitai (that contributes to Kilbirnie growth area) are shown in the figure below. The options involve extra storage at pump station PS17, which is considered a system-wide upgrade for all growth areas (except Miramar) in the Moa Point WWTP catchment, and new pipes and upgrade work through Hataitai. These upgrade works will provide extra capacity in the network and reduce the frequency of overflows at constructed wastewater overflows.

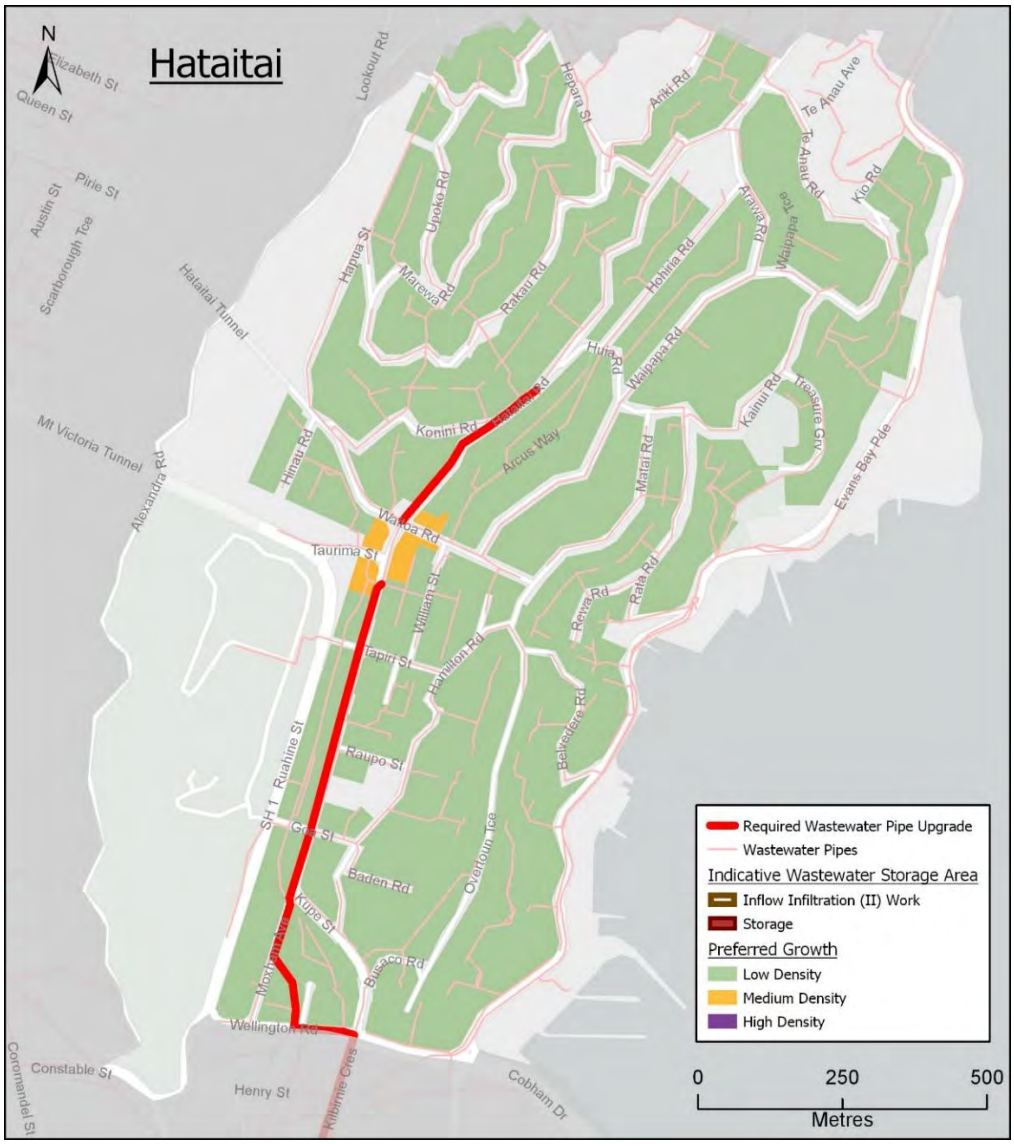


**Figure 39 – Proposed wastewater upgrades for Hataitai**

### 4.10.3. Stormwater

The area of Kilbirnie where growth is proposed is subject to existing flooding problems. In 2008 the Tacy Street Stormwater Pump Station project was completed which helps reduce the flooding from the eastern side of Kilbirnie. However the full benefits of this project will not be realised until the upstream network is upgraded. Also this project does not address flooding on the western side of the suburb. Between 2009 and the start of 2014 approximately 170 complaints have been made in relation to localised flooding, ponding, or water flowing out of the stormwater network in the Kilbirnie catchment.

Recently a major pipe upgrade was installed along Bay Road and Evans Bay Parade. This has raised the level of service but flooding risks remain in large storm events and when rainfall coincides with high tides. The low-lying areas of Kilbirnie are also vulnerable to the impacts of sea level rise. This area will become increasingly difficult to protect without investment in infrastructure.

In order to manage flood risks in Kilbirnie and accommodate growth, 3 km of stormwater network, predominately along Ross Street, Onepu Road, and Kilbirnie Crescent would require upgrading.

To manage rising sea level associated with climate change, the upgrades also include the planned Kilbirnie pump station.

Water quality improvements have also been considered as part of the upgrades to the network.

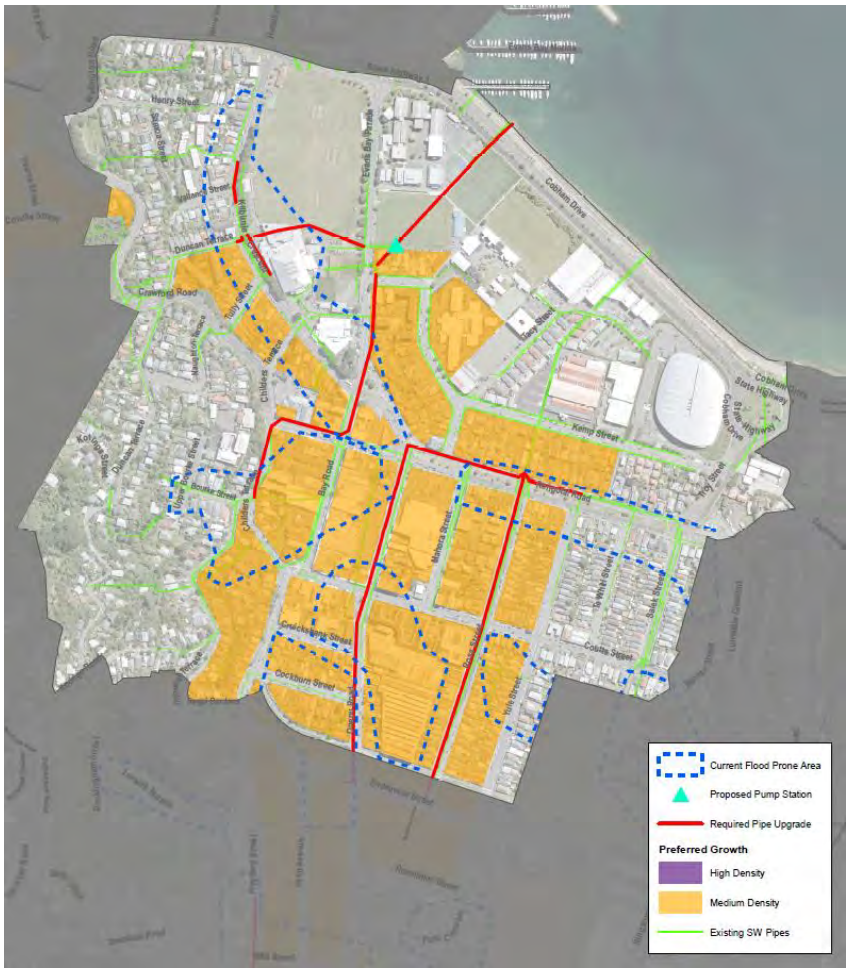


**Figure 40 – Predicted flooding and potential stormwater upgrades for Kilbirnie.**

## 4.11. Lyall Bay

The estimated costing band of providing three waters at an adequate level of service to provide for projected growth in the Lyall Bay growth area is Band A, $10M to $25M].


**Figure 41 – Lyall Bay Preferred Growth Scenario for 500 additional people**[16]

| | Existing Constraints | Needed Infrastructure |
|---|---|---|
| **Water** | No major constraints | Only mains upgrades to maintain existing pressures are required |
| **Wastewater** | Poor condition pipe and treatment plant capacity | 1.7 km of pipe renewals, 0.3 ML of storage and contribution to WWTP upgrades |
| **Stormwater** | Existing flooding likely to be compounded by high tide and sea level rise | 670 m of stormwater trunk main upgrade along Freyberg St. and stormwater treatment devices |

[16] Image Source BECA. Name of Map: Preferred Growth Scenario. Date: 12/07/2019

### 4.11.1. Water supply

**Water supply zone**: The preferred growth area in Lyall bay is connected to the Kilbirnie DMA and is fed from the Carmichael Reservoir and with a TWL of 92 m.

**Pressure**: Some mains upgrades maybe needed to maintain existing pressures. However, further detailed investigation is needed to confirm this.

**Mains**: Only mains upgrades to maintain existing pressures are required (please refer to section 4.2.1 with regard to modelling).

There are about 11 km of distribution network in Lyall Bay, and 2 km are AC pipes. It is recommended to replace the AC pipes over time. There are also about 4 km of pipes with other materials which have been installed more than 70 years ago in this area. Those would be close to their end of life cycle when the proposed growth developments are fully implemented.

**Storage**: Although the day-to-day operational storage for this zone is supplied from the Macalister Park and Carmichael reservoirs in Wellington City Central, for the purpose of calculating seismic storage requirement it is assumed that the Aramoana reservoir would be the primary source. No additional storage would be required for the small amount of growth for this growth area.

### 4.11.2. Wastewater

Wastewater from the Lyall Bay growth area is conveyed to the Moa Point WWTP for treatment and disposal.

Although there are no existing constraints in the local wastewater pipes in the Lyall Bay growth area, additional wastewater flows from future populations will contribute to constraints in the downstream network and WWTP. In addition, there are approximately 1.7 km of poor or very poor condition (grade 4 and 5) wastewater pipes which will need to be renewed to alleviate adverse effects of wastewater leaks on water quality.

### 4.11.3. Stormwater

The growth area in Lyall Bay is subject to existing flood risks. Similar to the Kilbirnie growth area, much of this area is low laying and prone to flooding, especially along Freyberg Street and Onepu Road is likely to be compounded by high tide and sea level rise.

In order to manage flood risks in Lyall Bay area and accommodate growth, 650 m of stormwater trunk main upgrade is proposed along Freyberg Street.

Lyall Bay is also a popular beach and therefore to meet the requirements of the NPS-FM and WWL's stormwater discharge consent conditions, stormwater will need to be treated so that the water quality of Wellington City's streams and coastal waters are maintained or improved. To account for this additional level of service, new stormwater treatment devices, such as rain gardens, were identified based on the catchment area of land proposed for medium density growth.

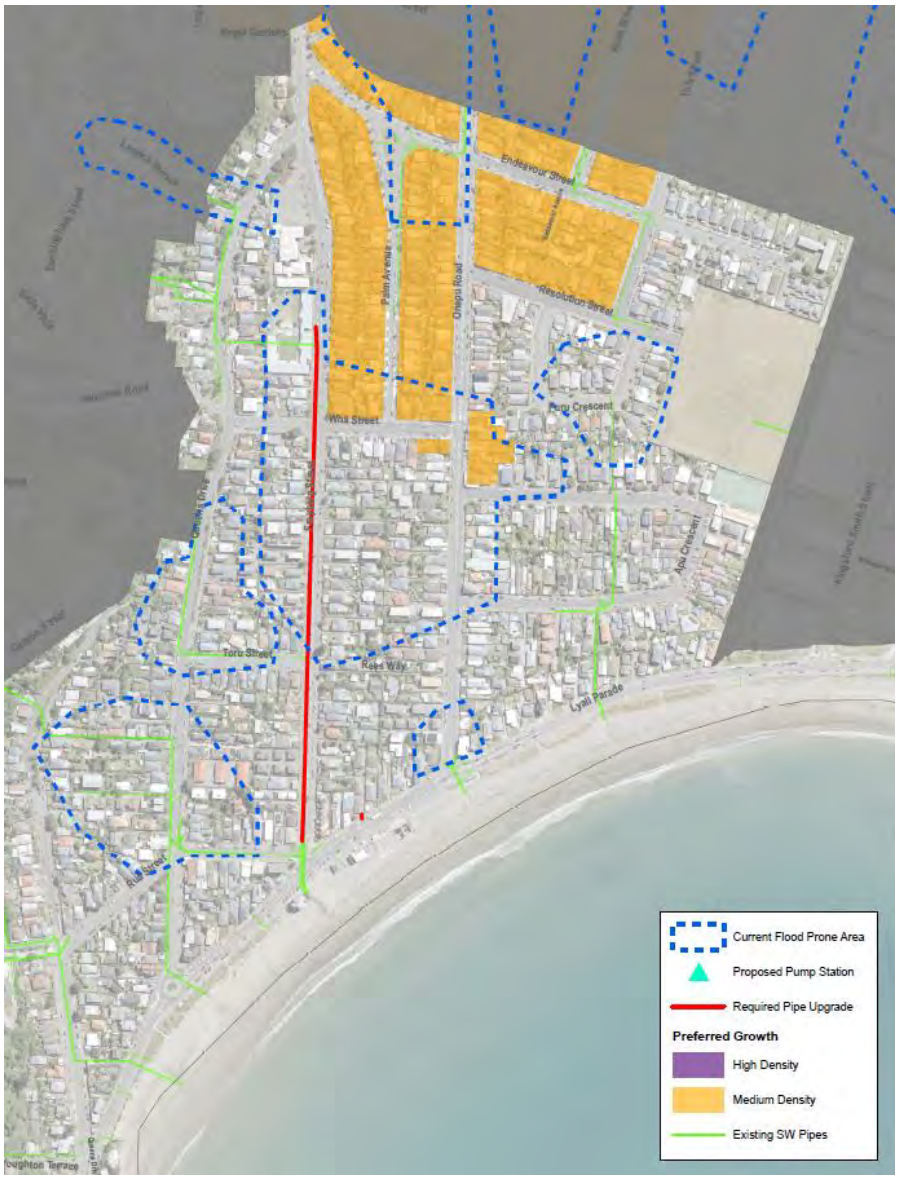


**Figure 42 – Predicted flooding and potential stormwater upgrades for Lyall Bay.**

## 4.12. Miramar

The estimated costing band of providing three waters at an adequate level of service to provide for projected growth in the Miramar growth area is Band E, $100M to $200M].

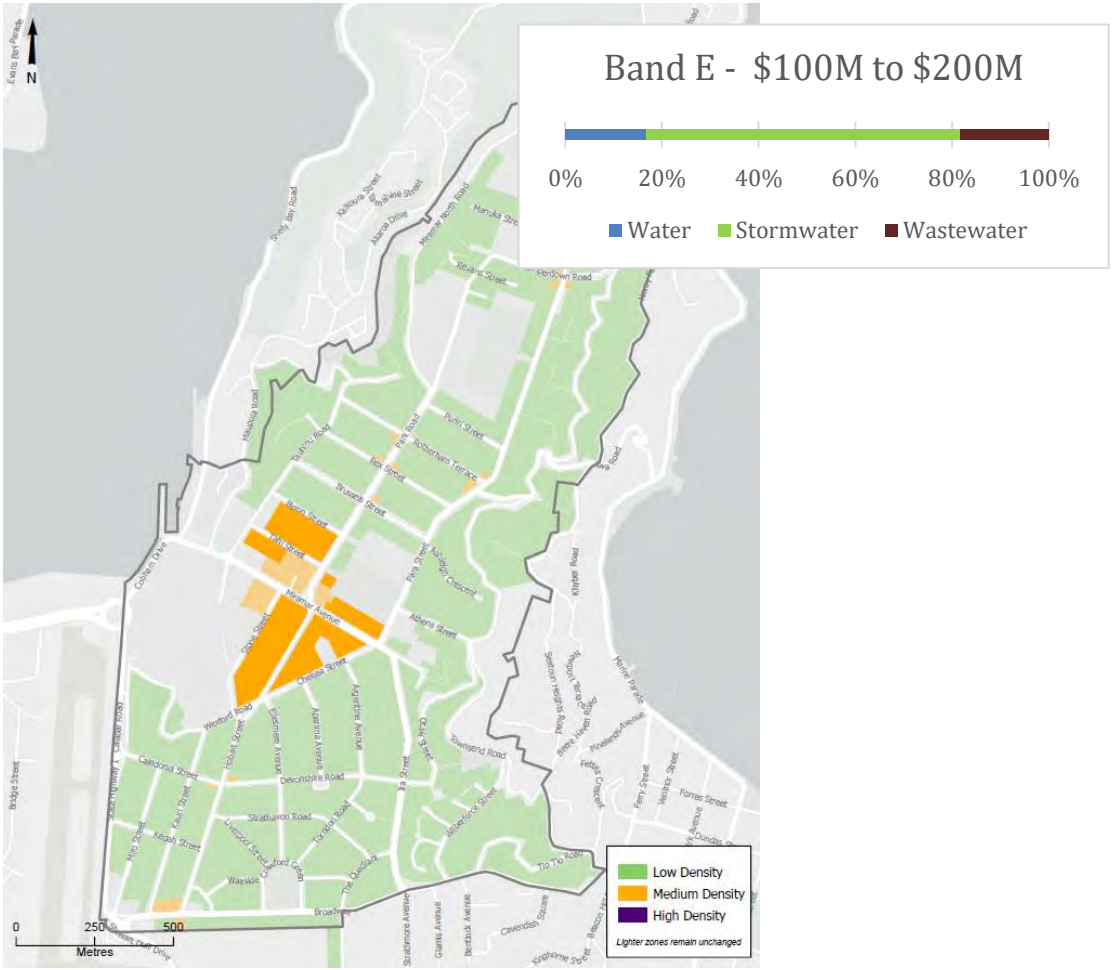


**Figure 43 – Miramar Preferred Growth Scenario for 800 additional people[17]**

| | Existing Constraints | Needed Infrastructure |
|---|---|---|
| **Water** | No major constraints | Mains upgrades and around 12 ML storage required. |
| **Wastewater** | Main wastewater pipes are under capacity and prone to high levels of I&I | Upgrade and replacement of pipes (8 km), upgrade of pump station PS23 and rising mains and contribution to WWTP upgrades |
| **Stormwater** | A large area is a former lake and prone to flooding. Flooding can be exacerbated with future sea level rise. | 2.5 km of stormwater pipe would require upgrading in addition to stormwater treatment devices. To address rising sea levels, the proposed upgrades include a large pump station and associated outlet pipe with significant capacity of up to 40 $m^3/s$. |

[17] Image Source BECA. Name of Map: Preferred Growth Scenario. Date: 12/07/2019

### 4.12.1. Water supply

**Water supply zone**: The preferred growth area in Miramar is connected to the Miramar North, Miramar South and Aramoana DMAs. The zone is fed from the Carmichael Reservoir with a TWL of 92 m through Hataitai DMA via two 300 mm mains along Kilbirnie Crescent. The Aramoana Reservoir operates effectively as a push-pull setup, although it is supplied by gravity from Carmichael reservoir.

**Pressure**: Some mains upgrades are to maintain existing pressures. However, further detailed investigation is needed to confirm this.

**Mains**: Mains upgrades to maintain existing pressures are required. There are about 44 km of distribution network in Miramar, which 7 km are AC pipes. It is recommended to replace the AC pipes over time. There are also about 12 km of pipes with other materials which have been installed more than 70 years ago in this area. Those would be close to their end of life cycle when the proposed growth developments are fully implemented and are not included in estimates.

**Storage**: Although the day-to-day operational storage for this zone is supplied from the Macalister Park and Carmichael reservoirs in Wellington City Central, for the purpose of calculating seismic storage requirement it is assumed that the Aramoana Reservoir would be the primary source for six DMAs – Kilbirnie, Miramar North, Miramar South, Aramoana Strathmore and Seatoun. The Aramoana reservoir (6.5 ML) operates effectively as a push-pull setup.

A preliminary analysis indicated that in order to accommodate the projected growth in both Kilbirnie and Miramar suburbs, there would be around 12 ML combined additional water storage required of which 10 ML is to cover for current shortfall. The investment needed for additional storage has been assigned to the Miramar growth zone for this assessment.

It should be noted that if Kilbirnie and Miramar zones are considered to be supplied from Wellington Central system in a seismic event, some of this shortfall is likely to be covered by the construction of Omāroro Reservoir. Further detailed investigations are needed to refine these initial findings.

### 4.12.2. Wastewater

Wastewater from the Miramar growth area is conveyed to the Moa Point WWTP for treatment and disposal.

The majority of the pipes in the Miramar catchment are under capacity due to both downstream constraints and pipe diameters. The downstream constraints are the pump station and rising main. The Evans Bay catchment is very flat and has high groundwater levels which result in high inflow & infiltration volumes which exacerbate the under capacity in the pipes[18]. To service for growth 3.6 km of pipes have been identified for upgrades and 4.3 km of renewals to meet water quality requirements.

Inflow and infiltration is high in this wastewater catchment. During a 1-year ARI, the network is surcharged and groundwater levels in places (such as near the Roxy Cinema) are close to the surface. Consequently the terminal pump station PS23 struggles to draw the water level down to reduce the occurrences of overflows.

[18] Wellington Water Ltd. 2019. NPS-UDC Three Waters Infrastructure Enabled Development Capacity Wellington City Council. May 2019.

Options to address current capacity constraints is to provide extra capacity for pump station PS23 an upgrades to the rising main capacity. Storage was not considered as a viable option for this growth areas, due to wet ground and its proximity to Moa Point WWTP.

These options will need to be assessed in conjunction with targeted I&I reduction, including replacement of pipes with poor service scores in wet ground. Estimated costs for I&I reduction are not included in the cost estimate for growth.

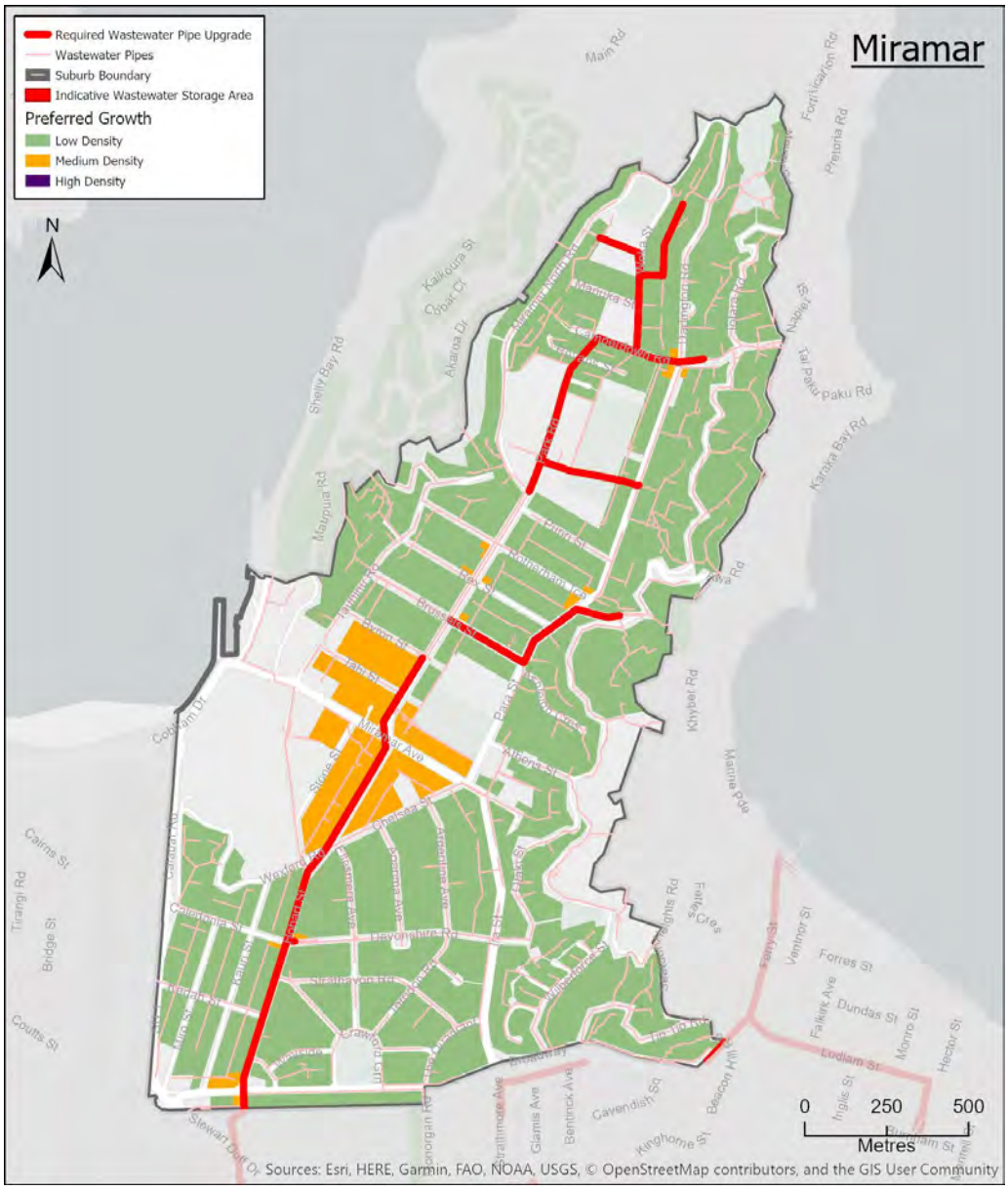


**Figure 44 – Proposed wastewater upgrades for Miramar**

### 4.12.3. Stormwater

The Miramar peninsula is bowl-shaped with rainfall that lands on the hills passing overland or through the stormwater pipe networks and eventually discharging through a pipe outlet to Evans Bay that is restricted and tidally influenced. The basin of the bowl, a former lake, is the Miramar central area, which is proposed for medium density growth. This area floods regularly, and climate change will increase the frequency and severity of flooding.

In order to manage flood risks in Miramar and accommodate growth, 2.5 km of stormwater network would require upgrading. Some of this will require large diameter pipes.

To manage rising sea levels associated with climate change, the identified upgrades also include the need for a very large pump station to push flood flows out against the tide.

Alternative options could include managed retreat from the lowest lying areas and the creation of storage to reduce the dependency on pumps.

In addition to alleviating flood risks to growth, new stormwater treatment devices, such as rain gardens, were identified based on the catchment area of land proposed for medium density growth.

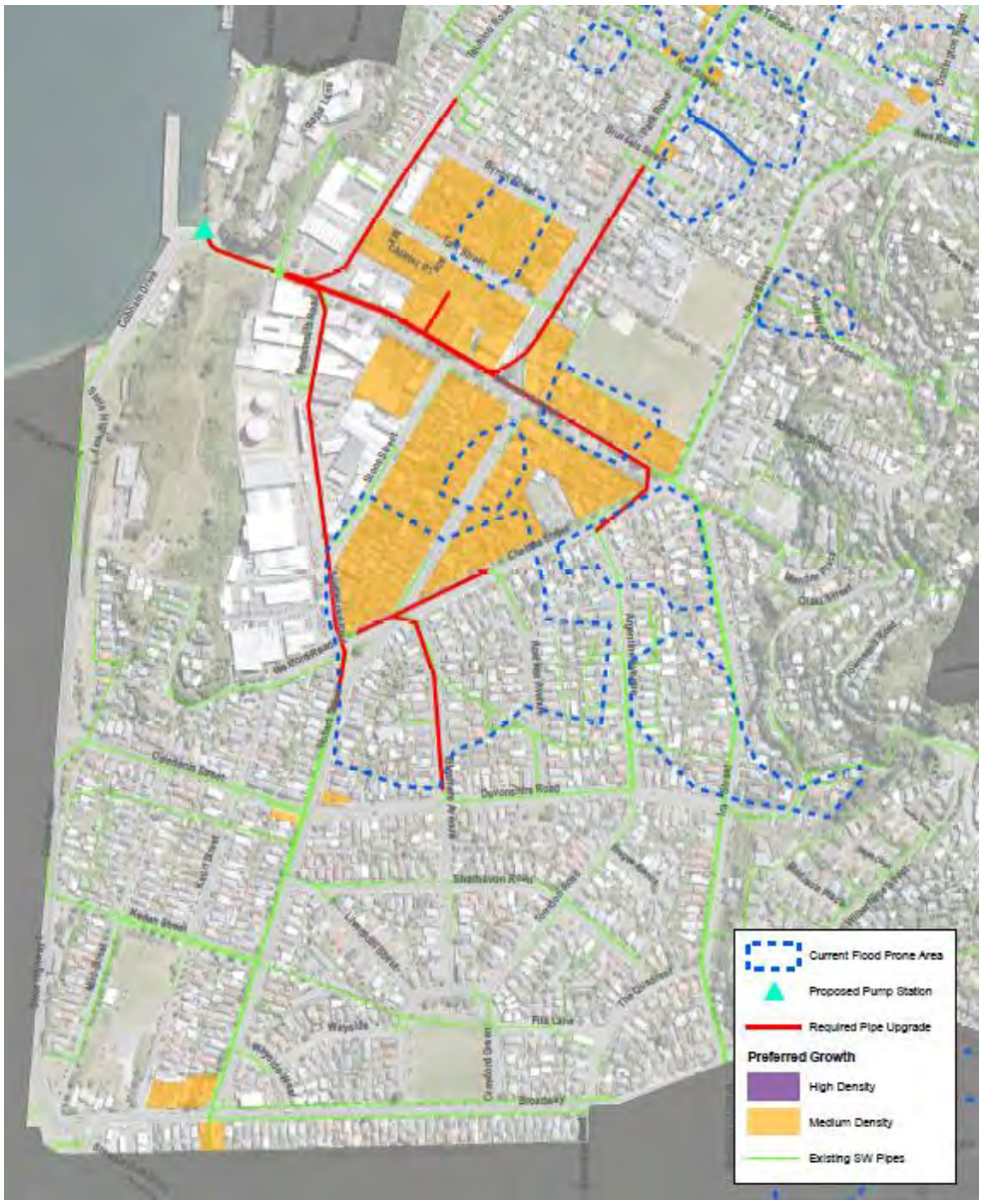


**Figure 45 – Predicted flooding and potential stormwater upgrades for Miramar.**

## 4.13. Mount Cook

The estimated costing band of providing three waters at an adequate level of service to provide for projected growth in the Brooklyn growth area is Band E, $100M to $200M.

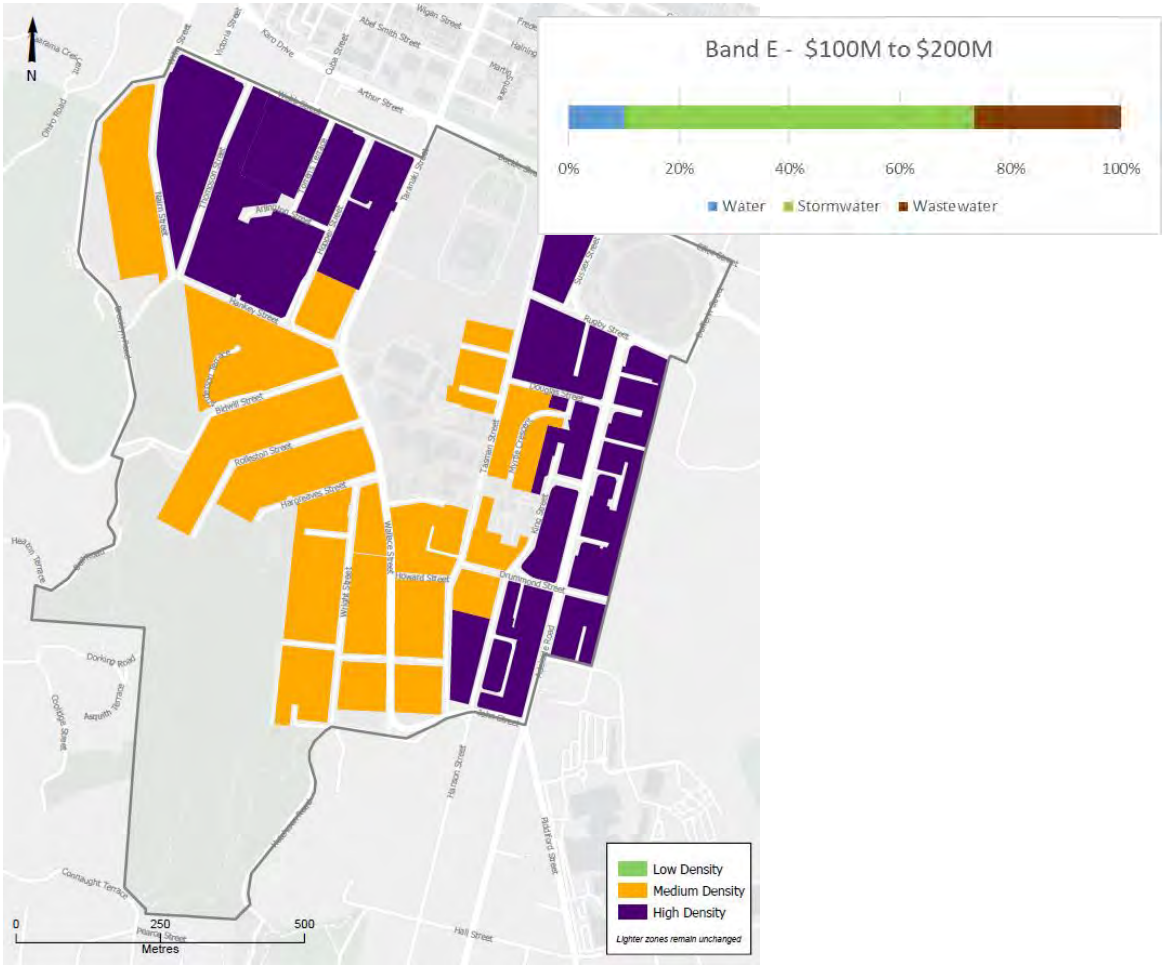


**Figure 46 – Mount Cook Preferred Growth Scenario for 2,500 additional people**[19]

| | Existing Constraints | Needed Infrastructure |
|---|---|---|
| **Water** | No major constraints | Only mains upgrades to maintain existing pressures are required. |
| **Wastewater** | Poor condition pipes, increased wet weather overflows under capacity pumps and rising mains | Renewal of pipes (3.0 km), upgrade of pump stations and rising main, storage (1.4 ML) and contributions to WWTP upgrades |
| **Stormwater** | Stormwater from this catchment contributes to flooding in the CBD | 630 m of stormwater pipe upgrades and stormwater treatment devices |

[19] Image Source BECA. Name of Map: Preferred Growth Scenario. Date: 12/07/2019

### 4.13.1. Water supply

**Water supply zone:** The growth area in Mount Cook is connected to 4 water supply zones; Bell Road, Te Aro, CBD Central and Newtown West water supply zones. The Bell Road reservoir (106 m TWL) supplies the Bell Road zone. The areas connected to Te Aro, CBD Central and Newtown West zones are supplied jointly from Carmichael and Macalister reservoirs with a TWL of 92m.

**Pressure:** Some mains upgrades to maintain existing pressures are required. However, further detailed investigation is needed to confirm this.

**Mains:** Only mains upgrades to maintain existing pressures are required. There are about 20 km of distribution network in Mount Cook suburb, and 3 km are AC pipes. It is recommended to replace the AC pipes over time. There are also about 9 km of pipes with other materials which have been installed more than 70 years ago in this area. Those would be close to their end of life cycle when the proposed growth developments are fully implemented.

This area is part of the very large Low Level Water Supply Zone for which a draft hydraulic model was recently completed. That work is subject to review and assessed growth implications in excess of the proposed growth. While not necessarily aligning spatially with the growth areas it does not indicate any major mains upgrades. This would be subject to further assessment.

**Storage**: A preliminary analysis indicated that for areas that are currently supplied from Bell Road reservoir, the proposed new Moe-i-te-Ra Reservoir will provide adequate water storage for projected growth. However for the high density identified areas where currently supplied from the Low Level Zone there might be future storage shortfall. However, the seismic storage calculations indicate that by 2047 the entire Wellington Central system would need additional 14 ML storage (along with larger diameter supply and delivery mains (800mm diameter) for the reservoir) to fulfil the seismic storage requirements considering the additional population. The additional storage has been prorated to the Berhampore, Mount Victoria, Newtown, Pipitea, Te Aro, Wellington Central, Mount Cook and Thorndon growth areas.

### 4.13.2. Wastewater

Wastewater from the Mount Cook growth area is conveyed to the Moa Point WWTP for treatment and disposal.

Although there are no existing constraints in the local wastewater pipes in the Mount Cook growth area, additional wastewater flows from future populations will contribute to constraints in the downstream network and WWTP. In addition, there are approximately 3.0 km of poor or very poor condition (grade 4 and 5) wastewater pipes which will need to be renewed to alleviate adverse effects of wastewater leaks on water quality.

### 4.13.3. Stormwater

Stormwater runoff from the large and heavily developed catchments that extend up to the Wellington Zoo in Newtown flows through constrained pipe networks in Mount Cook area. There are frequent and damaging floods in this area that will be exacerbated by climate change. Recent, severe flooding occurred at the northern end of Adelaide Road extending into the Basin Reserve.

Major upgrades to the stormwater network are required to reduce the flooding in this area. These upgrades also will require integration with upgrades north of the Basin Reserve[20].

[20] Stantec. 2019. Wellington CBD Stormwater Master Planning. Prepared for Wellington Water. July 2019

To inform the WCC Spatial Plan, 650 m of required stormwater trunk upgrades were identified to manage flooding on Adelaide Road and the Basin Reserve. The size of the catchment means storage is not feasible and the constrained area makes daylighting the stream difficult. This is a costly but high priority upgrade for the city.

In addition to alleviating flood risks, stormwater treatment devices were identified based on the catchment area of land proposed for medium and high density growth.

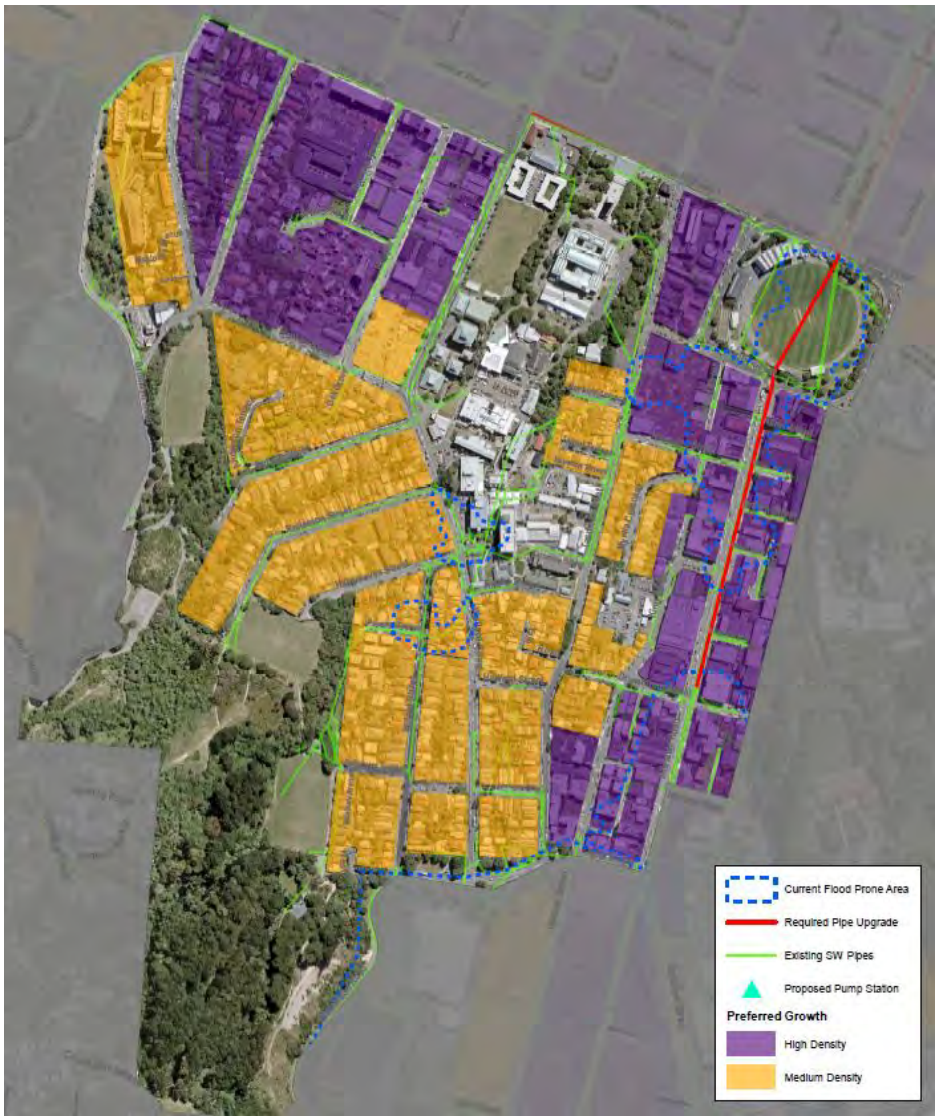


**Figure 47 – Predicted flooding and potential stormwater upgrades for Mount Cook.**

## 4.14. Mount Victoria

The estimated costing band of providing three waters at an adequate level of service to provide for projected growth in the Mount Victoria growth area is Band C, $50M to $75M.

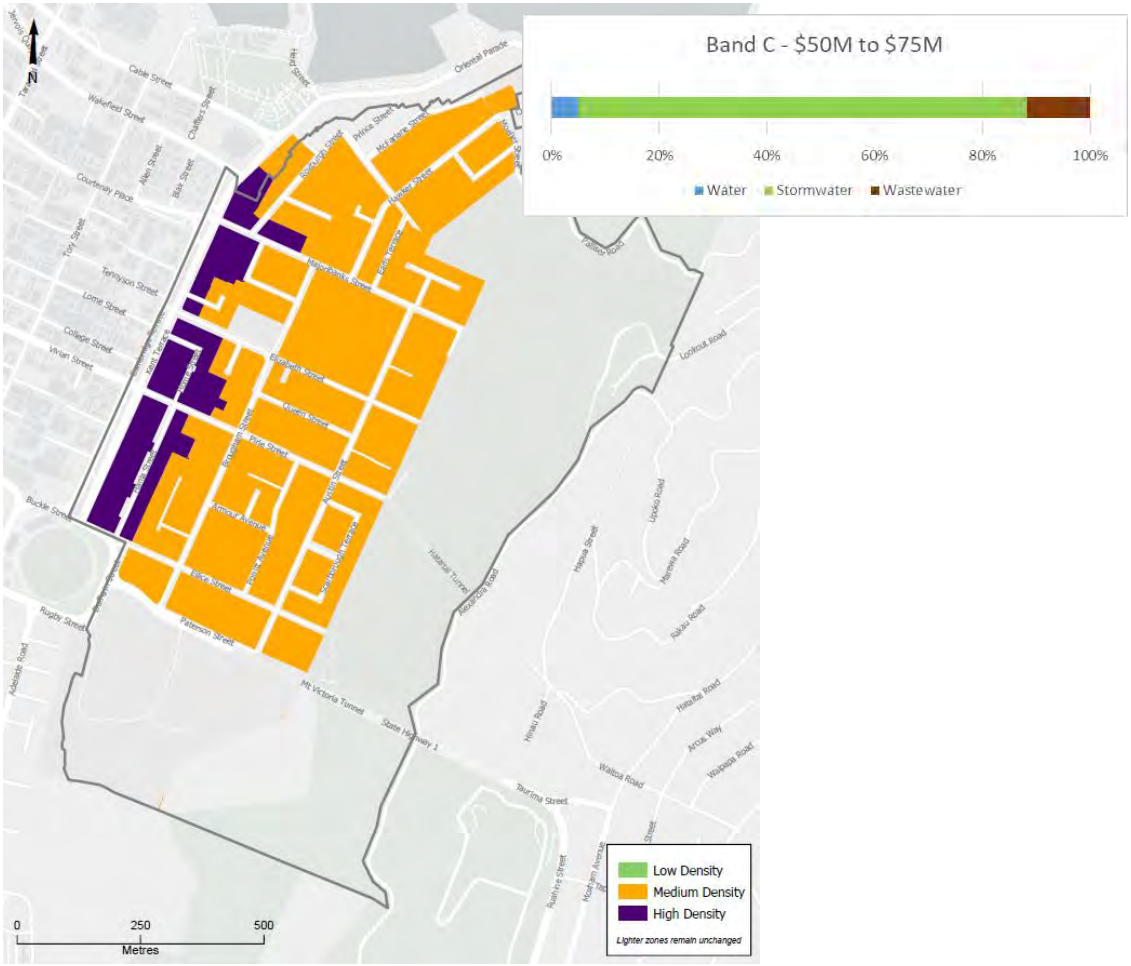


**Figure 48 – Mount Victoria Preferred Growth Scenario for 200 additional people[21]**

| | Existing Constraints | Needed Infrastructure |
|---|---|---|
| **Water** | No major constraints | Mains upgrades and 14ML additional storage prorated to the Berhampore, Mount Victoria, Newtown, Pipitea, Te Aro, Wellington Central, Mount Cook and Thorndon growth zones. |
| **Wastewater** | Poor condition pipes, increased wet weather overflows, under capacity pumps and rising mains | Renewal of pipes (1.4 km), upgrade of pump stations and rising main. Provision storage (0.12 ML) and contributions to WWTP upgrades |
| **Stormwater** | Numerous overland flow paths | Protection of overland flow paths, 1.3 km of pipe upgrades and stormwater treatment devices |

[21] Image Source BECA. Name of Map: Preferred Growth Scenario. Date: 12/07/2019

### 4.14.1. Water supply

**Water supply zone**: Wellington CBD Central area is divided into two DMAs – CBD and Te Aro DMAs. The growth area in Mount Victoria is connected to the Te Aro DMA.

Both Wellington Central DMA and Te Aro DMA are supplied from the bulk network interfaces with the Low Level zone at the Thorndon pump station site, although water to the Low Level zone bypasses the pumps. The water to the zone passes through either one of the two key flow meters. One flow meter delivers water directly to the Wellington central area via a PRV. The other flow meter delivers water to the main storage reservoirs for the zone, which are Macalister Park reservoir (92 m TWL, 20 ML) and Carmichael reservoir (92 m TWL, 7 ML).

**Pressure**: Approximately 7 buildings located at Stafford Street are suspected to have low pressures. These properties are located at a relatively high altitude (approx. 60 m and one property approx. 6 8m) compared to the other properties in the zone. The current HGL of the zone is not high enough to supply these properties with minimum pressure of 25m. The headloss through the supplying main is negligible and therefore a pipe upgrade would not improve the pressures.

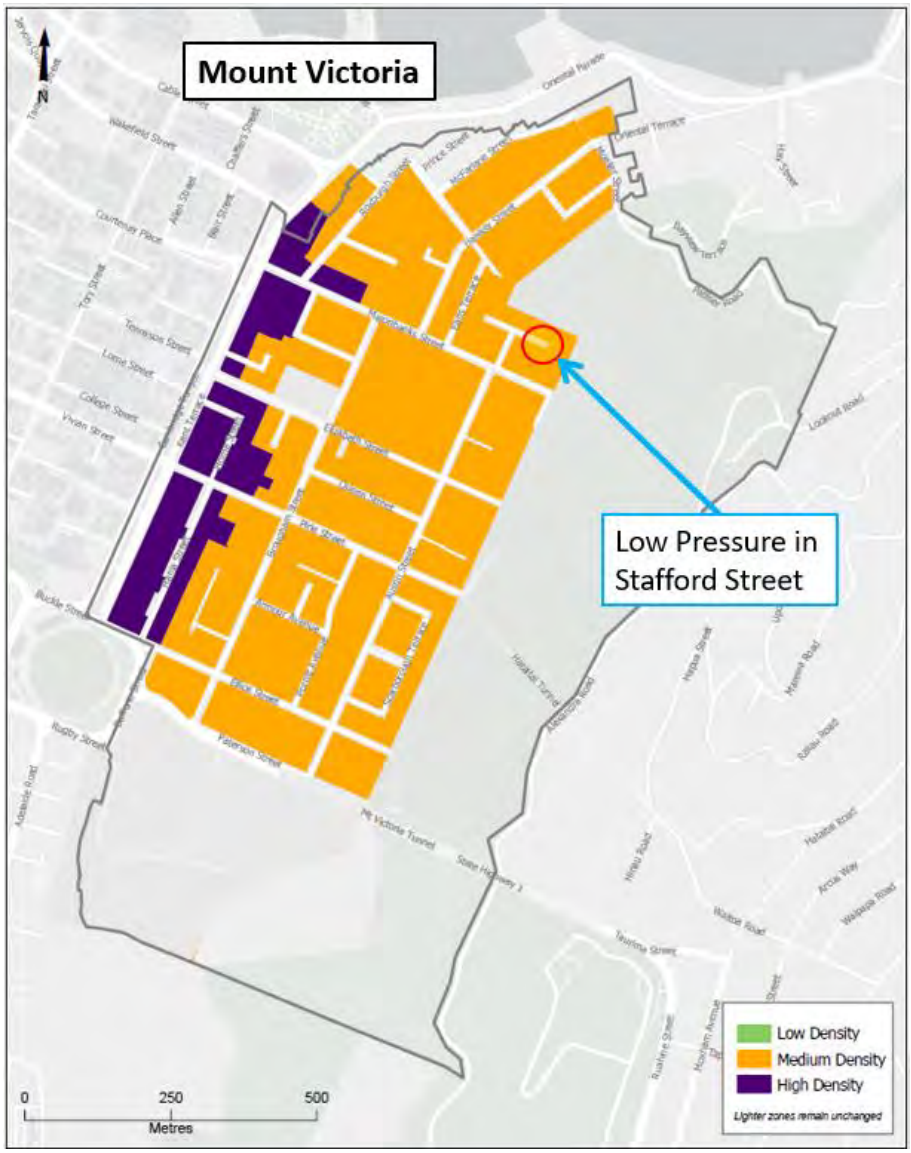


**Figure 49 – Predicted areas of existing low water pressure in Mount Victoria**

**Mains**: Only mains upgrades to maintain existing pressures are required. Refer also to 4.2.1 with regard to modelling.

There are about 17 km of distribution network in Mount Victoria, and 3 km are AC pipes. It is recommended to replace the AC pipes over time. There are also about 9 km of pipes with other materials which have been installed more than 70 years ago in this area. Those would be close to their end of life cycle when the proposed growth developments are fully implemented and are not included in estimates.

**Storage**: Please refer to the storage requirement for Wellington Central suburb (section 4.22.1) as this area is supplied from the same reservoirs.

### 4.14.2. Wastewater

Wastewater from the Mount Victoria growth area is conveyed to the Moa Point WWTP for treatment and disposal.

Although there are no existing constraints in the local wastewater pipes in the Mount Victoria growth area, additional wastewater flows from future populations will contribute to constraints in the downstream network and WWTP. In addition, there are approximately 1.4 km of poor or very poor condition (grade 4 and 5) wastewater pipes which will need to be renewed to alleviate adverse effects of wastewater leaks on water quality.

### 4.14.3. Stormwater

Stormwater runoff from the Mount Victoria catchment flows down to the bottom of the hill via numerous overland flow paths located on local roads and private properties. These flows combine with the flows from Newtown on Kent and Cambridge Terrace before passing through the multiple culverts under the roads and out to Waitangi Park and the harbour.

The low-lying areas in this catchment experience regular flooding particularly on Hania Street and around the fire station on Kent Terrace. The upgrades proposed for this area will need to be undertaken in coordination with the Kent Terrace upgrade proposed in the Te Aro section of this report (please see section 4.20.3).

To accommodate the proposed areas for medium and high density, the overland flow paths should be protected through planning provisions or easements. In addition, to inform the WCC Spatial Plan options to upgrade the piped network are identified. The required network upgrade is estimated to be 2.1 km. These proposed upgrades are preliminary and are subject to further assessment and optioneering.

In addition to alleviating flood risks to growth, there are also water quality constraints that will require WWL to manage stormwater to address the outcomes of the Te Whanganui-o-Tara Whaitua, the NPS-FM and the global stormwater discharge consent conditions. It is anticipated that as a minimum, runoff from new growth will need to be treated so that the water quality of Wellington City's streams and coastal waters are maintained or improved. To account for this additional level of service, new stormwater treatment devices, such as rain gardens, were identified based on the catchment area of land proposed for medium and high density growth.

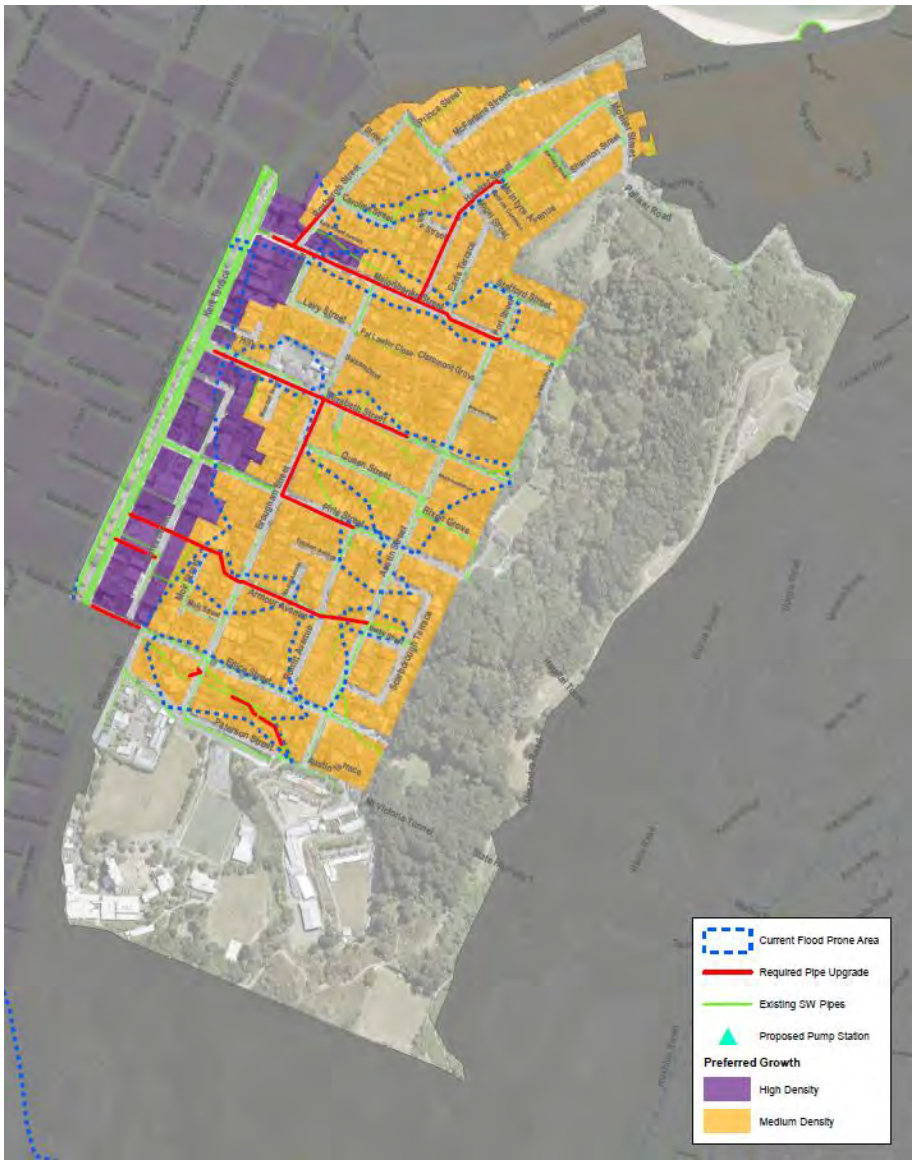


**Figure 50 – Predicted flooding and potential stormwater upgrades for Mount Victoria.**

## 4.15. Newlands

The estimated costing band of providing three waters at an adequate level of service to provide for projected growth in the Newlands growth area is Band E, $100M to $200M.

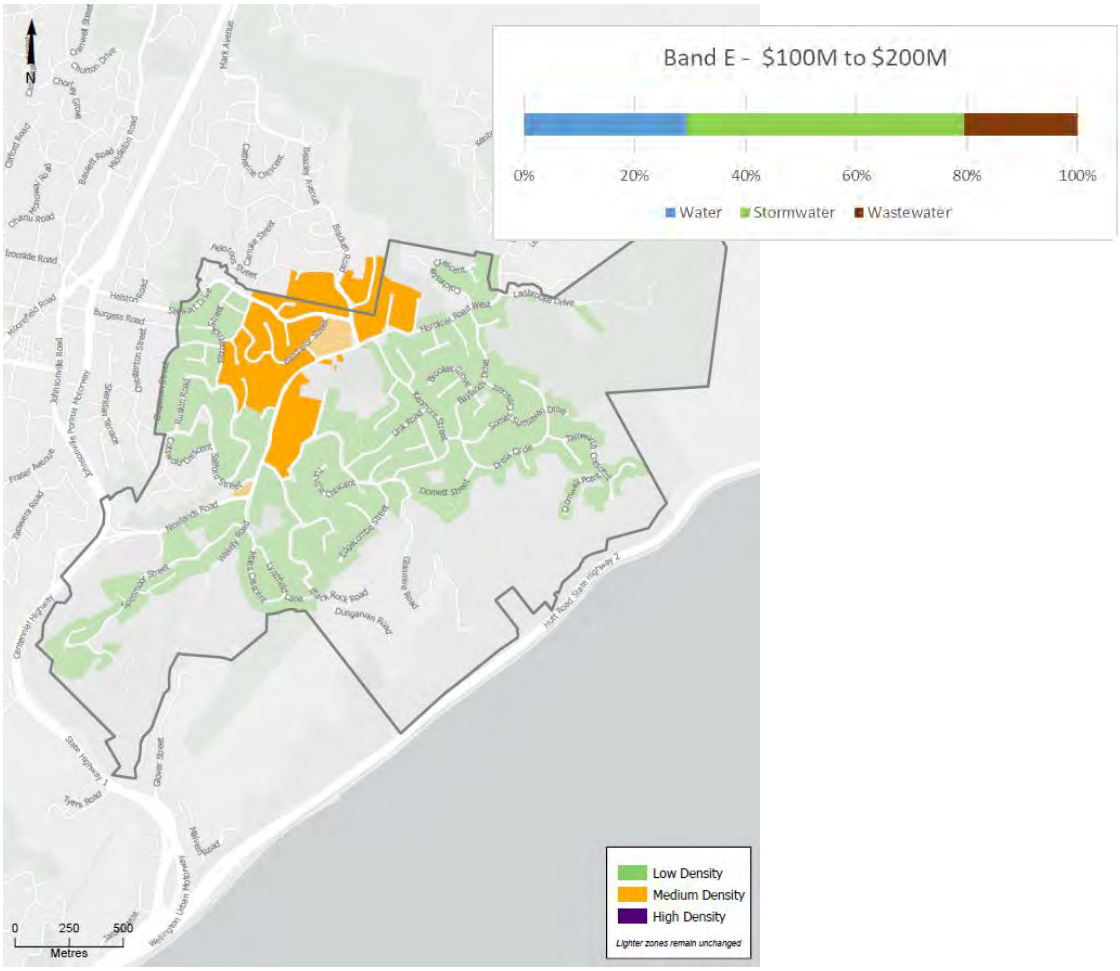


**Figure 51 – Newlands Preferred Growth Scenario for 2,400 additional people[22]**

| | Existing Constraints | Needed Infrastructure |
|---|---|---|
| **Water** | A few properties with low water pressure | Some mains upgrades and 2.2 ML additional water storage required |
| **Wastewater** | Under capacity and poor condition pipes and increased wet weather overflows | Renewal and upgrades of pipes (1.6 km), storage (1.4 ML) and contributions to WWTP upgrades |
| **Stormwater** | Existing flooding in low laying areas | 3.5 km of stormwater pipes require upgrading and stormwater treatment devices |

[22] Image Source BECA. Name of Map: Preferred Growth Scenario. Date: 12/07/2019

### 4.15.1. Water supply

**Water supply zone**: The Newlands zone is supplied from Newlands Reservoirs No 1 and No 2 with the TWL of 266 m. The system also supplies Woodridge Reservoir by gravity.

The identified medium density area in Newlands is located within 3 DMAs which are Newlands North, Newlands East and Newlands West. The hydraulic model for this area has not been calibrated yet so all current issues may have not been captured here.

**Pressure**: There are approximately 90 properties where low pressures is expected for properties located at a relatively high altitude (at 240 m to 260 m elevation) in the vicinity of Newlands reservoirs in Ruskin Road and Chapman Street. Their situation however is not expected to significantly worsen due to intensification.

There are also a number of locations where low pressures exist, where network head losses are not currently excessive but could get impacted by the intensification. These areas are as follows:

- approximately 70 properties in Edgecombe Street (from 240m to 246m elevation)
- approximately 40 properties in Kenmore St and Balmain St (from 240m to 250m elevation)
- approximately 130 properties in Baylands Drive, Cheyne Walk and Somes Crescent (from 240 m to 250 m elevation).

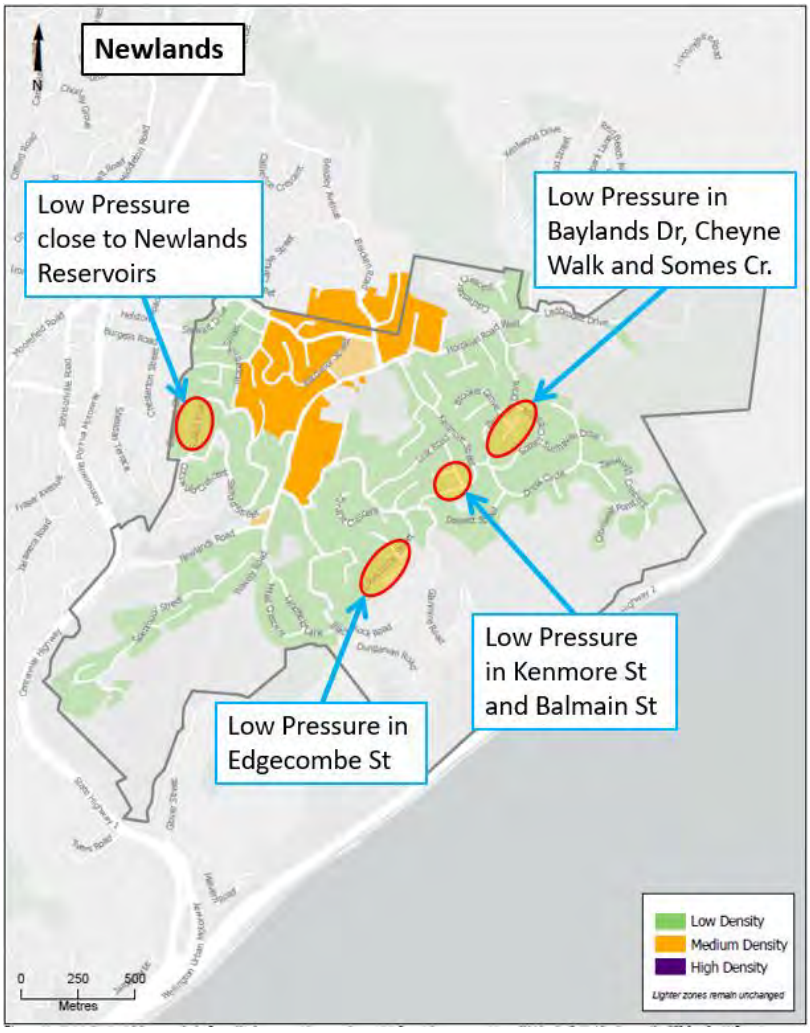


**Figure 52 – Predicted areas of existing low water pressure in Newlands**

**Mains**: To accommodate the proposed growth, 3.2 km of main needs to be upgraded to 300 mm diameter; 1.9 km from the Newlands reservoirs via Ruskin Road, Salford Street, Horokiwi Road West to Bracken Road intersection and 1.3km from Newlands reservoir via Ruskin Road, Fitzpatrick Street, Stewart Drive, Bracken Road to Bracken Road/Horokiwi Road West intersection. Only mains upgrades to address low pressure areas are required.

There are about 31 km of distribution network in Newlands, and 15 km are AC pipes. It is recommended to replace the AC pipes over time and are not included in estimates.

**Storage**: A preliminary analysis indicated that in order to accommodate the projected growth in Newlands suburb, there would be around 2.2 ML additional water storage required of which about 0.6 ML is required for the existing shortfall.

### 4.15.2. Wastewater

Wastewater from the Newlands growth area is conveyed to the Moa Point WWTP for treatment and disposal.

A number of upgrade options have been proposed to address current deficiencies.

Pipe upgrades of around 1.4 km have been proposed to divert flow from Horokiwi West Road to Newlands Road to alleviate possible unconstructed wastewater overflows in Pinkerton Park. The other area prone to capacity issues is along Newlands Road (from Black Rock Road to Ngauranga Gorge). It is anticipated upgrades will be necessary along Newlands Road to accommodate future growth projections.

Approximately 192 m of poor condition pipe are identified for renewal to help meet water quality requirements.

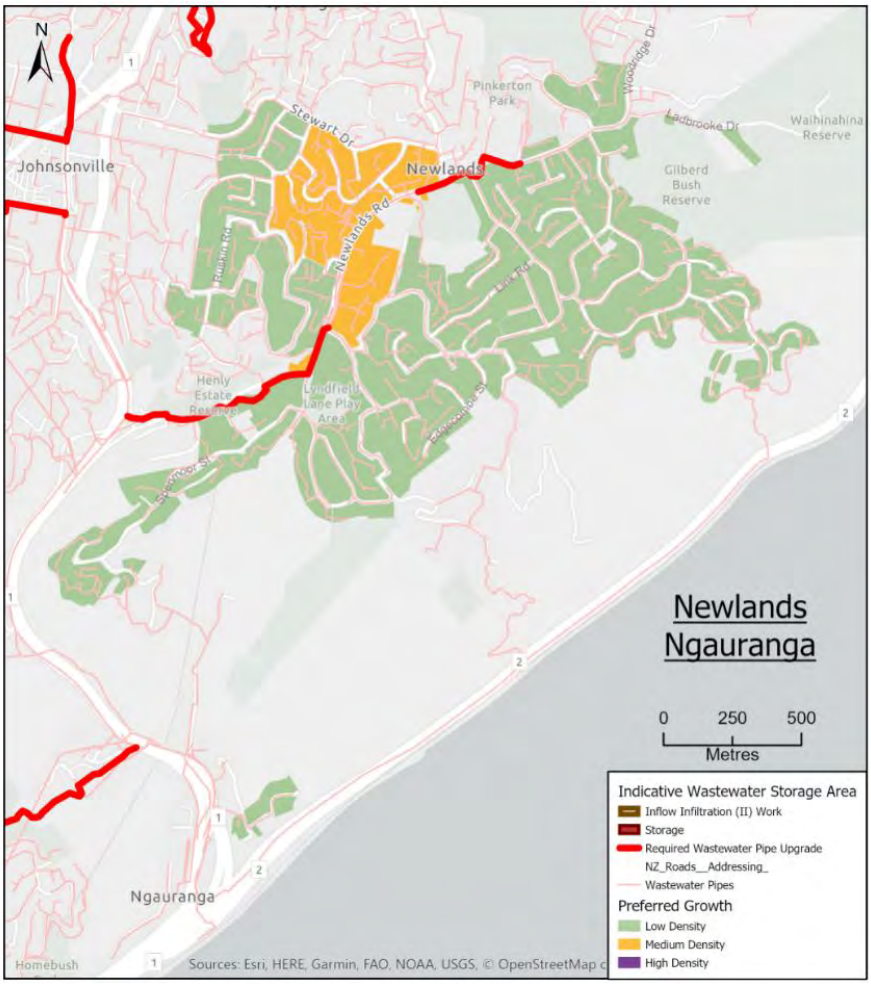


**Figure 53 – Proposed wastewater upgrades in Newlands**

### 4.15.3. Stormwater

The proposed growth area of Newlands is subject to existing flood risks. In particular, the low laying areas adjacent to Newlands Road and Batchelor Street are subject to flooding.

To manage flood risks and accommodate the proposed growth, 3.5 km of stormwater network would require upgrading. This could be larger pipes or secured overland flow paths. These proposed upgrades are preliminary and are subject to further assessment and optioneering.

In addition to alleviating flood risks to growth, new stormwater treatment devices, such as rain gardens, were identified based on the catchment area of land proposed for growth.

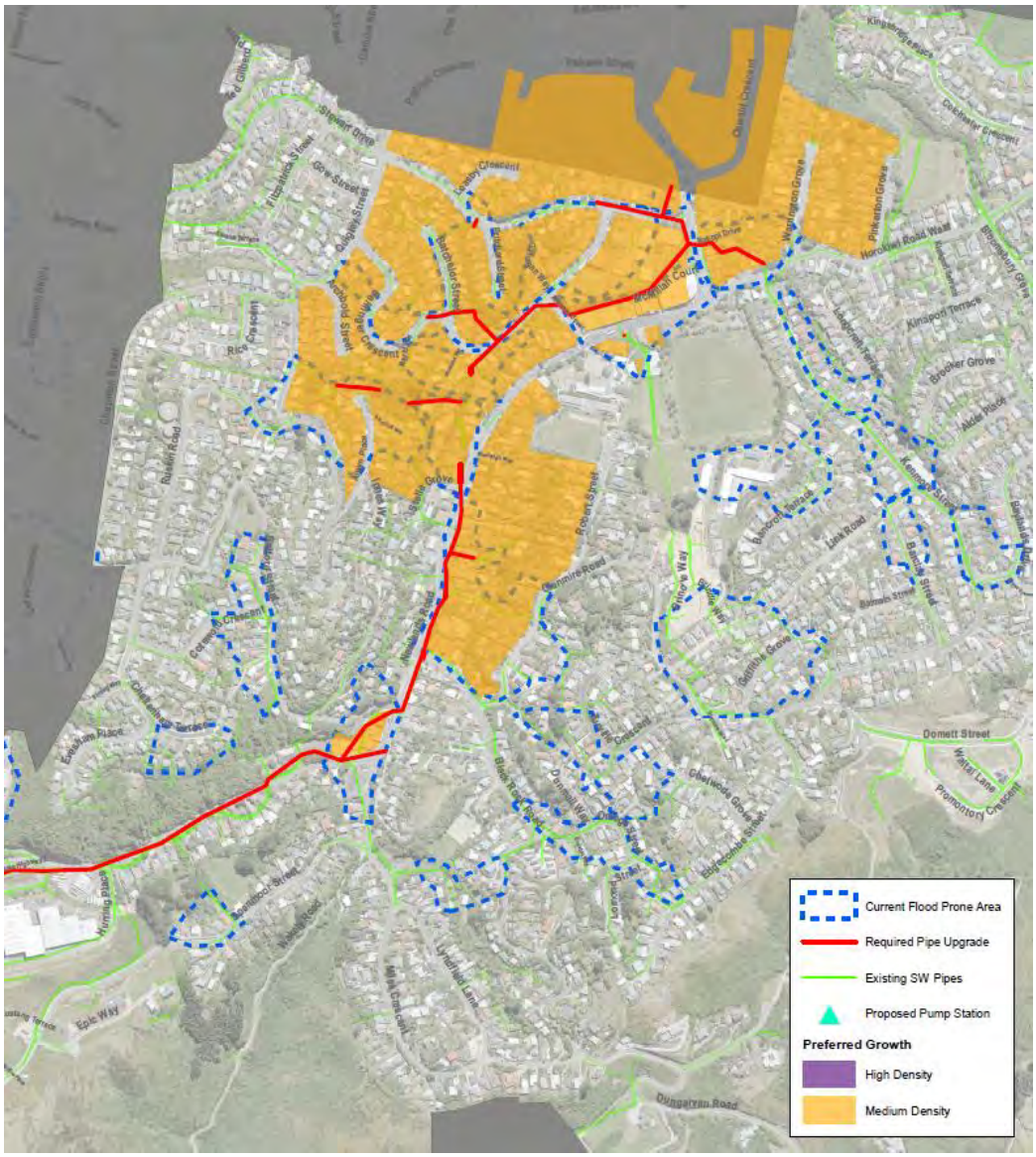


**Figure 54 – Predicted flooding and potential stormwater upgrades for Newlands.**

## 4.16. Newtown

The estimated costing band of providing three waters at an adequate level of service to provide for projected growth in the Brooklyn growth area is Band E, $100M to $200M.

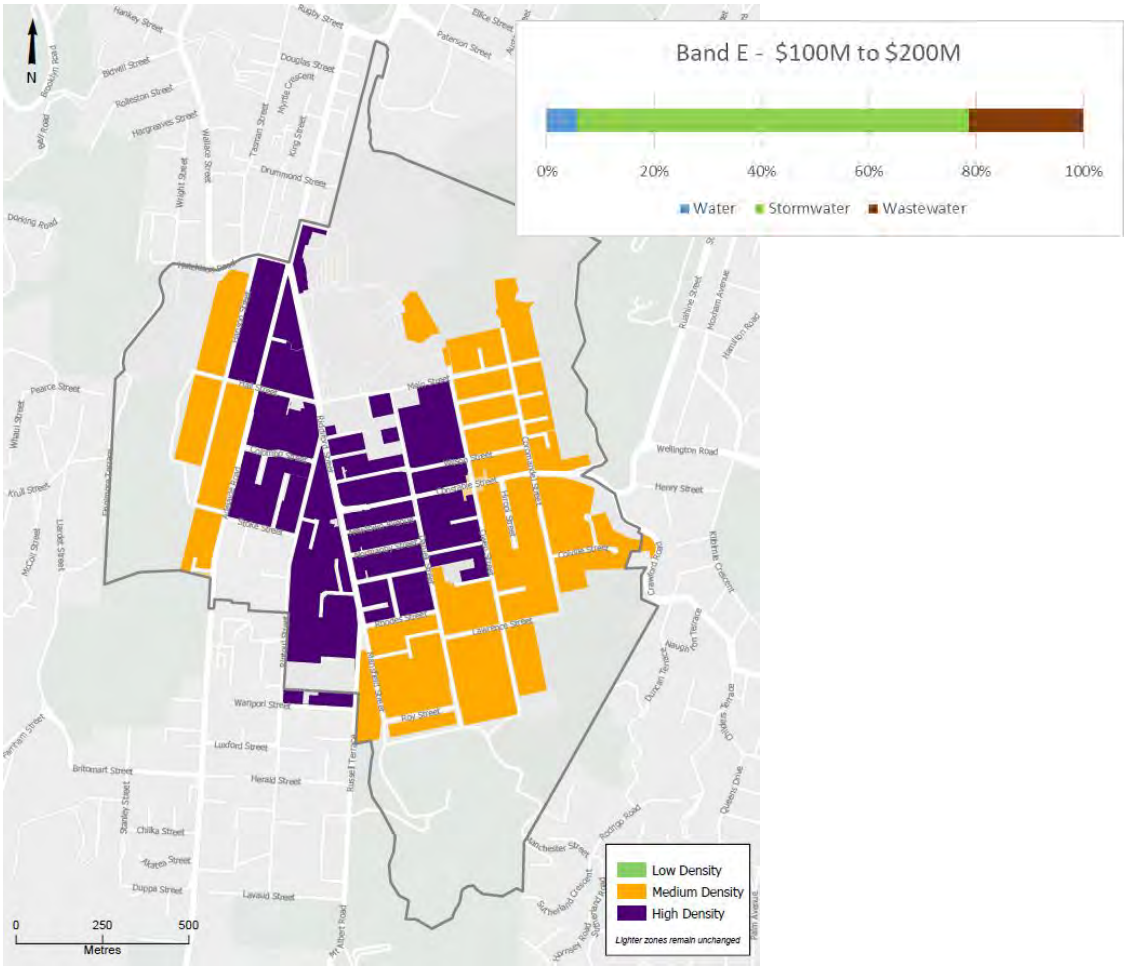


**Figure 55 – Newtown Preferred Growth Scenario for 2,900 additional people[23]**

| C | Existing Constraints | Needed Infrastructure |
|---|---|---|
| **Water** | Numerous properties with low water pressure | Mains upgrades and 14 ML additional storage prorated to the Berhampore, Mount Victoria, Newtown, Pipitea, Te Aro, Wellington Central, Mount Cook and Thorndon growth zones |
| **Wastewater** | Poor condition pipes and wet increased weather overflows | Renewal and upgrade 4.9 km of pipes, 1.7 ML storage and contributions to WWTP upgrades |
| **Stormwater** | Existing extensive flooding and lack of protected overland flow paths | 4.7 km of stormwater pipe upgrade and stormwater treatment devices |

[23] Image Source BECA. Name of Map: Preferred Growth Scenario. Date: 12/07/2019

### 4.16.1. Water supply

**Water supply zone**: Water for the growth area in Newtown is supplied from Newtown West and Newtown East DMAs. Both DMAs are connected to the Carmichael and the Macalister reservoirs with the TWL of 92 m.

**Pressure**: Low water pressure is expected for the following locations in this suburb:

- approximately 20 properties at Colville Street, Paeroa Street and end of Constable Street.
- approximately 20 properties along Coromandel Street and Owen in the vicinity of Carmichael Reservoir
- approximately 15 properties at Torquay Terrace

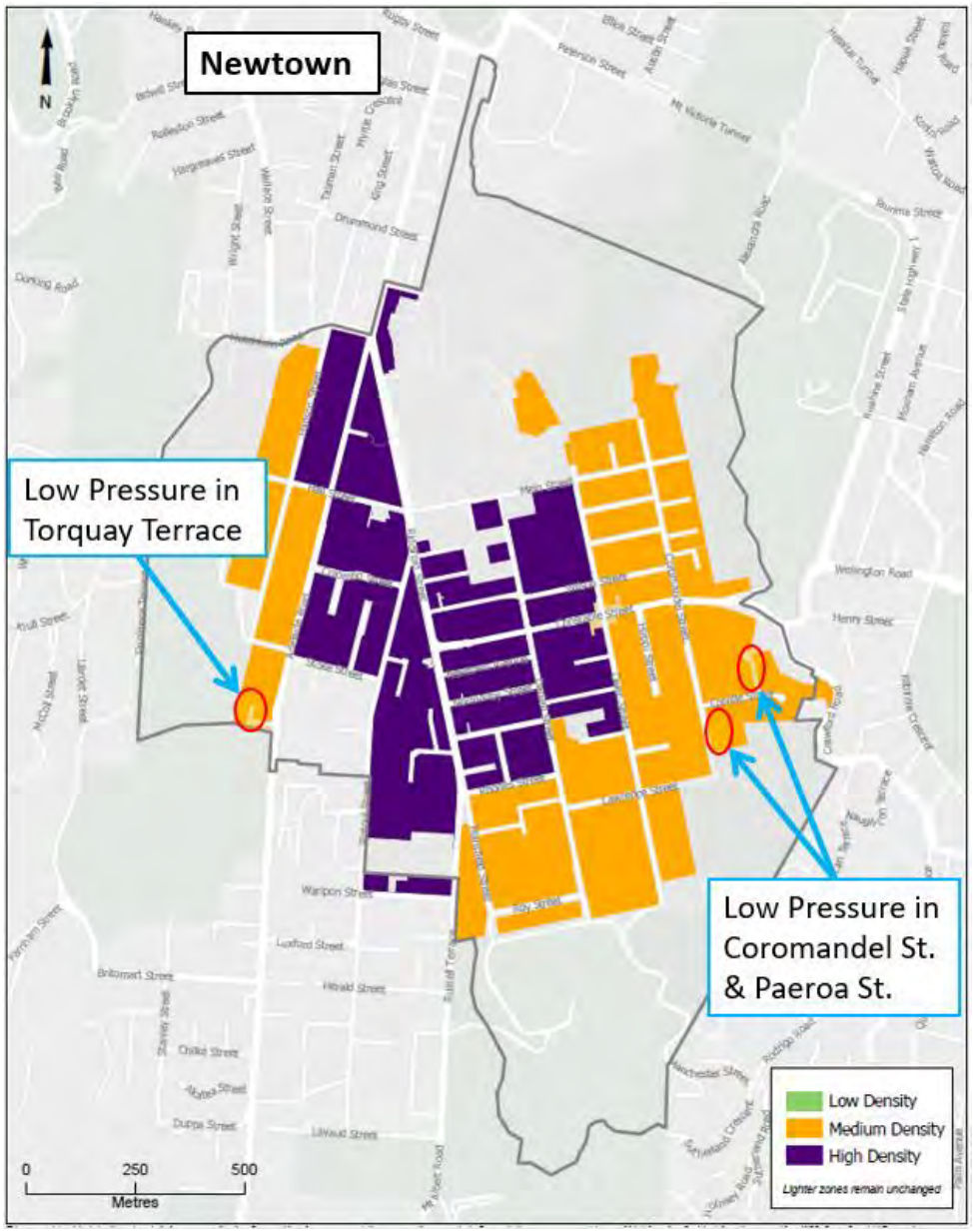


**Figure 56 – Predicted areas of existing low water pressure in Newtown**

In order to prevent the detrimental impacts of proposed Medium Density growth in Colville and Paeroa streets on the existing conditions, about 250 m of mains upgrade with 150 mm pipe may be required. This needs to be confirmed with future detailed analysis. A number of

properties being close in elevation to Carmichael reservoir will still have minimum pressures that are not expected to significantly worsen in the future as the low pressure is not caused by demand related head loss.

**Mains**: Mains upgrades to address low pressure areas are required (please refer also to 4.2.1 with regard to modelling).

There are about 30 km of distribution network in Newtown, and 2 km are AC pipes. It is recommended to replace the AC pipes over time. There are also about 10km of pipes with other materials which have been installed more than 70 years ago in this area. Those would be close to their end of life cycle when the proposed growth developments are fully implemented and are not included in estimates.

**Storage**: Please refer to the storage requirement for Wellington Central suburb (section 4.22.1) as this area is supplied from the same reservoirs.

### 4.16.2. Wastewater

Wastewater from the Newtown growth area is conveyed to the Moa Point WWTP for treatment and disposal.

The wastewater catchment that services the Newtown growth area is part of a larger catchment that services the CBD growth area. Within the local area, 229 m of pipes are identified for upgrade and 4.6 km of poor condition pipes for replacement to meet water quality requirements.

The performance of the wastewater network in this catchment is low due to the age of the wastewater network and the effect of a relatively large number of constructed overflows on the quality of the receiving waters and bathing beaches[24].

During a 1-year ARI, the trunk main along Riddiford runs full and in places is starting to surcharge. Pipe upgrades have been proposed to address these current deficiencies.

Given the high density of proposed development, options for future upgrades will need to be assessed in detail. It is likely future work will be a mix of upgrades and renewals, neither of which has been costed.

One potential option to alleviate future flows along Riddiford Street would be re-establish the bifurcation on Wilson Street. Originally wastewater flows would have drained into the abandoned trunk wastewater that runs through the Hospital grounds.

[24]Wellington Water Ltd. 2019. NPS-UDC Three Waters Infrastructure Enabled Development Capacity Wellington City Council. May 2019.

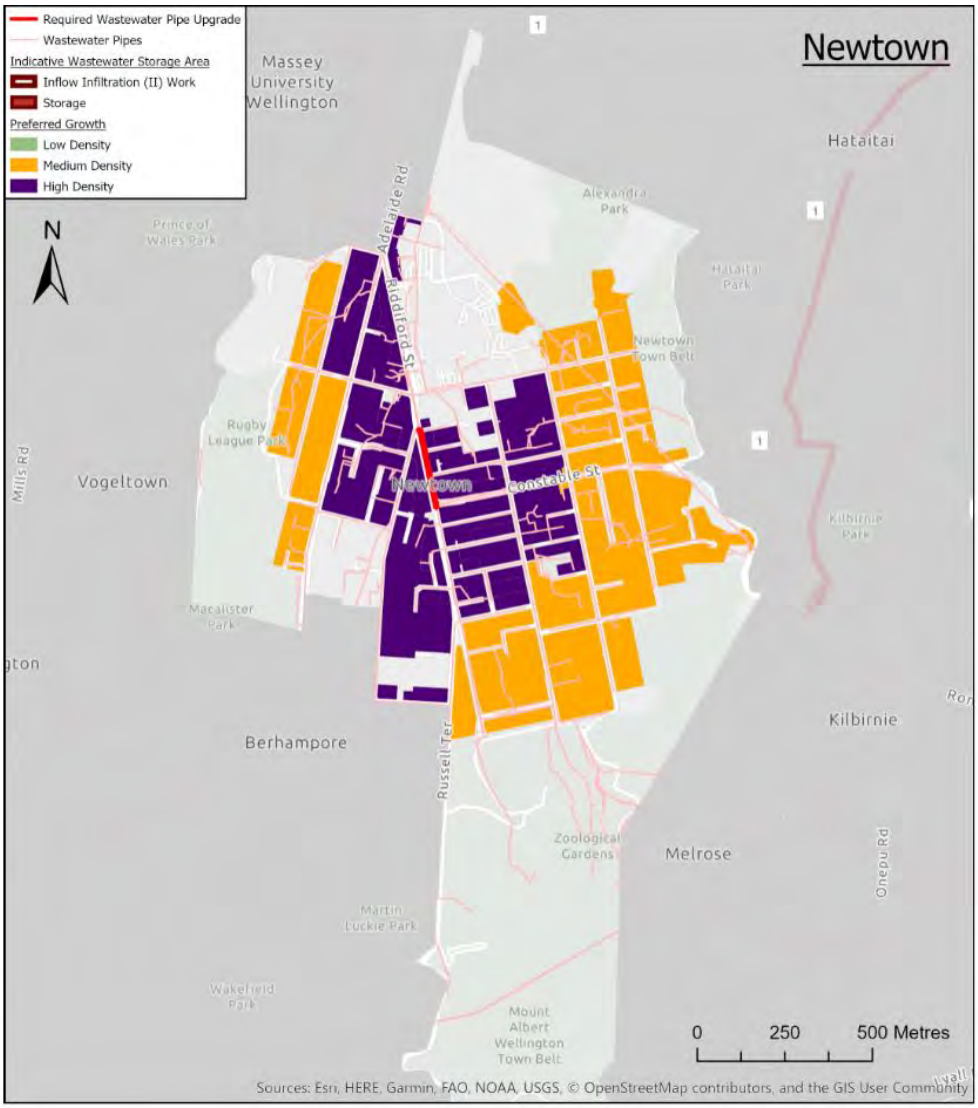


**Figure 57 – Proposed wastewater upgrades in Newtown**

### 4.16.3. Stormwater

Stormwater runoff from the large and heavily-developed catchments that extend up to the Wellington Zoo in Newtown flows through constrained pipe networks. This stormwater combines with flows from Mount Cook and Mount Victoria before passing through the low-lying CBD and discharging into the harbour.

The original piping of the stream through this area was not sized for the density and development that has since been achieved in the catchment and Newtown area suffers from regular flooding and property damage. A large proportion of the proposed high and medium density areas are within the flood prone area, including the area surrounding the hospital.

In order to manage flood risks and accommodate the proposed growth, an extensive multi phased upgrade of the stormwater network is required. Over 5 km of stormwater pipes will require upgrading. These upgrades will need to be designed so they are integrated with upgrades along the network all the way to the harbour. For the purpose of informing the WCC Spatial Plan, proposed upgrades are preliminary and would need to be subject to further assessment and optioneering once the spatial plan is finalised.

In addition to alleviating flood risks to growth, there are also water quality constraints that will require WWL to manage stormwater to address the outcomes of the Te Whanganui-o-Tara

Whaitua, the NPS-FM and the global stormwater discharge consent conditions. It is anticipated that as a minimum, runoff from new growth will need to be treated so that the water quality of Wellington City's streams and coastal waters are maintained or improved. To account for this additional level of service, new stormwater treatment devices, such as rain gardens, were identified based on the catchment area of land proposed for medium and high density growth.

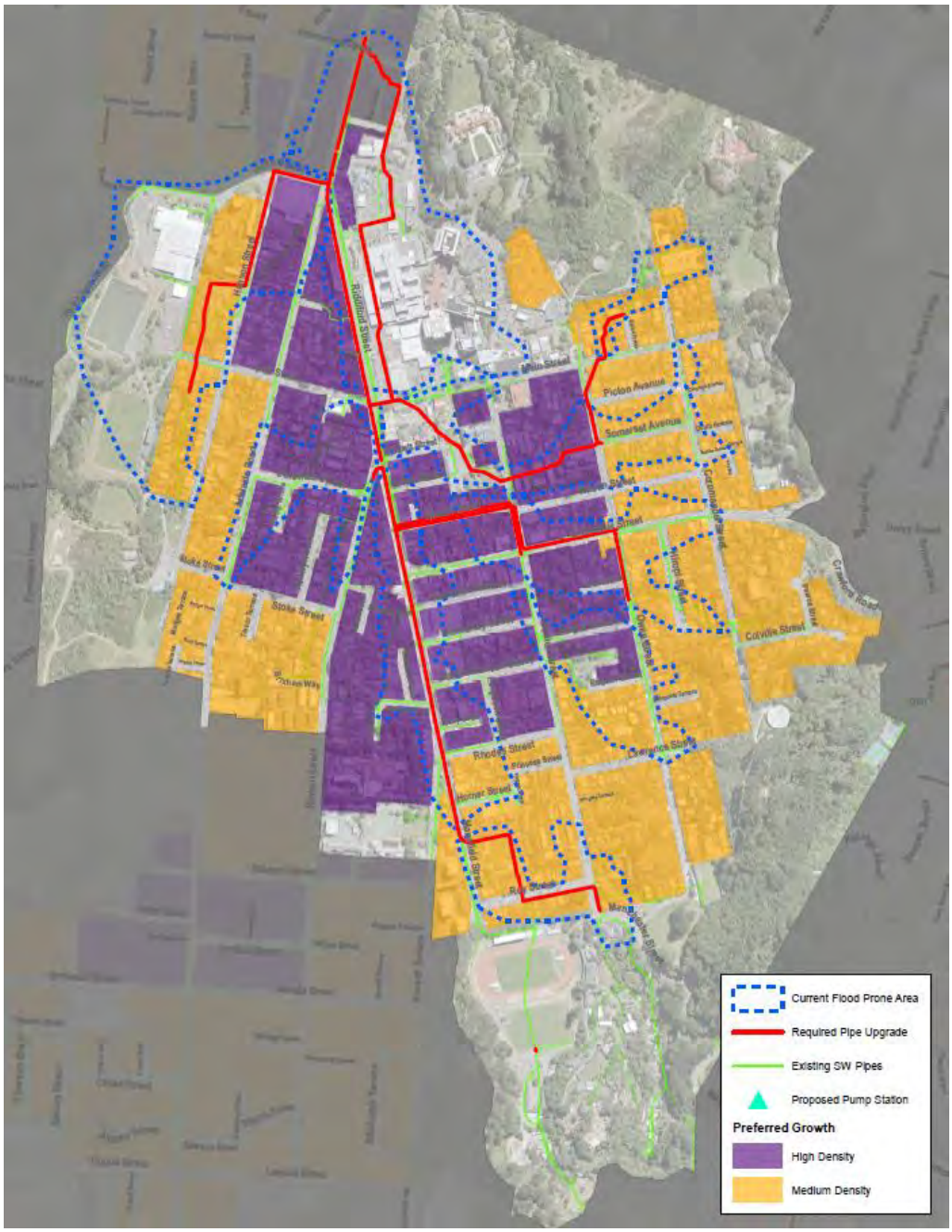


**Figure 58 – Predicted flooding and potential stormwater upgrades for Newtown.**

## 4.17. Ngaio

The estimated costing band of providing three waters at an adequate level of service to provide for projected growth in the Ngaio growth area is Band B, $25M to $50M.

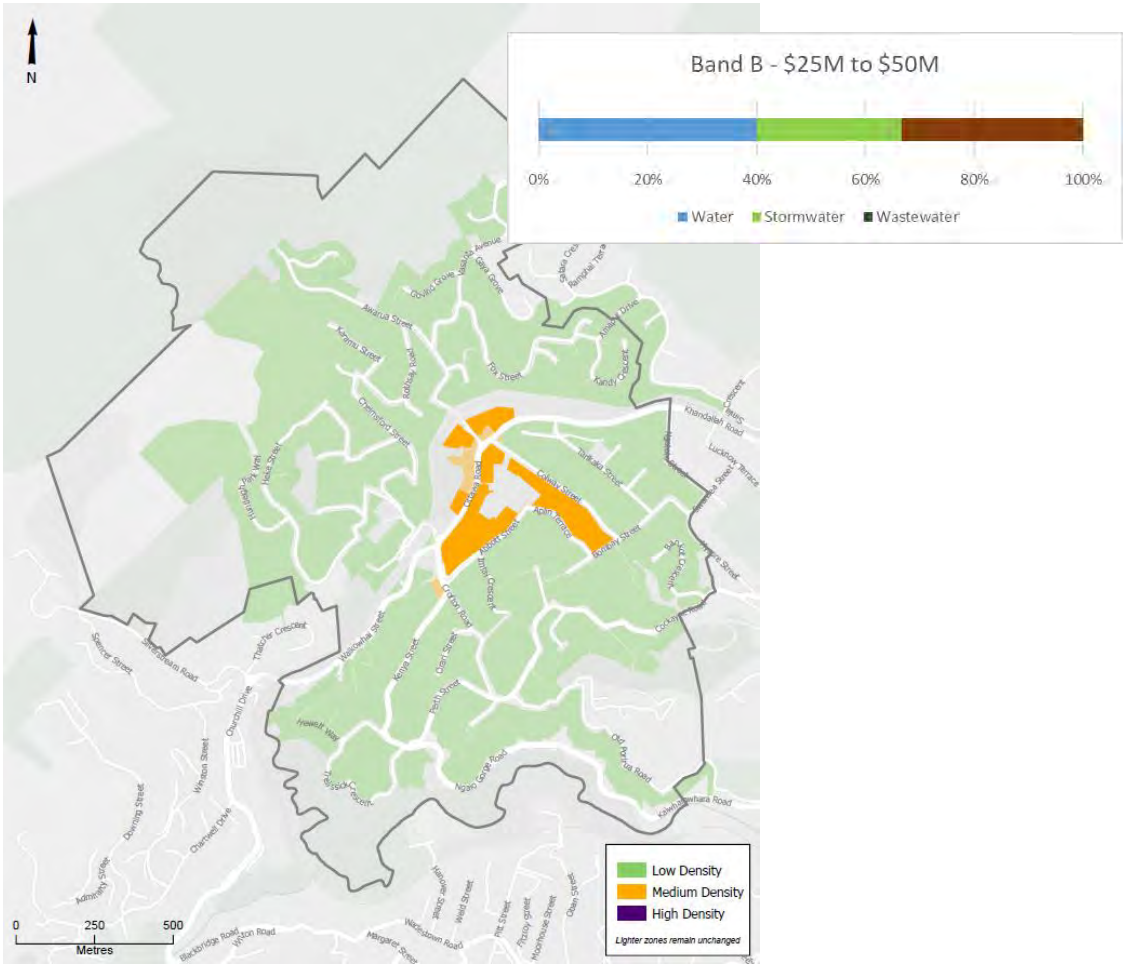


**Figure 59 – Ngaio Preferred Growth Scenario for 1,300 additional people**[25]

| C | Existing Constraints | Needed Infrastructure |
|---|---|---|
| **Water** | No major constraints | Mains upgrades and 0.6 ML storage required |
| **Wastewater** | Poor condition and under capacity pipes and increased wet weather overflows | Renewal and upgrade of pipes (1.5 km) and storage (0.75 ML) and contribution to WWTP upgrades |
| **Stormwater** | Flooding along existing stream west of Ottawa Road and Khandallah Road | Approximately 600 m of stormwater pipe upgrades and improvement of overland flowpaths |

[25] Image Source BECA. Name of Map: Preferred Growth Scenario. Date: 12/07/2019

### 4.17.1. Water supply

**Water supply zone:** Water for the growth area in Ngaio is supplied jointly from the Ngaio DMA and Onslow DMA. Northern dwellings in the Ottawa Road and Colway Street are connected to Ngaio DMA and southern properties in the Abbott Street and Aplin Terrace are within the Onslow DMA. Ngaio Reservoir operates on the TWL of 171 m and Onslow reservoir at a TWL of 220 m.

**Pressure**: Minimum pressure is not an issue with available pressure ranging from 55 m to 110 m on public mains in this area. Due to the hilly nature of this area maximum pressure exceeds 90m criteria set in the Regional Standard for Water Services for some properties connected to the Onslow reservoir. There might be an opportunity to re-zone those properties to Ngaio to reduce maximum pressure. In addition, the existing pipe (DN100mm) in Abbott Street and Aplin Terrace may need to be upsized to cater for additional demand. However, this needs to be confirmed with further analysis

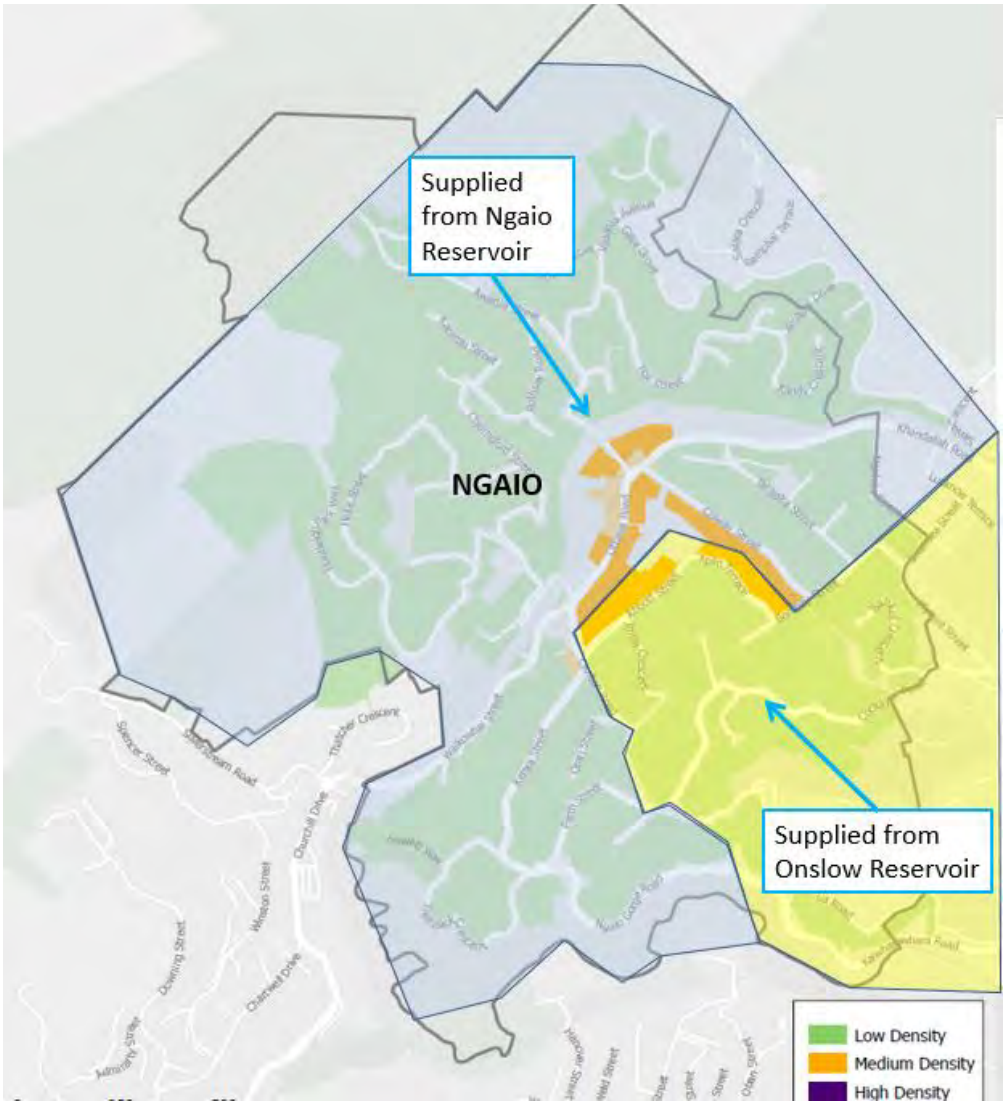


**Figure 60 – Two reservoirs supply water to Ngaio**

**Mains**: Only mains upgrades to maintain existing pressures are required.

There are about 25 km of distribution network in this zone, which about 9 km are AC pipes. It is recommended to replace the AC pipes over time. There are also about 16 km of pipes with other materials which have been installed more than 70 years ago and would be close to their

end of life cycle when the proposed growth developments are fully implemented and are not included in estimates.

**Storage**: Ngaio Reservoir supplies both medium density growth areas in Ngaio and Crofton Downs. A preliminary analysis indicated that in order to accommodate for projected growth in Ngaio and Crofton Downs, there would be around 1.3 ML additional water storage required (0.6 ML for Ngaio and 0.6 ML for Crofton Downs) of which 0.3 ML is to cover for current shortfall. Further investigations are needed to confirm the actual capacity and location of this future reservoir.

### 4.17.2. Wastewater

Wastewater from the Ngaio growth area is conveyed to the Moa Point WWTP for treatment and disposal.

During a 1-year ARI there are a number of current capacity issues in the local wastewater network. Proposed upgrade options extend the trunk network.

The network downstream of the proposed growth area is served by two trunk lines. Future trunk options will need to be assessed in detail. These lines may need upgrading with the additional development flows. Approximately 1.1km of pipes have been identified for upgrades.

To address future water quality requirements around 413 m of poor condition pipes need to be renewed.

Any development in this catchment needs to be considered together with the possible upgrades and/or storage.

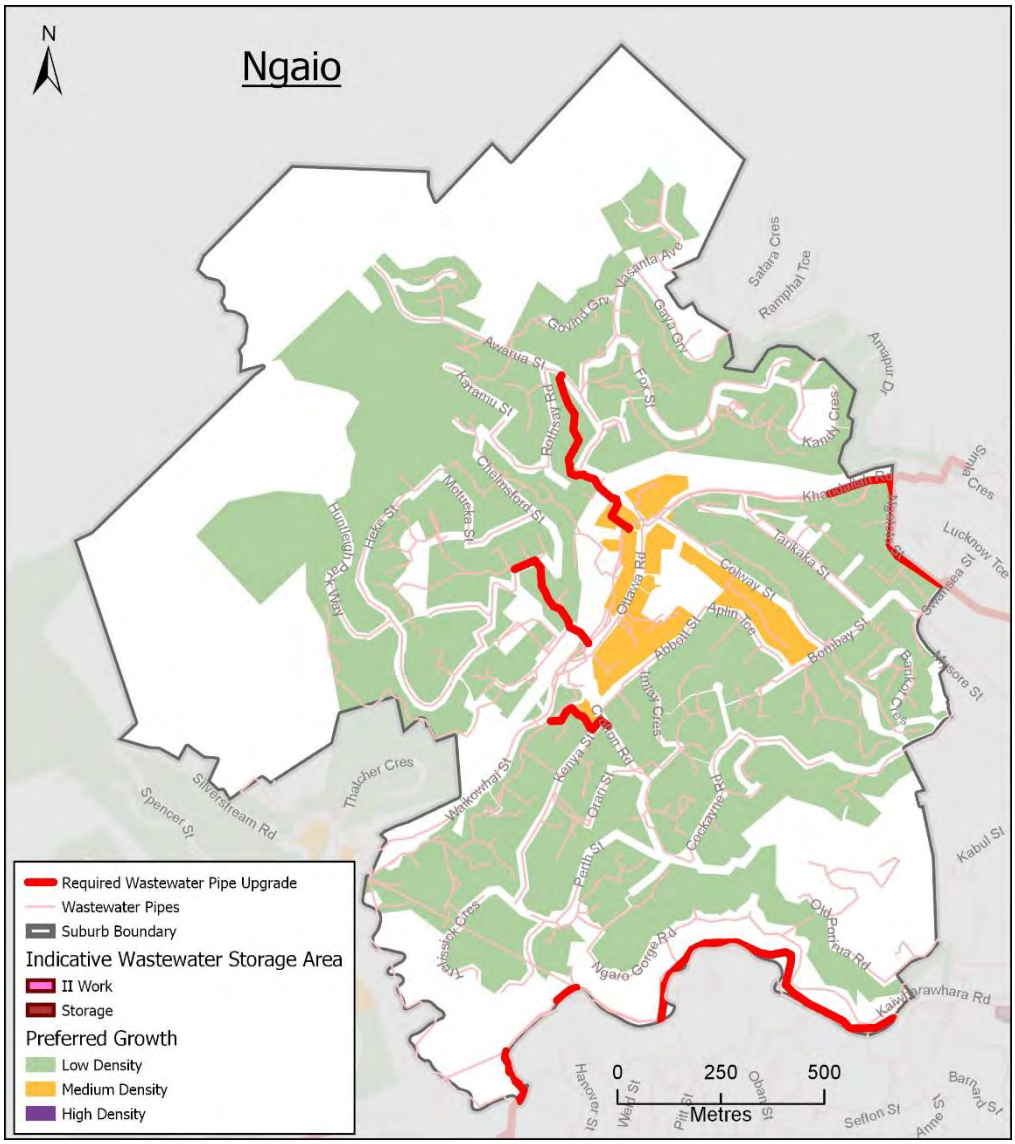


**Figure 61 – Proposed wastewater upgrades in Ngaio**

### 4.17.3. Stormwater

The Ngaio area especially west of the Ottawa Road and Khandallah Road along the stream and across Awarua Street has experienced flooding previously and would require overland flowpath improvement works which constrains proposed intensification. It is likely that densification will require some existing property removal from the flood plain and upgrade of around 600m of stormwater pipes servicing the area.

In addition to alleviating flood risks to growth, new stormwater treatment devices, such as rain gardens, were identified based on the catchment area of land proposed for growth.

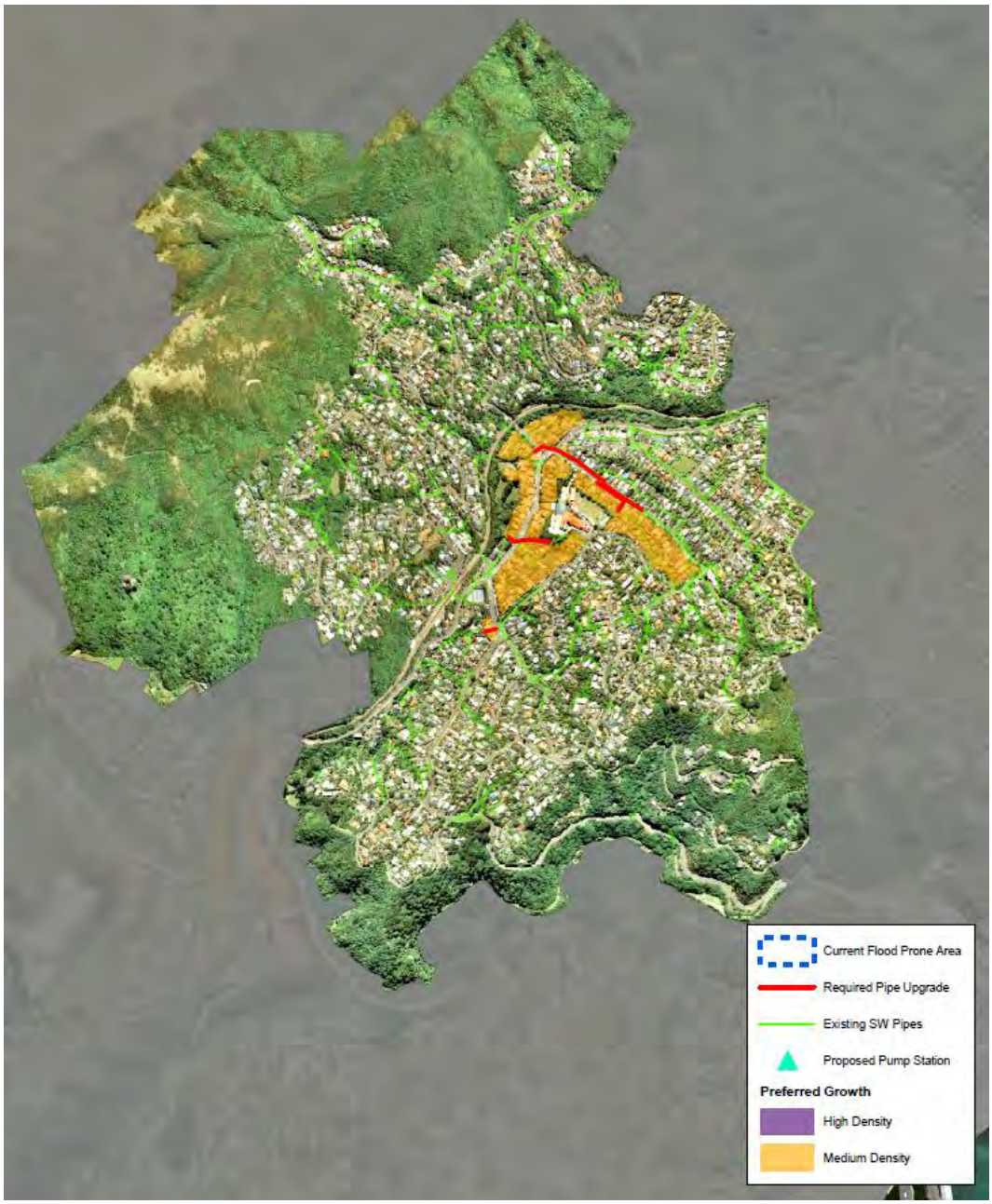


**Figure 62 - Potential stormwater upgrades for Ngaio.**

## 4.18. Pipitea

The estimated costing band of providing three waters at an adequate level of service to provide for projected growth in the Pipitea growth area is Band E $100M to $200M.


**Figure 63 – Pipitea Preferred Growth Scenario for 2,100 additional people**[26]

| | Existing Constraints | Needed Infrastructure |
|---|---|---|
| **Water** | Potential supply issues. | Mains upgrades and 14ML additional storage has been prorated to the Berhampore, Mount Victoria, Newtown, Pipitea, Te Aro, Wellington Central, Mount Cook and Thorndon growth zones |
| **Wastewater** | Under capacity and poor condition pipes and wet weather overflows. | 0.4 km of renewal and upgrade of pipes, storage (1.21 ML) and contribution to WWTP upgrades |
| **Stormwater** | Flooding in major storm events and water quality | Stormwater main upgrade (3.6 km), future flood water pump station and stormwater treatment devices |

[26]Image Source BECA. Name of Map: Preferred Growth Scenario. Date: 12/07/2019

### 4.18.1. Water supply

**Water supply zone:** The identified Growth area in Pipitea suburb is part of to the Thorndon DMA which is supplied from the Wellington Central network and the bulk network connection at Thorndon Pump Station. Storage wise the area relies on both Macalister Park reservoir (92 m TWL, 20 ML) and Carmichael reservoir (92 m TWL, 7 ML).

**Pressure**: There are few high-elevation properties in Sar Street which may experience low water pressure. However, the pressure at the point of supply (on the public main) is within the normal range. No other significant low pressures have been identified as part of this high level analysis for the identified area in Pipitea. Further detailed investigation is needed to confirm this.


**Figure 64 – Predicted areas of existing low water pressure in Pipitea**

**Mains**: A 800 mm diameter mains upgrade from the intersection of Tasman Street and Buckle Street to mid CBD (apportioned between the Te Aro, Wellington Central, Mount Cook and Thorndon growth zones) along with some minor mains upgrades is required. This is to improve supply to the area by reducing dependency on the bulk water direct supply (not via a reservoir) at Thorndon. Refer also to 4.2.1 with regard to modelling.

There are about 13 km of distribution network in Pipitea suburb, and 1 km are AC pipes. It is recommended to replace the AC pipes over time. There are also about 3 km of pipes with

other materials which have been installed more than 70 years ago in this area. Those would be close to their end of life cycle when the proposed growth developments are fully implemented and are not included in estimates.

**Storage**: Please refer to the storage requirement for Wellington Central suburb (section 4.22.1) as this area is supplied from the same reservoirs.

### 4.18.2. Wastewater

Wastewater from the Pipitea growth area is conveyed to the Moa Point WWTP for treatment and disposal.

Along with a few minor existing constraints in the local wastewater pipes (104 m) in the Pipitea growth area, additional wastewater flows from future populations will contribute to constraints in the downstream network and WWTP. In addition, there are approximately 218 m of poor or very poor condition (grade 4 and 5) wastewater pipes which will need to be renewed to alleviate adverse effects of wastewater leaks on water quality.

It is expected that pump station and rising main renewals can be sized to accommodate future growth in Pipitea.

### 4.18.3. Stormwater

Significant portion of Pipitea in particular the area around Thorndon Quay and extending onto the railway tracks are vulnerable to the predicted impacts of climate change and are flood prone during major storm events. Some of the proposed high-density growth is within the likely affected area.

In order to manage flooding and accommodate proposed growth 3.5km of stormwater network are likely to require upgrading. These proposed upgrades are preliminary and are subject to further assessment and optioneering.

Of note is that Thorndon area catchments also rely on these trunks identified for potential upgrade (please refer to section 4.21.3). It is unlikely that Thorndon flooding issues could be resolved unless downstream network, discussed here, is upgraded.

In addition to alleviating flood risks to growth, new stormwater treatment devices, such as rain gardens, were identified based on the catchment area of land proposed for growth.

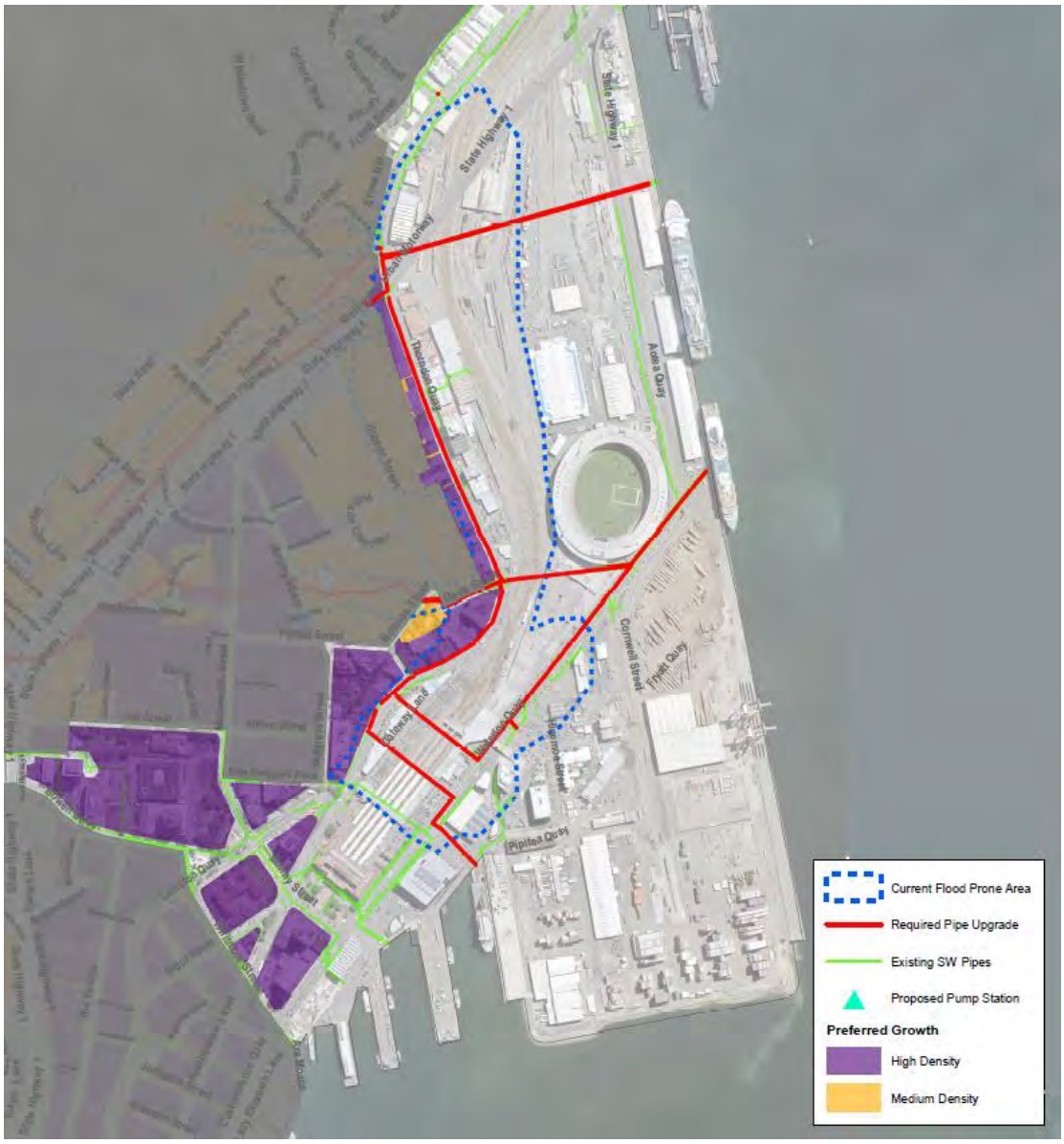


**Figure 65 – Predicted flooding and potential stormwater upgrades for Pipitea.**

## 4.19. Tawa

The estimated costing band of providing three waters at an adequate level of service to provide for projected growth in the Tawa growth area is Band F, $200M to $550M.

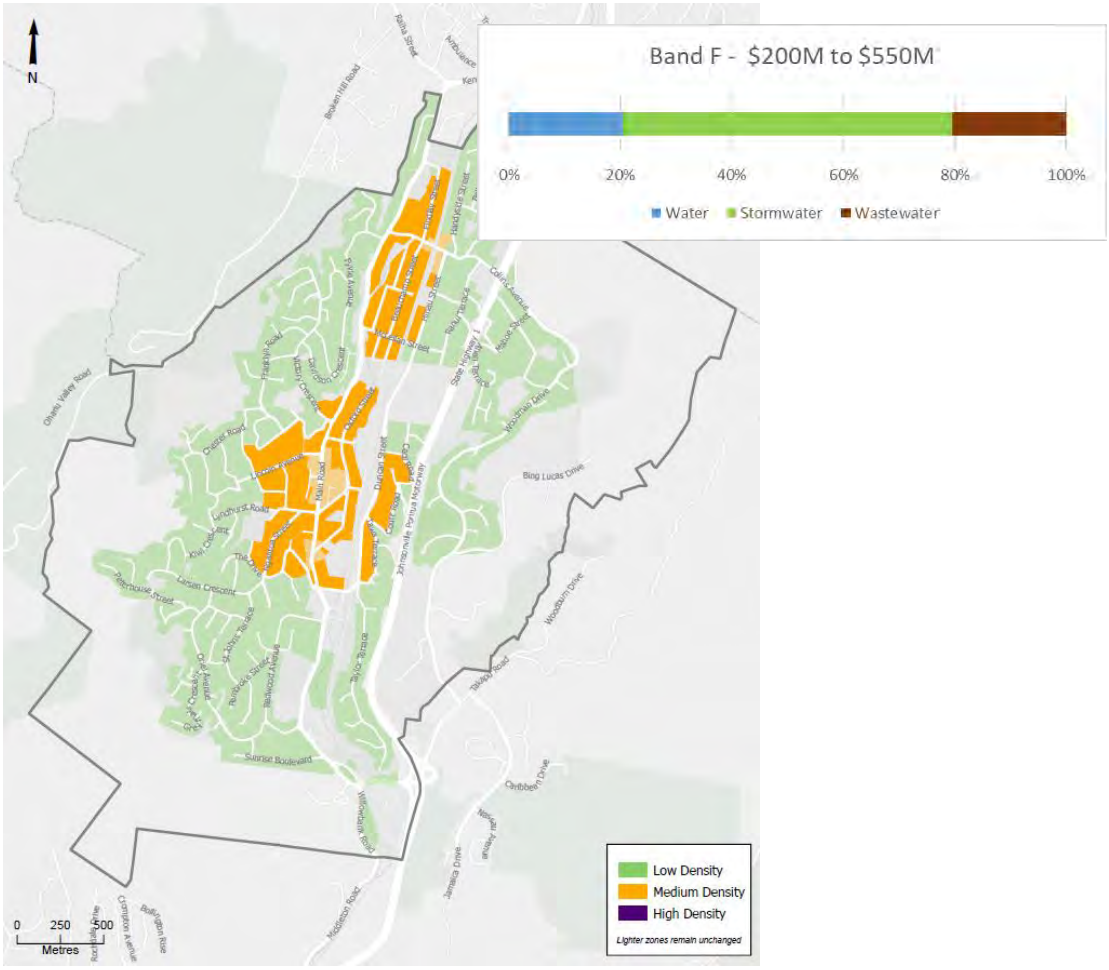


**Figure 66 – Tawa Preferred Growth Scenario for 5,300 additional people**[27]

| | Existing Constraints | Needed Infrastructure |
|---|---|---|
| **Water** | Numerous properties with low water pressure | Mains upgrades and around 6 ML additional water storage required. |
| **Wastewater** | Extensive overflows from under capacity mains and poor condition pipes | Approximately 6 km of local pipe upgrades and significant upgrades to the Porirua Joint Venture network |
| **Stormwater** | Significant flooding and overland flow paths restrictions | Multiple stormwater pipe and overland flow path upgrades and stormwater treatment devices |

[27] Image Source BECA. Name of Map: Preferred Growth Scenario. Date: 12/07/2019

### 4.19.1. Water supply

**Water supply zone:** The growth area in Tawa is supplied from Tawa DMA and Tawa North DMA. Tawa DMA is fed by the Tawa Reservoir (TWL 101 m) and Tawa North DMA is supplied from Linden reservoir (TWL 141 m).

**Pressure**: Low water pressure is expected for approximately 20 properties at the Kilkelly Close. These properties are located at a relatively high altitude (approx. 132 m) in the vicinity of Linden reservoir and it is not expected that the situation get worse by the proposed medium density developments.

Marginal pressures are also expected for approximately 20 properties in Bartlett Grove. These properties are located at a relatively high elevation (approx. 72 m) in relation to the supply at Tawa reservoir (TWL 100.7 m).

There are also few properties at the north end of Victory Crescent which currently experiencing low pressure. There is a possibility to re-zone this area to Broken Hill Reservoir (which is the Porirua City Council area) to rectify the issue.

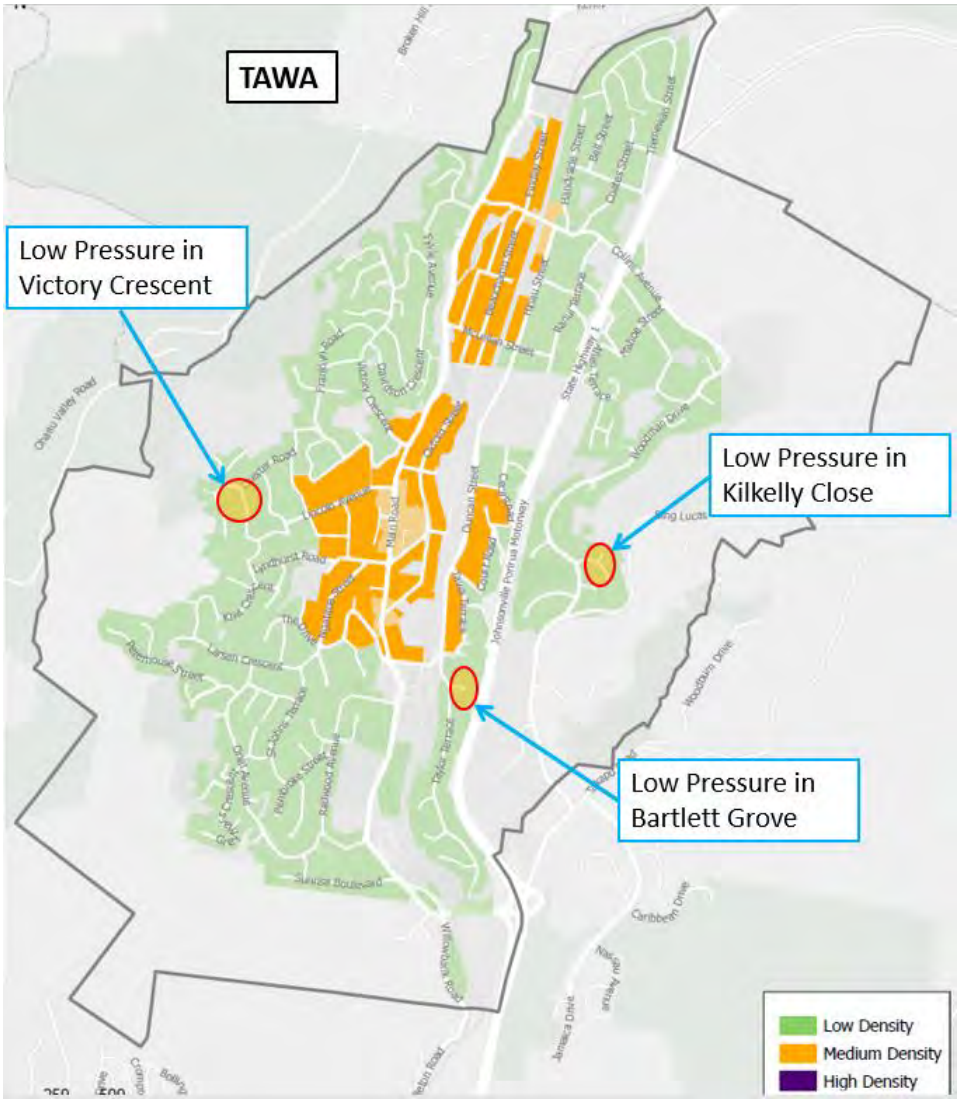


**Figure 67 – Predicted areas of existing low water pressure in Tawa**

**Mains**: To accommodate the proposed growth, 1.2 km of mains need to be upgraded to 450 mm diameter from the Tawa Reservoir to the intersection of Oxford Street and Main Road. Also required is upgrades to 1.3 km of 250 mm to 300mm diameter main on Main Road from

intersection of Cambridge Street and Main Road to Beauchamp Street via McLellan St and end at Rawson St. In addition, mains upgrades to address low pressure areas are required.

There are about 78 km of distribution network in Tawa suburb, which 32 km are AC pipes. It is recommended to replace the AC pipes over time and are not included in estimates.

**Storage**: A preliminary analysis indicated that in order to accommodate the projected growth in Tawa suburb, there would be around 6 ML additional water storage required of which 2.5 ML is to cover for current shortfall. It is likely that 3 ML extra storage in Tawa zone and 3 ML extra storage in Linden zone would be required. Further investigations are needed to confirm the actual capacity, number and location of those required reservoirs.

### 4.19.2. Wastewater

Wastewater from the Tawa growth area is conveyed to the Porirua WWTP for treatment and disposal.

Without upgrades to the wastewater pipes, projected population growth in Tawa would result in increased frequency and volume of untreated wastewater overflows from manholes and constructed overflows.

During a 1-year ARI there are a number of current capacity issues in the local network. Currently, however, the trunk main running through the catchment has spare capacity.

Proposed option upgrades have focused on providing extra pipe capacity to the trunk along Duncan Street, in and around Tawa Rugby Club and on Lincoln Ave. Providing extra capacity in the local wastewaters will pass more peak flow to the trunk wastewater and eventually the Joint Venture assets managed jointly by PCC and WCC. A total of 4.2km of pipes have been identified for upgrades and 1.8km for water quality improvement.

Development and increases in pipe capacity within this catchment will need to be considered in detail with the possible upgrade works associated with proposed development in Porirua.

In order to accommodate future growth in northern suburbs of Wellington and in Porirua a detailed modelling and assessment has been undertaken to determine the upgrades that would be required in the PCC Joint Venture network. A proportion of the WCC component of the total estimated cost is allocated to the Tawa growth area, based on the projected additional population for this area.

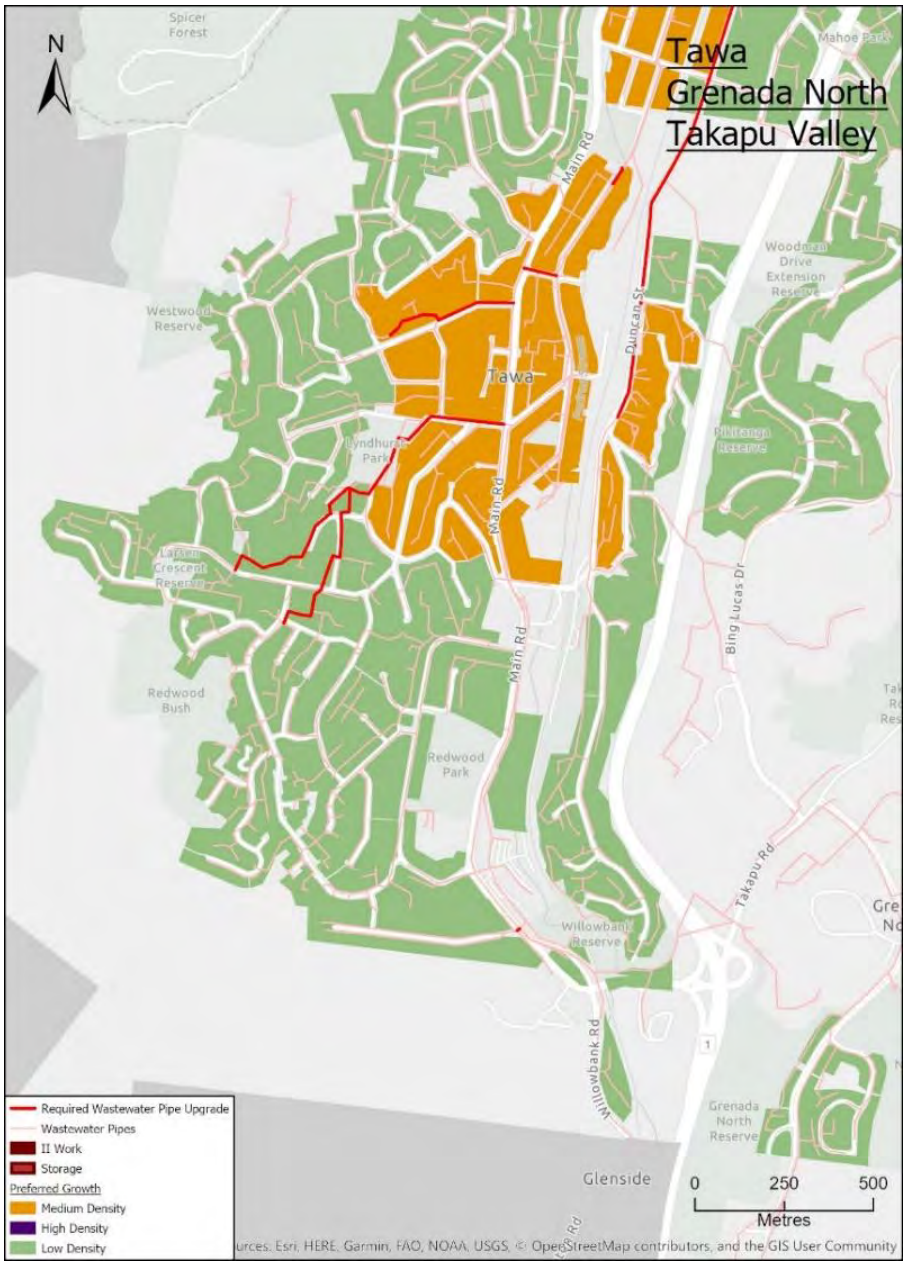


**Figure 68 – Proposed wastewater upgrades in southern Tawa.**

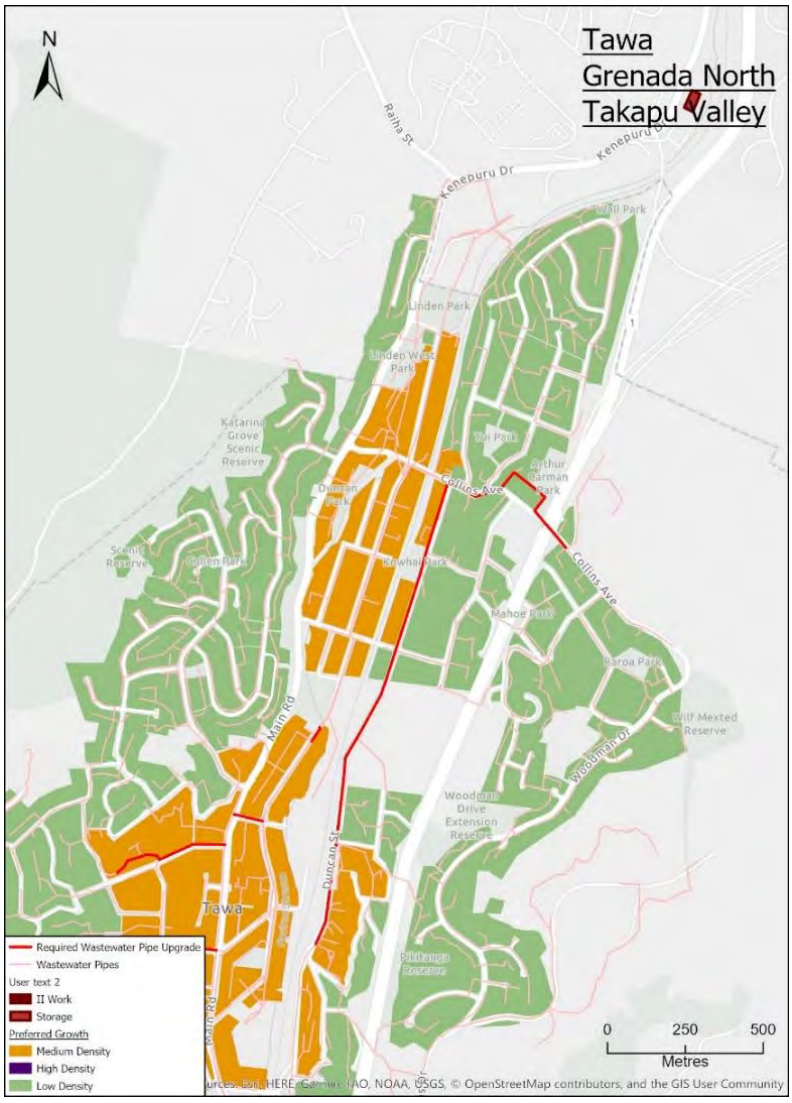


**Figure 69 – Proposed wastewater upgrades in northern Tawa.**

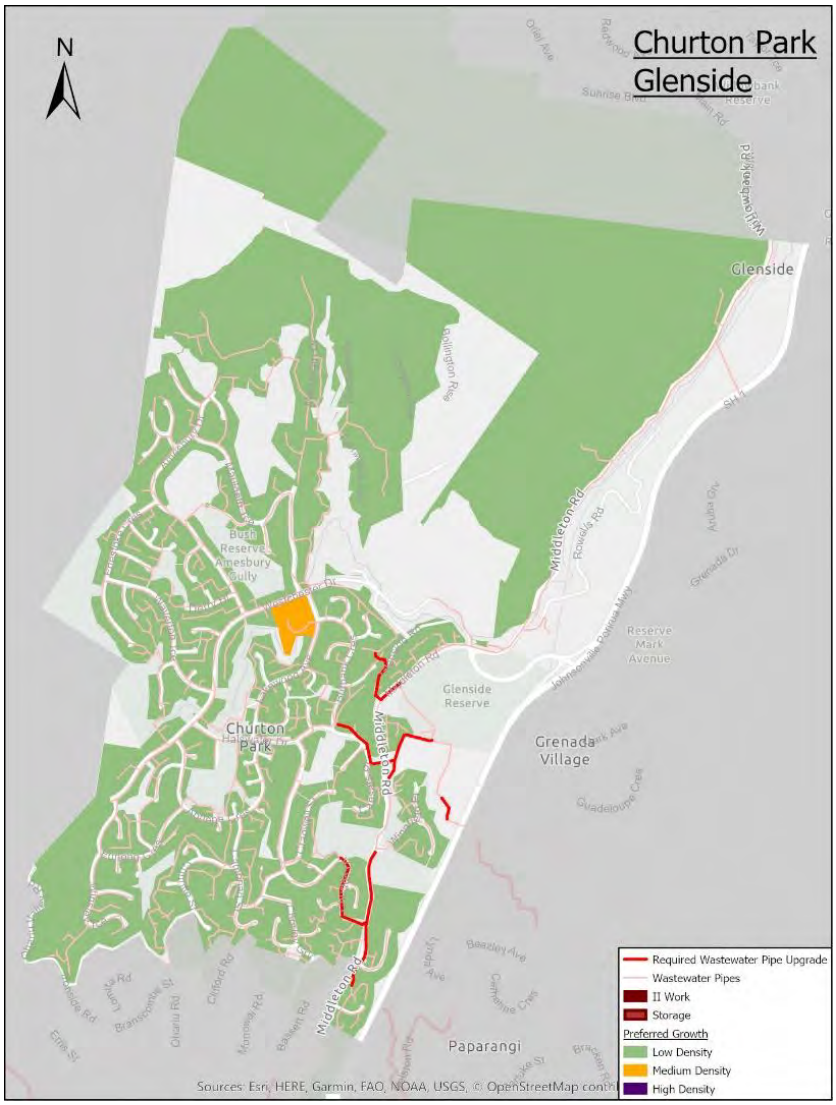


**Figure 70 – Proposed wastewater upgrades in northern Churton Park.**

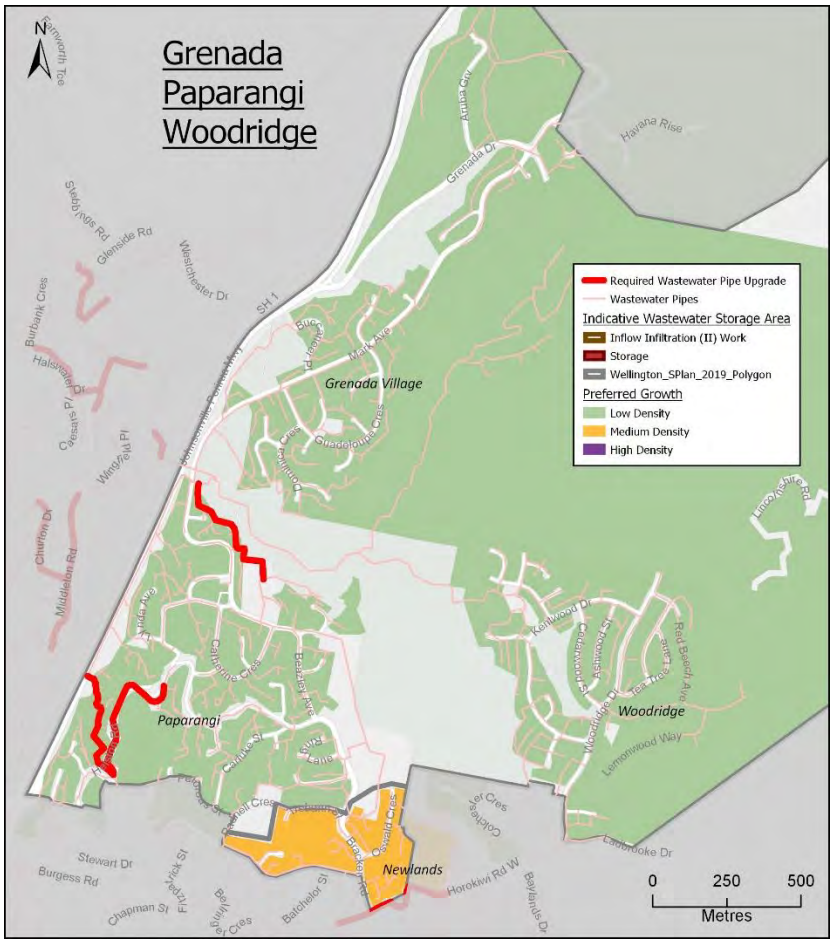


**Figure 71 – Proposed wastewater upgrades in Grenada.**

### 4.19.3. Stormwater

Significant flood events occurred in the Tawa catchment in February 2013 and May 2015. The valley is drained by many overland flow paths and streams that have been restricted by development. Much of the pipe networks and culverts in the valley are not able to convey even a 10-year rainfall event. Furthermore, high water levels in the Porirua Stream can contribute to upstream flooding by restricting the ability of the stormwater pipes to discharge into the stream.

On the valley slopes there are many locations of overland flows damaging property. The flooding spreads and deepens when it reaches the valley floor including around the central commercial properties between Lincoln Avenue and Lyndhurst Road.

Flood risk is prevalent in Tawa. In response to flooding complaints during the May 2015 event and prior flood events, Wellington Water investigated the flood mechanisms at most of the flood-prone areas and quantified the number of habitable and commercial floors at risk of flooding during the 10-year event and during the 100-year event with climate change. For some of these investigations, Capex and Opex improvements are at various levels of development and implementation. For other investigations, solutions have yet to be selected.

In 2017/18, two large catchment-wide investigations developed catchment-wide solutions for four highly flood-prone areas: Beauchamp/Collins, Lincoln, CBD, and The Drive. The WCC 2018-28 Long Term Plan confirms $18 million to reduce flooding in Tawa within 10 years. However catchment studies completed to date identify a funding gap of around $40 million to achieve consistent levels of service improvement across the suburb. Therefore the funded upgrades will need to be targeted on the areas of highest return for investment.

The medium density growth area identified in Tawa is largely in the flood prone areas and therefore mitigation flood work is recommended prior to any significant infill development. This is also identified in the Te Awarua-o-Porirua Whaitua as an area of high priority for water quality improvements. Therefore significant investment is needed in this area to improve water quality.

## 4.20. Te Aro

The estimated costing band of providing three waters at an adequate level of service to provide for projected growth in the Te Aro growth area is Band F, $200M to $550M.

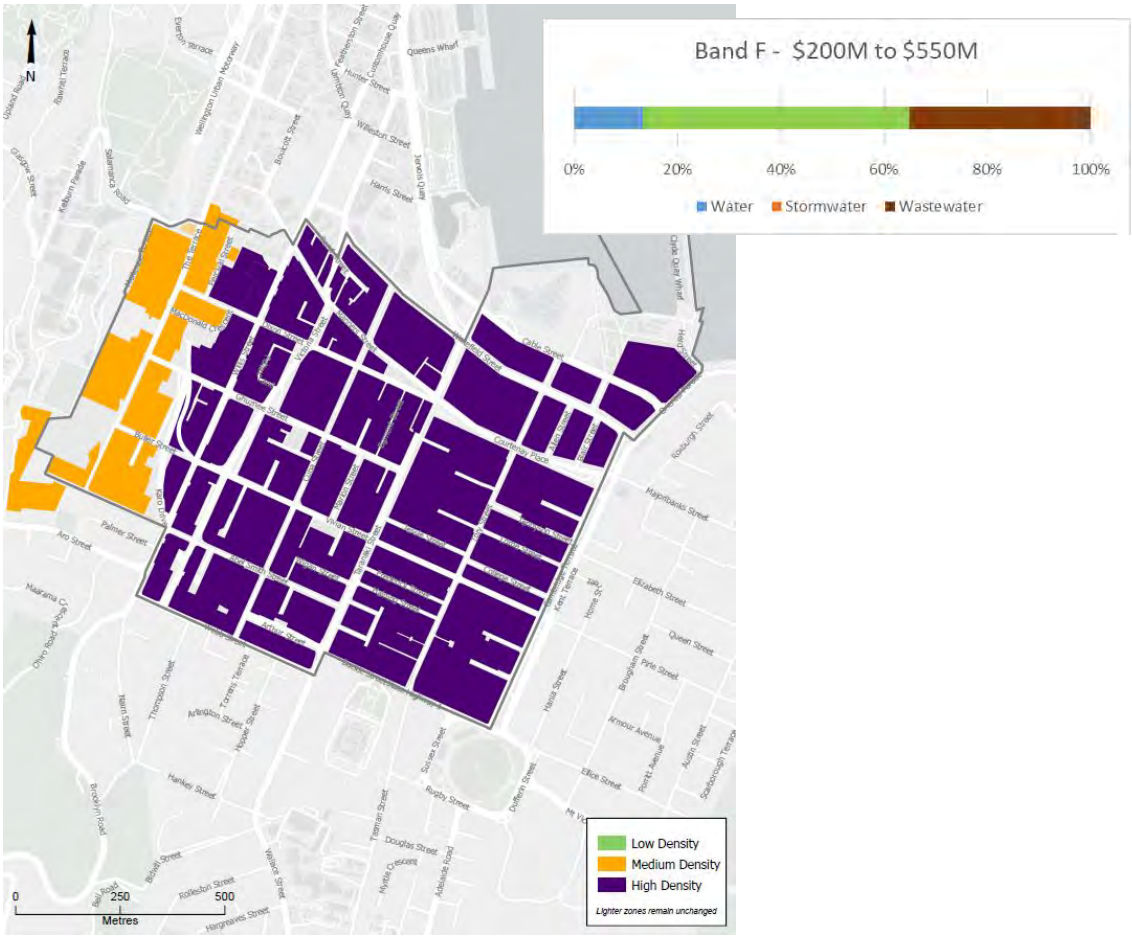


**Figure 72 – Te Aro Preferred Growth Scenario for 17,600 additional people**[28]

| | Existing Constraints | Needed Infrastructure |
|---|---|---|
| **Water** | Potential supply issues | Mains upgrades and 14 ML additional storage prorated to the Berhampore, Mount Victoria, Newtown, Pipitea, Te Aro, Wellington Central, Mount Cook and Thorndon growth zones |
| **Wastewater** | Under capacity and poor condition pipes, pumping capacity and increased wet weather overflows | Pipe renewal and upgrades (3.5 km), pump station and rising main upgrades, a new pump station and storage (10 ML) and contributions to WWTP upgrades |
| **Stormwater** | Existing flooding and lack of protected overland flow paths | A new stormwater main and/or open channel along Kent Terrace with coastal outlet, stormwater treatment devices and a pump station to service low lying areas affected by sea level |

[28] Image Source BECA. Name of Map: Preferred Growth Scenario. Date: 12/07/2019

### 4.20.1. Water supply

**Water supply zone:** Wellington CBD Central area is divided into two DMAs – CBD and Te Aro DMAs.

The growth area in Te Aro is connected to the Te Aro DMA which is located south of the Wellington Central DMA (please refer to section 4.4.1 for more information on zoning).

**Pressure**: No significant low pressures were identified as part of this high level analysis for the identified area in Te Aro. However, further detailed investigation is needed to confirm this.

**Mains**: A 800 mm diameter mains upgrade is required from the intersection of Tasman Street and Buckle Street to mid CBD (apportioned between the Te Aro, Wellington Central, Mount Cook and Thorndon growth zones) along with some minor mains upgrades. This is to improve supply to the area by reducing dependency on the bulk water direct supply (not via a reservoir) at Thorndon. Mains upgrades to address future low pressure areas are required (please also refer to section 4.2.1 with regard to modelling).

There are about 29 km of distribution network in Te Aro suburb, and 3 km are AC pipes. It is recommended to replace the AC pipes over time. There are also about 5 km of pipes with other materials which have been installed more than 70 years ago in this area. Those would be close to their end of life cycle when the proposed growth developments are fully implemented and are not included in estimates.

**Storage**: Please refer to the storage requirement for Wellington Central growth area (section 4.22.1) as this area is supplied from the same reservoirs.

### 4.20.2. Wastewater

Wastewater from the Te Aro growth area is conveyed to the Moa Point WWTP for treatment and disposal.

Currently there is one main capacity issue specific to the Te Aro catchment. The common rising main that serves pump stations PS01, PS02, PS03 and PS04 is in poor condition and has insufficient wet weather capacity. An additional pump station is also proposed at Taranaki Street.

During heavy rainfall events, pump station PS02 is known to back up and spill at the constructed wastewater overflow on Kent Terrace/Wakefield Street. To allow for future growth, the Oriental Parade rising main will need to be renewed.

During a 1-year ARI the wastewater interceptor running through Te Aro runs full. Given that we don’t yet know whether the interceptor wastewater can handle surcharging it is proposed to limit the peak pumped flows from Te Aro and allow for distributed storage at existing and new pumps stations.

Approximately 3.5 km of pipes have been identified for renewal or upgrade mainly due to poor condition.

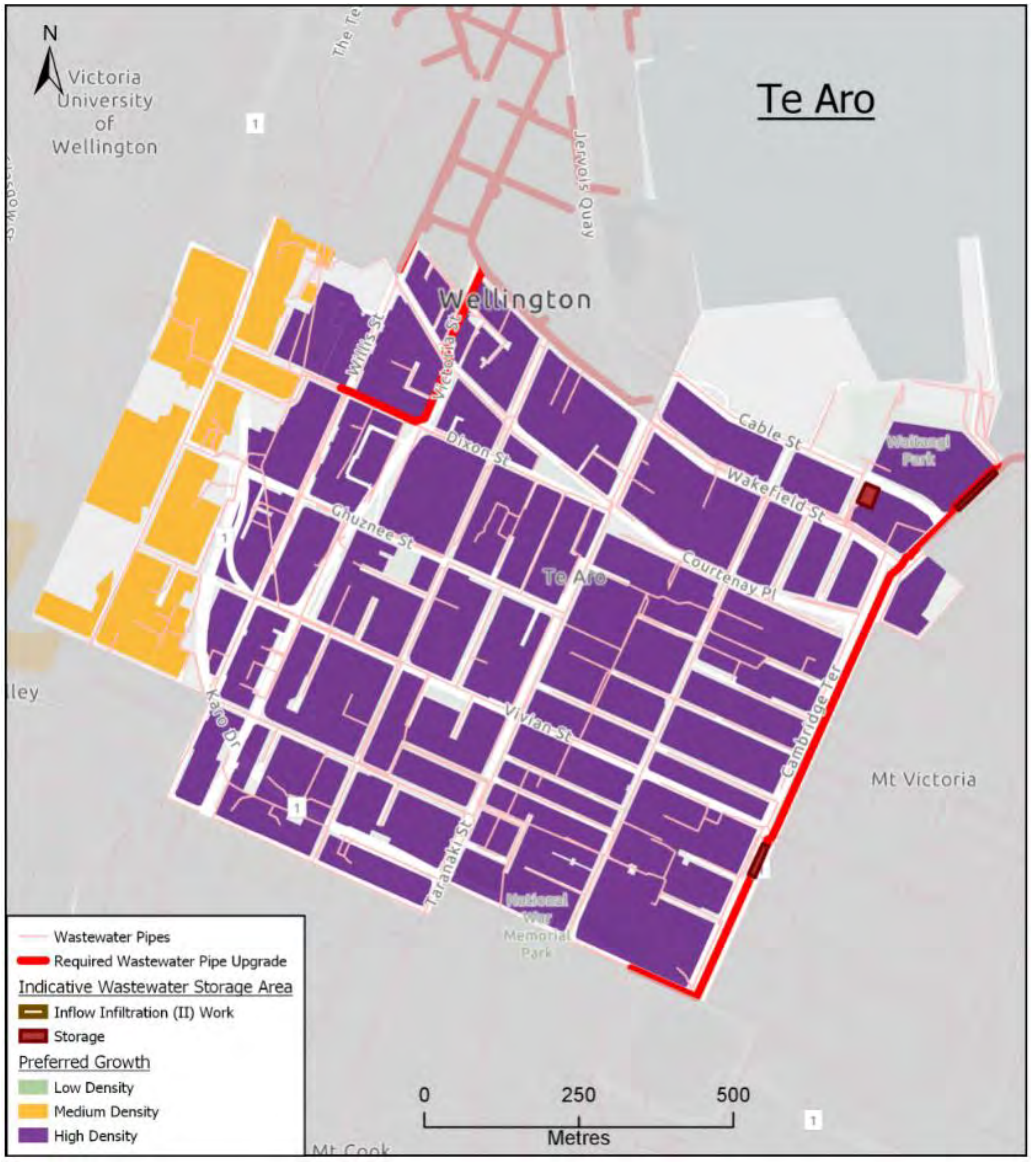


**Figure 73 – Proposed wastewater upgrades in Te Aro**

### 4.20.3. Stormwater

Stormwater runoff from the large and heavily developed catchments that extend up to the Wellington Zoo in Newtown flows through constrained pipe networks under the low lying CBD before discharging into the harbour. This results in the Te Aro area of the CBD having the highest flood risk in Wellington. Exacerbating the flooding is the reclaimed land bordering the harbour which is at a higher elevation than the inland area surrounding Wakefield Street. The flooding is likely to be compounded by high tides and sea level rise.

Flooding has been reported in many parts of the catchment. The most affected areas are the Basin Reserve, Kent Terrace, Cambridge Street and Wakefield Street. The locations of predicted flooding problems and potential upgrade requirements indicated in Fig XX below.

For the purpose of informing the WCC Spatial Plan and to mitigate flooding problems and accommodate the proposed growth, 1.5 km of stormwater trunk with the longest segment along Kent Terrace and 1.6 km of local reticulation upgrades in the north-western quarter of Te Aro were identified to be upgraded. These proposed upgrades are preliminary and are subject to further assessment and optioneering.

The lower area of Te Aro primarily around Wakefield Street which is likely to be impacted by sea level rise in the long term will require flood pump stations to meet an acceptable level of service.

There are also extensive opportunities to support development by integrating green infrastructure, such as daylighting the stream under Kent Terrace, with the urban form. This area is under current investigation to explore the options, risks, costs and benefits.

For the WCC Spatial Plan, new stormwater treatment devices, such as rain gardens, were identified based on the catchment area of land proposed for growth.

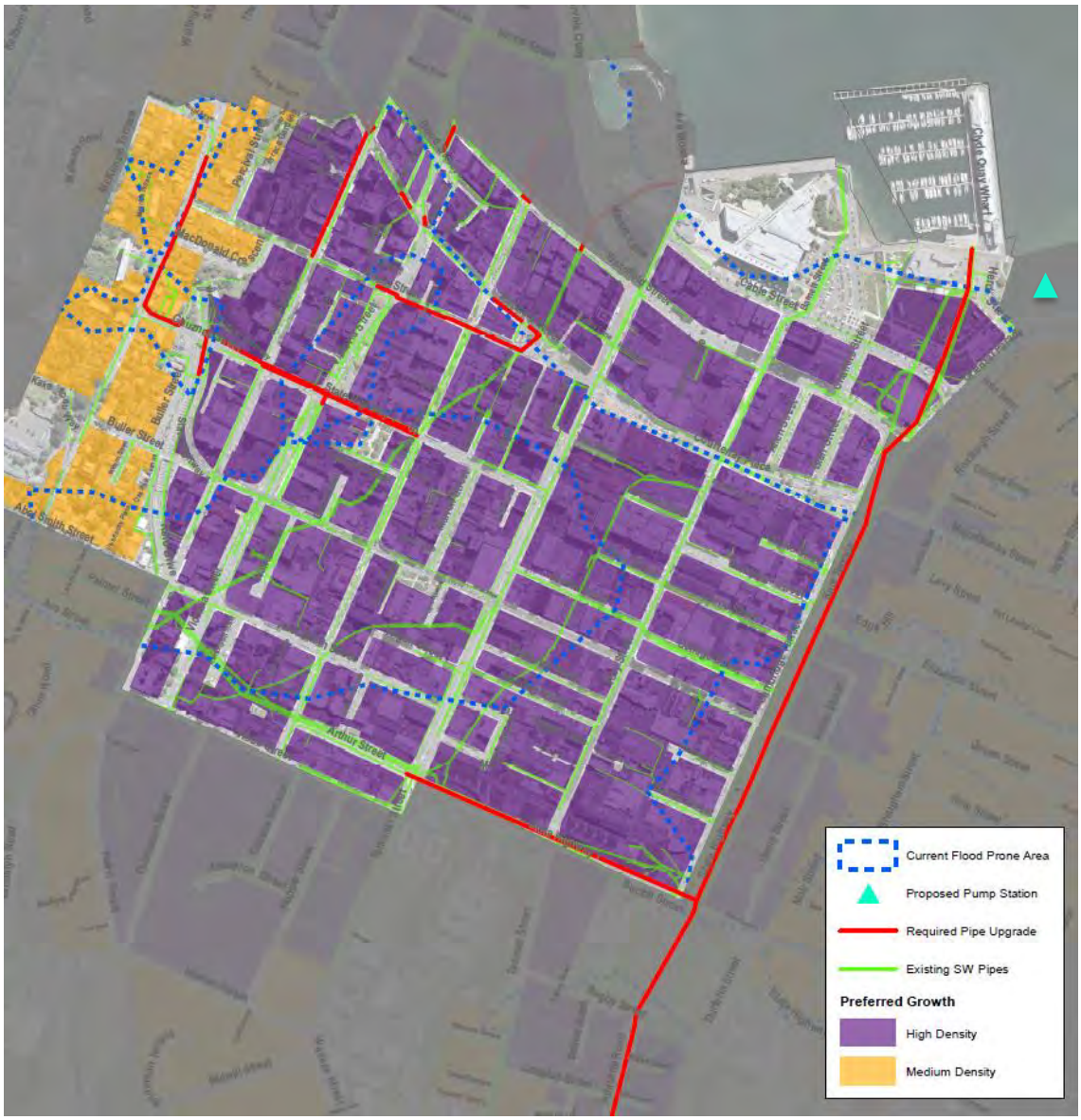


**Figure 74 – Predicted flooding and potential stormwater upgrades for Te Aro.**

## 4.21. Thorndon

The estimated costing band of providing three waters at an adequate level of service to provide for projected growth in the Thorndon growth area is Band E, $100M to $200M.

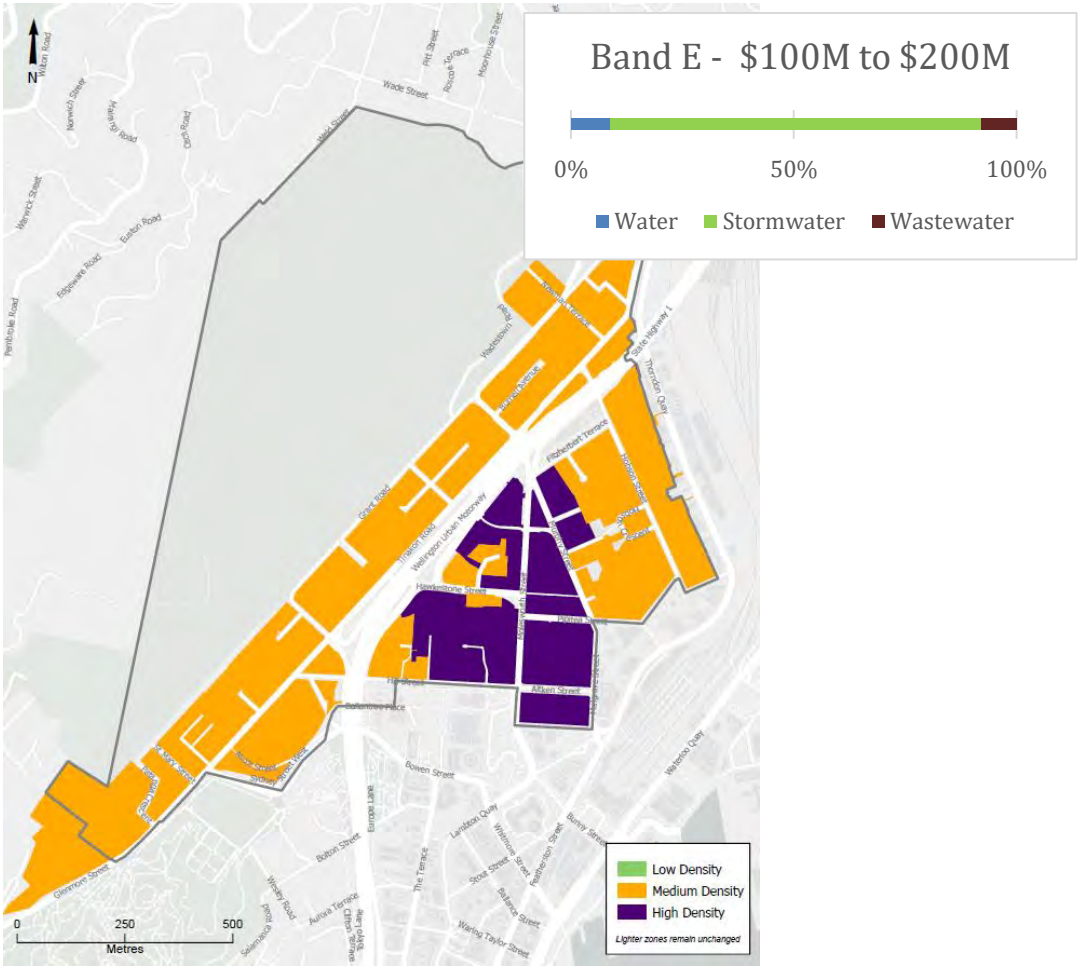


**Figure 75 – Thorndon Preferred Growth Scenario for 1,300 additional people**[29]

| C | Existing Constraints | Needed Infrastructure |
|---|---|---|
| **Water** | Potential supply issues | Mains upgrades and 14 ML additional storage prorated to the Berhampore, Mount Victoria, Newtown, Pipitea, Te Aro, Wellington Central, Mount Cook and Thorndon growth zones |
| **Wastewater** | Pipe capacity and wet weather overflows. | Minor pipe upgrade (300 m) and storage (0.75 ML) and contributions to WWTP upgrades |
| **Stormwater** | Existing flooding and under capacity stormwater pipe | Upgrade of around 1.8 km of stormwater pipe and stormwater treatment devices |

[29] Image Source BECA. Name of Map: Preferred Growth Scenario. Date: 12/07/2019

### 4.21.1. Water supply

**Water supply zone**: Wellington CBD Central area is divided into two DMAs – CBD and Te Aro DMAs. The growth area in Wellington Central is connected to the CBD DMA which is north of Te Aro (please refer to section 4.14.1 for more information on the zoning).

**Pressure**: Approximately 15 properties located at Tinakori Road and Upton Terrace are predicted to have low pressures. These properties are located at a relatively high altitude (approx. 60 m) compared to the other properties in the zone. The current HGL of the zone is not high enough to supply these properties with minimum pressure of 25 m. A possible solution to improve pressures at this location is to re-zone these properties into Aro Zone with supply from Aro Reservoir (TWL 137 m)

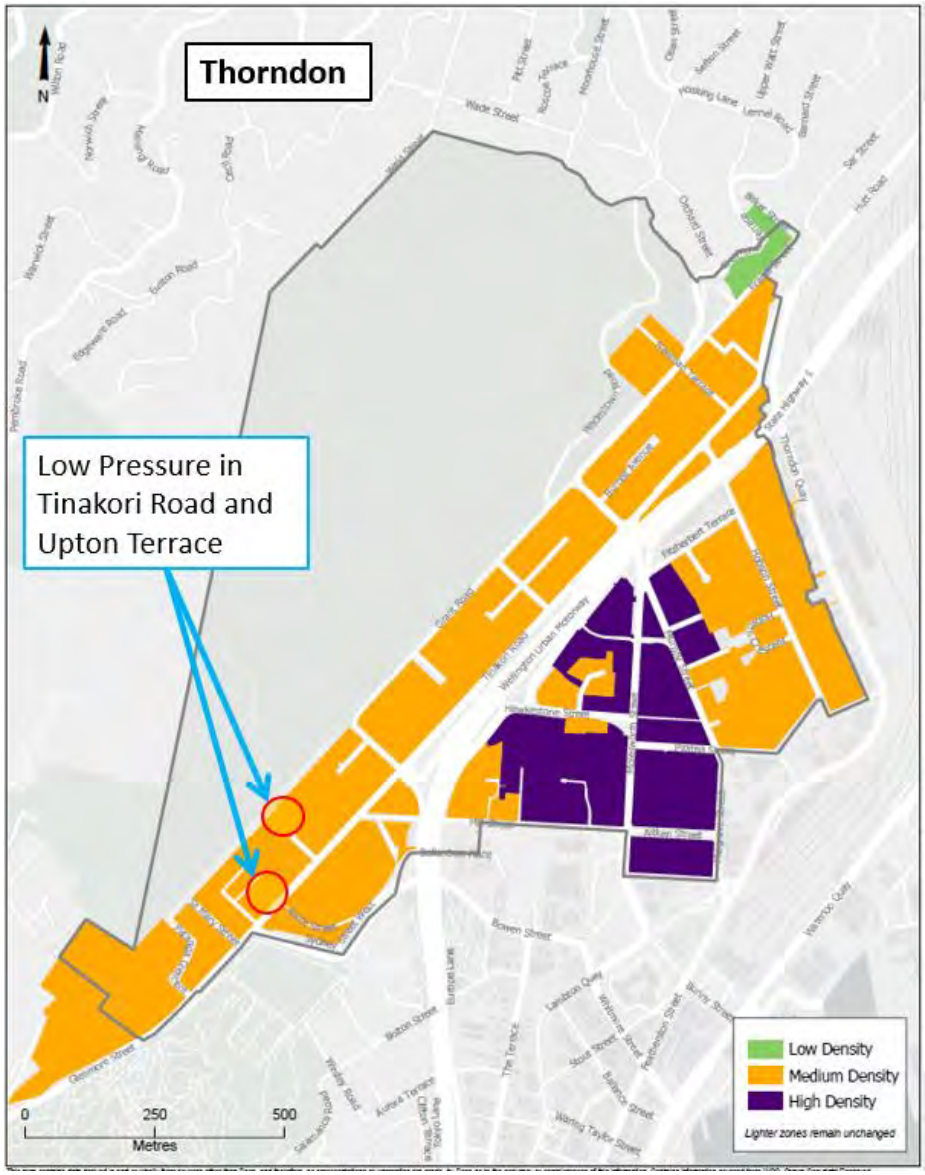


**Figure 76 – Predicted areas of existing low water pressure in Thorndon**

**Mains**: A 800 mm diameter mains upgrade is required from the intersection of Tasman Street and Buckle Street to mid CBD (apportioned between the Te Aro, Wellington Central, Mount Cook and Thorndon growth zones) along with some minor mains upgrades. This is to improve supply to the area by reducing dependency on the bulk water direct supply (not via a reservoir) at Thorndon (please refer to section 4.2.1 with regard to modelling).

There are about 14 km of distribution network in Thorndon suburb, and 3 km are AC pipes. It is recommended to replace the AC pipes over time. There are also about 3 km of pipes with other materials which have been installed more than 70 years ago in this area. Those would be close to their end of life cycle when the proposed growth developments are fully implemented and are not included in estimates.

**Storage**: Please refer to the storage requirement for Wellington Central suburb (section 4.22.1) as this area is supplied from the same reservoirs.

### 4.21.2. Wastewater

Wastewater from the Thorndon growth area is conveyed to the Moa Point WWTP for treatment and disposal.

Only around 300 m of pipe upgrades have been identified as need to service for growth in this catchment

In the Thorndon catchment there is a major constructed wastewater overflow at Murphy Street. The wastewater interceptor next to New World has very little headroom and hence the wastewater has a capacity bottleneck. High Inflow and infiltration loads from upstream and this bottleneck are the main reason for overflows. Based on monitored flows the current overflow spills about 20,000 $m^3$ about 4 times a year.

Upgrade options to allow for future growth will need to be confirmed in detail. However storage at Ngaio Gorge is expected to alleviate wastewater overflows at Murphy Street. Future options at Ngaio Gorge will however need to be considered in conjunction with targeted Inflow and infiltration reduction upstream.

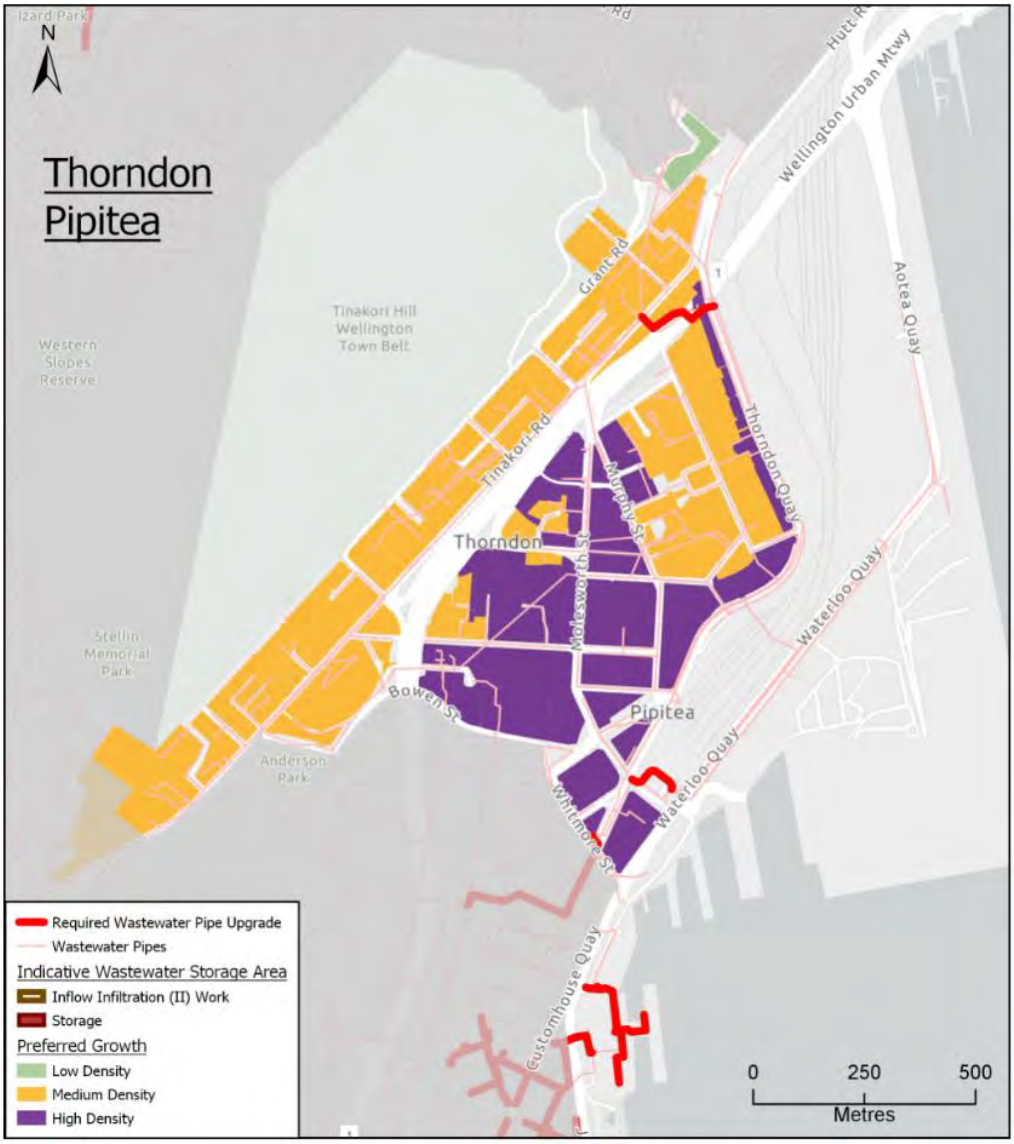


**Figure 77 – Proposed wastewater upgrades in Thorndon.**

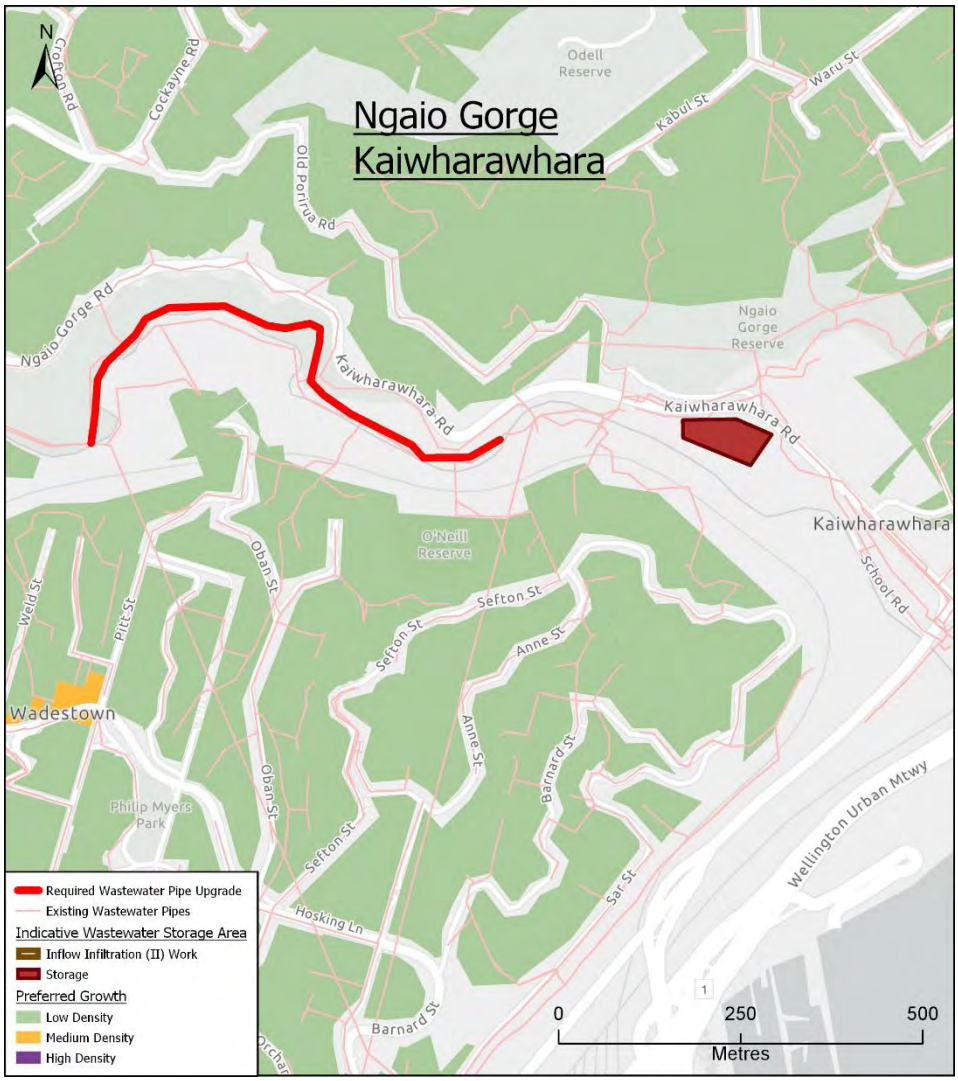


**Figure 78 – Proposed wastewater upgrades in Ngaio Gorge to support Thorndon.**

### 4.21.3. Stormwater

Tinakori Rd in Thorndon is expected to experience flooding during major storm events. A large portion of medium-density growth is within this area of potential flood risk.

In order to manage flood risk and accommodate proposed growth, 1.8 km of stormwater network would be required. These proposed upgrades are preliminary and are subject to further assessment and optioneering.

Of note is that Thorndon area also subject to the downstream network constraints in Pipitea area (please refer to section 4.18.3). It is unlikely that Thorndon flooding issues could be resolved unless downstream network is upgraded.

In addition to alleviating flood risks to growth, new stormwater treatment devices, such as rain gardens, were identified based on the catchment area of land proposed for growth.

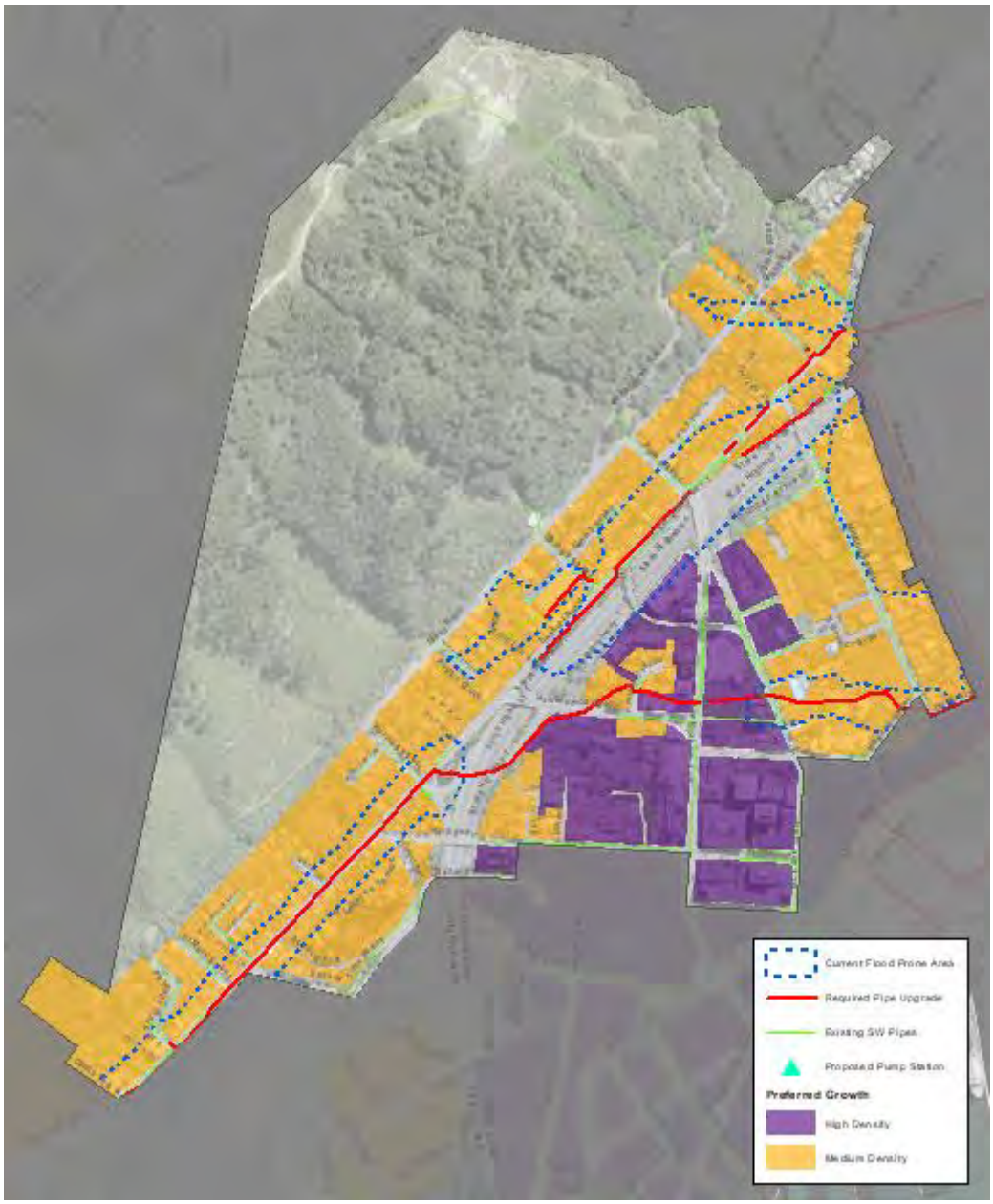


**Figure 79 – Predicted flooding and potential stormwater upgrades for Thorndon.**

## 4.22. Wellington Central

The estimated costing band of providing three waters at an adequate level of service to provide for projected growth in the Wellington Central growth area is Band E, $100M to $200M.

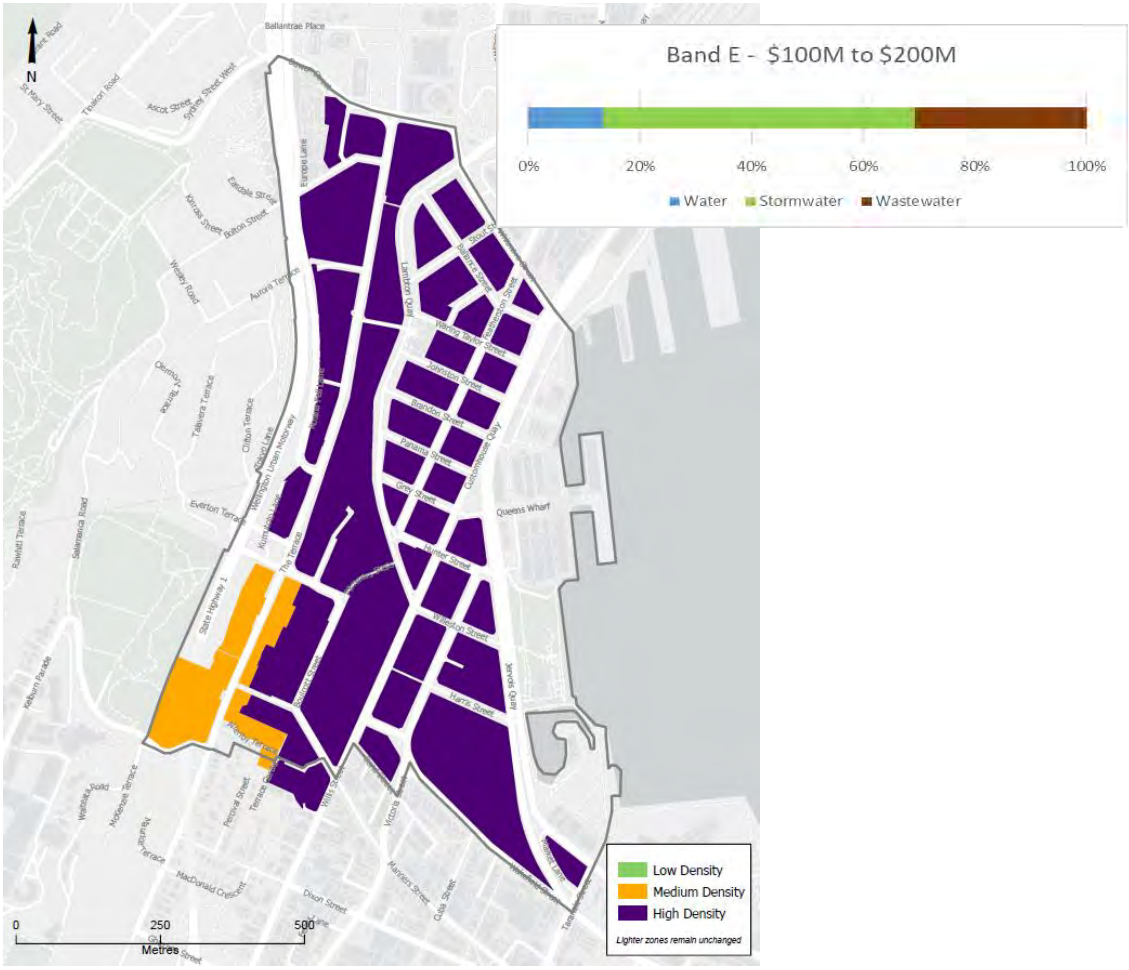


**Figure 80 – Wellington Central Preferred Growth Scenario for 2,900 additional people**[30]

| C | Existing Constraints | Needed Infrastructure |
|---|---|---|
| **Water** | Potential supply issues | Mains upgrades and 14ML additional storage prorated to the Berhampore, Mount Victoria, Newtown, Pipitea, Te Aro, Wellington Central, Mount Cook and Thorndon growth zones |
| **Wastewater** | Capacity of pipes, pump stations and rising main and wet weather overflows | 3.7 km of pipe upgrades and storage (1.7 ML) to manage wet weather overflows and contributions to WWTP upgrades |
| **Stormwater** | Flooding due to lack of network capacity and low-lying areas | Stormwater pump station together with pipe upgrades and stormwater treatment devices |

[30] Image Source BECA. Name of Map: Preferred Growth Scenario. Date: 12/07/2019

### 4.22.1. Water supply

**Water supply zone**: Wellington CBD Central area is divided into two DMAs – CBD and Te Aro DMAs. The growth area in Wellington Central suburb is connected to the CBD DMA which is north of Te Aro (please refer to section 4.14.1 for more information on zoning).

**Pressure**: No significant low pressures have been identified as part of this high level analysis for the identified area in Wellington Central. However, further detailed investigation is needed to confirm this.

**Mains**: A 800 mm diameter mains upgrade from the intersection of Tasman Street and Buckle Street to mid CBD (apportioned between the Te Aro and Wellington Central Growth zones) along with some minor mains upgrades are required. This is to improve supply to the area by reducing dependency on the bulk water direct supply (not via a reservoir) at Thorndon. Mains upgrades to maintain existing pressures are required (please refer to section 4.2.1 with regard to modelling).

There are about 18 km of distribution network in Wellington Central, and 1 km are AC pipes. It is recommended to replace the AC pipes over time. There are also about 3 km of pipes with other materials which have been installed more than 70 years ago in this area. Those would be close to their end of life cycle when the proposed growth developments are fully implemented and are not included in estimates.

**Storage**: A preliminary analysis indicated that with the construction of the Omāroro Reservoir, existing storage shortfall for day-to-day operational purposes (in average and peak day demand) will be covered to cater for the projected growth up to 2047 in this zone. However, the seismic storage calculations indicate that by 2047 the entire Wellington Central system would need a further 14 ML storage (along with larger diameter supply and delivery mains (800 mm diameter) to fulfil the seismic storage requirements considering the additional population. The additional storage has been prorated to the Berhampore, Mount Victoria, Newtown, Pipitea, Te Aro, Wellington Central, Mount Cook and Thorndon growth zones.

It should be noted this preliminary results are very sensitive to the assumptions for population per dwelling, estimated average and peak residential demand per dwelling, critical users consumptions (i.e. civil defence centres), commercial consumptions in the zone and estimated leakage per connection. Some of these assumptions will be confirmed when the current study of the Wellington Low Level Zone Management Plan is finalised (please refer to the storage requirement for Berhampore, Mount Victoria, Newtown, Pipitea, Te Aro and Thorndon areas as those are all supplied from the same reservoirs).

### 4.22.2. Wastewater

Wastewater from the Wellington Central growth area is conveyed to the Moa Point WWTP for treatment and disposal.

Currently there are a number of capacity issues in the Wellington Central wastewater network.

A common rising main that serves pump stations PS05, PS06 and PS07 needs to be renewed and reconfigured. The rising main is cast iron and has very little remaining useful life. In addition to the pumping stations PS05, PS06, PS07 another 4km of pipes have been identified as needing to be upgraded to support the projected population growth.

The other significant issue for the wastewater network in the Wellington Central area is tidal ingress. Currently about 50 litres per second of seawater enters the network during high tide. It is also possible that wastewater flows leave through the same holes during low tide.

A portion of the system-wide storage upgrades are also allocated to this growth area.

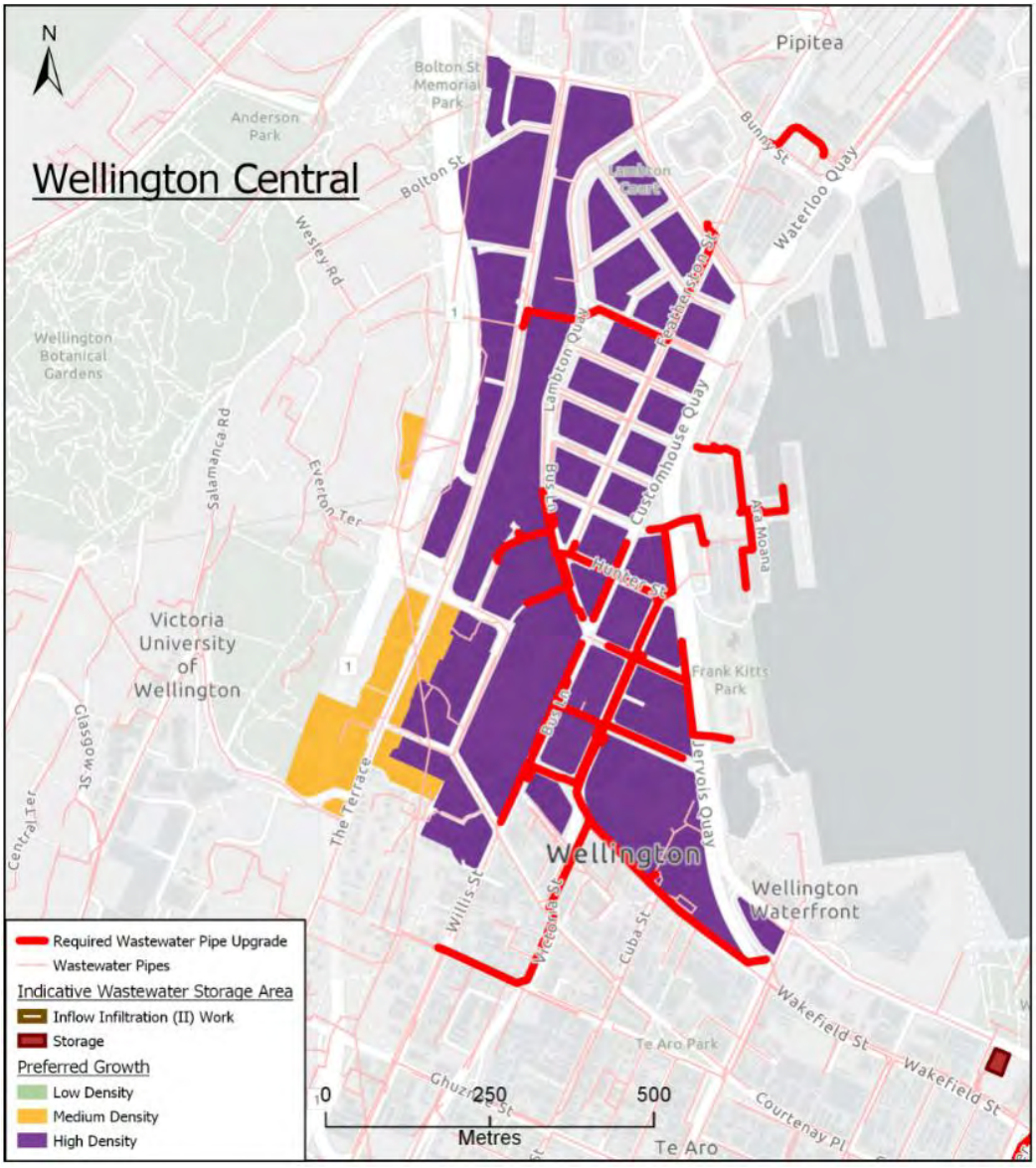


**Figure 81 – Proposed wastewater upgrades in Wellington Central.**

### 4.22.3. Stormwater

Wellington Central area is known for having high profile flooding issues such as at the Custom House Quay and Hunter Street intersection. This particular issue is attributed to network restriction on Hunter Street and a high road crest relative to the properties on either side. Exacerbating the flooding is the reclaimed land bordering the harbour which is at a higher elevation than the inland area surrounding Custom House Quay. The flooding is likely to be compounded by high tides and sea level rise.

In order to manage flood risks in Wellington Central and accommodate proposed growth, upgrades are needed to 900 m of stormwater pipe. These proposed upgrades are preliminary and are subject to further assessment and optioneering.

To manage for predicted future sea level rise, the Wellington Central would require one or two flood pump stations to meet the level of service. The total capacity of the pump station to manage peak flows was estimated to be 20 $m^3/s$.

To meet the requirements of the NPS-FM and WWL's stormwater discharge consent conditions, stormwater will need to be treated so that the water quality of Wellington City's

streams and coastal waters are maintained or improved. To account for this additional level of service, new stormwater treatment devices, such as rain gardens, were identified based on the catchment area of land proposed for medium and high density growth.

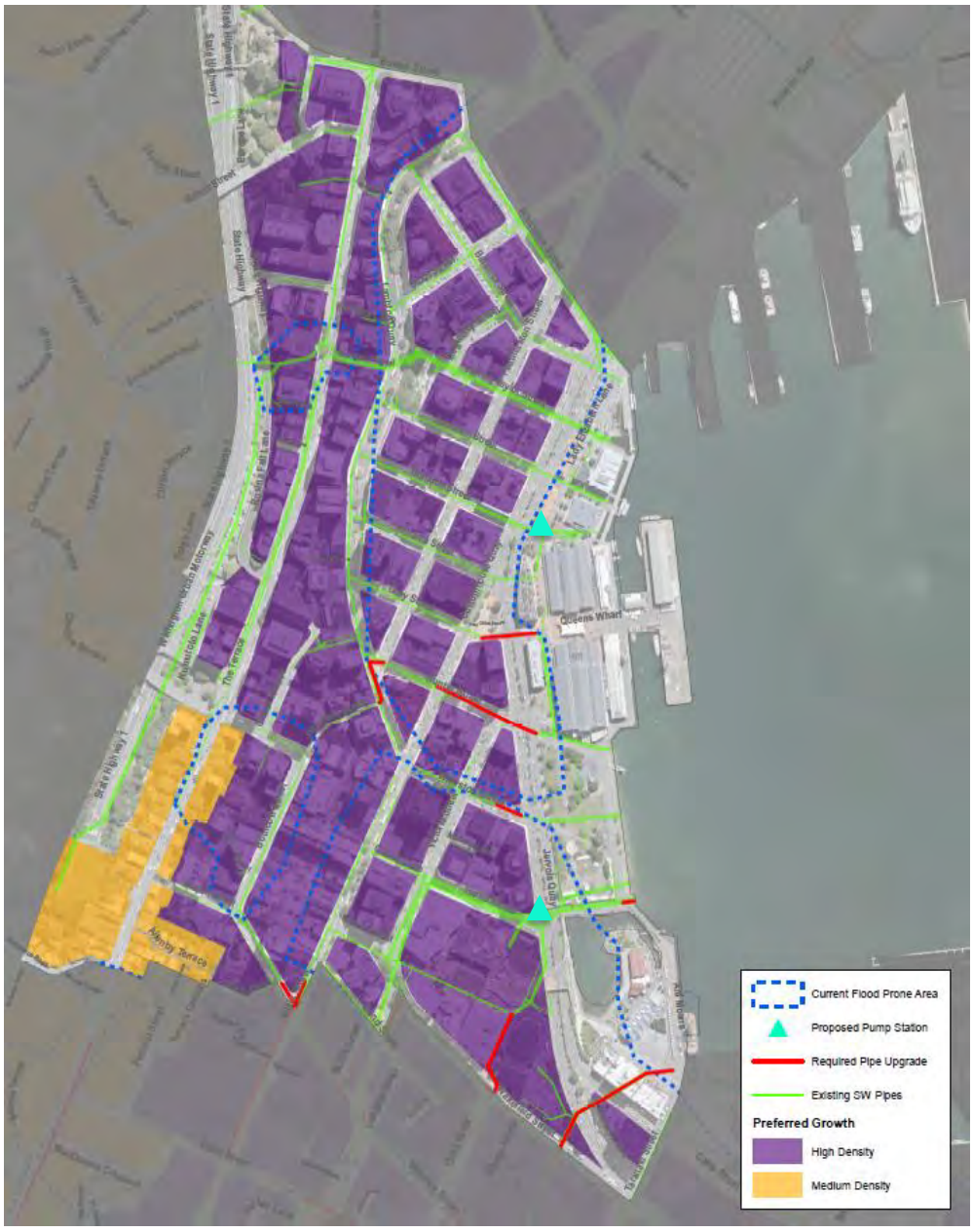


**Figure 82 – Predicted flooding and potential stormwater upgrades for Wellington Central.**

# 5. Summary

This report provides an information layer for inclusion in the WCC Spatial Plan. This information is a description of the existing performance and constraints in the water supply, wastewater networks and stormwater systems in the 22 growth areas identified in the WCC Preferred Growth Scenario. This existing performance and constraints were used as a baseline for an investigation of the comparative investment needed to support urban growth in these areas.

The report is a valuable layer for the WCC Spatial Plan, as the services our three water networks provide are vital to a modern and successful economy. WWL manages these networks on behalf of WCC to meet the three customer outcomes of safe and healthy water; respectful of the environment; and resilient networks that support our economy.

The level of Investigation used to identify infrastructure upgrade options was based on existing information, with considered of projected populations. This is a desktop assessment and no detailed modelling or site investigations were carried out. Therefore the proposed solutions are considered “pre-feasibility”.

The costs of these pre-feasibility solutions were estimated using a simplified method based on the WWL Cost Estimation Method (Revision D) (2019). Estimated costs for all upgrades across each of the three waters were summed within each growth area.

Estimated costs are presented in this report as cost bands, specifically for the purpose of comparing the suitability of growth within each of the 22 growth areas. The six cost bands and the growth areas that they are associated with are shown below.

| Cost Band | Preferred Growth Area |
|---|---|
| **Band A ($10 to $25M)** | Crofton Downs, Lyall Bay |
| **Band B ($25 to $50M)** | Ngaio |
| **Band C ($50 to $75M)** | Aro Valley, Mount Victoria |
| **Band D ($75 to $100M)** | Berhampore, Brooklyn |
| **Band E ($100 to $200M)** | Kelburn, Khandallah, Kilbirnie, Miramar, Mount Cook, Newlands, Newtown, Pipitea, Thorndon, Wellington Central |
| **Band F ($200 to $550M)** | Island Bay, Johnsonville, Karori, Tawa, Te Aro |

The table above indicates that significant investments in the water supply, wastewater networks and stormwater systems are needed in the majority of the preferred growth areas. This investment includes needed upgrades to the existing infrastructure (existing constraints), as well as new infrastructure required specifically for growth. In other words, upgrades for significant existing constraints (i.e., water storage shortfalls, wastewater overflows and existing flood risks) are included in the identified required upgrades.

Growth related projects identified in the 2018-2028 LTP are included in the above cost bands (refer to Section 3.5 of the report for details off allocated growth budgets in existing LTP).

This is especially relevant to the wastewater and stormwater systems. In particular, the costs associated with stormwater protection are based on pre-feasibility options to reduce known or predicted flooding even if no additional urban growth were to occur.

# 6. Recommendation and Next Steps

The next steps would be for the information in this report to be used a layer in the WCC Spatial Plan to help inform the suitability and cost of growth in each of the proposed 22 growth areas.

Once the Spatial Plan is adopted, more detailed investigations would be needed to determine preferred solutions, costs and a programme for delivery.

It is worth noting that there are relevant studies, plans and activities underway:

- CBD Three Waters Infrastructure Plan currently progressing;
- Porirua Wastewater Network Improvement Plan study – relates to WCC Northern Suburbs.
- Karori Wastewater Network Improvement Plan study is underway – relates to Karori only.
- Tawa Flooding Study – underway
- Flood mapping for WCC area – to be completed and verified.
- Sustainable Water Supply Study (Future Service Studies) for drinking water - continues.

Proposed Further Detailed Investigative Studies are recommended:

- Greenfield Areas – investigate bulk infrastructure requirements to service greenfields
- Detailed Growth Studies for adopted growth areas (scope to include renewal schedule and programmes) e.g. where flooding or wastewater overflow issues exist such as Island Bay, Johnsonville, Tawa, Karori and Miramar
- Feasibility Studies for Reservoirs to service the adopted growth areas;
- Moa Point - Wastewater Network Improvement Plan Study including optioneering for storage, I&I reduction, conveyance, and treatment;
- Stormwater Management Options for Water Quality studies
- The proportion of cost between LOS for existing populations and future population was not assessed, including cost of renewals – a separate study would be needed to determine this.

The above recommended studies would take the prefeasibility options presented in this report to preferred solutions that service the adopted growth areas.

Other measures that could contribute to managing water networks should be considered:

- Inflow and Infiltration (I&I) – addressing water services on private property;
- Policy and Bylaw changes;
- Demand Management – management of water use and loss;
- Education & Behavioural Change.

# 7. References

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