

Appendix B: Background to the Project

The information in this Appendix has been taken from the Notice of Requirement for the reservoir. It outlines the case for the reservoir and the Project Objectives and, while not directly relevant to the resource consent application, provides context to the resource consent application.

Introduction

The Project relates to the construction, operation, and maintenance of a 35,000 m³ reservoir within the Wellington Belt in the Prince of Wales Park, Mount Cook (*Figure 1*). The circular concrete reservoir will be completely buried with the exception of two small access hatches on the roof of the reservoir and a 2.5m by 2.5m doorway and 10m wide service access area to the reservoir's buried service and pipe tunnel. These accesses are necessary for the on-going operation and maintenance of the reservoir.

The reservoir is required to service the Wellington Low Level Water Supply Zone, which provides potable water to approximately 70,000 residents and a range of significant commercial, industrial, and critical community facilities. The Low Level Zone is described in more detail in Section 0.



Figure 1: High-level location plan showing Prince of Wales Park and surrounding suburbs and landmarks.

Context of the Project

The Prince of Wales/Omāroro Reservoir Project sits within the context of the Wellington City water supply network and the Wellington Low Level Water Supply Zone.

Wellington City water supply network

The bulk water supply for Wellington's CBD and the city's southern and eastern suburbs comes through the Bulk Supply Network from Wainuiomata, Waterloo, and Te Marua (Figure 2). The total water supplied to all of Wellington City (including areas outside of the Low Water zone) is about 30 million m³ (30 billion litres) per year. About 7 million m³ of this is used for commercial / industrial purposes.

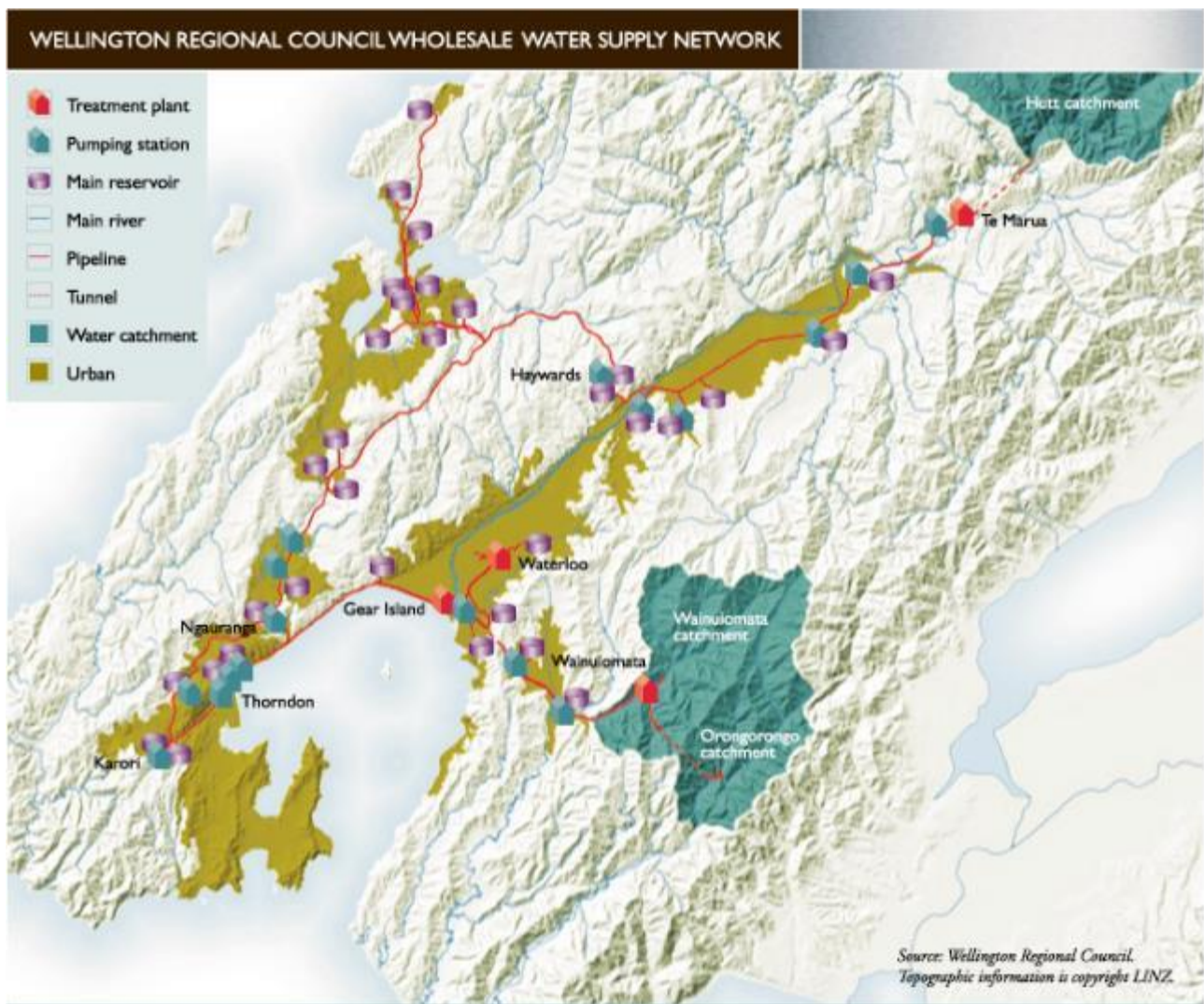


Figure 2: Wellington Region bulk water supply network

The primary supply to Wellington City comes along State Highway 2 via Hutt Road and Thorndon. This pipeline traverses liquefiable land, complex CBD environments, and shares the road with many other buried services. Wellington's water supply lines run mainly north to south due to Wellington's geography and have fewer cross connections to help with network resilience (relative to other cities).

This section of pipeline cannot be out of service for more than 18 hours; otherwise, there will be insufficient water to meet demand.

The water network across Wellington City includes:

81 reservoirs and tanks

Over 1,000 km of pipes

33 pumping stations

More than 100,000 fittings, valves, and controls

Major public investment in a gravity based network of water storage reservoirs near the CBD.

Wellington City's water distribution system is designed to make use of gravity as much as possible; however, pumping is also required. Pumping stations are required to boost flows when supply has to go uphill (against

gravity) or more quickly than gravity alone will allow or has to travel long distances. The stations help to provide a constant supply to all reservoirs, and this is a factor in looking at bulk water storage near the CBD.

Both the Waterloo and Gear Island treatment plants (which also supply Wellington City) incorporate distribution pumps. The need to pump bulk water to Wellington's water storage network makes Wellington's bulk water supply network one of the largest industrial users of power in Wellington. Approximately 17,000 megawatt-hours of electricity – equivalent to the usage of 2,200 households, is used annually.

Wellington Low Level Water Supply Zone

Water supply 'zones' are discrete areas, typically supplied from a common source, that separate areas with different operating heads¹. Within a water supply zone, an interconnected network of pipes and reservoirs supply water to residents, businesses, and industries.

The proposed reservoir will service the Wellington Low Level Water Supply Zone (Low Level Zone), which is a subset of the Wellington City water supply network. The Low Level Zone includes the Wellington Central Business District (CBD), Thorndon, Newtown, Mount Cook, Hataitai, Kilbirnie, Miramar, Strathmore, and Seatoun (*Figure 3*) and serves around 70,000 residents and businesses.

The Low Level Zone is the largest single supply zone in Wellington and serves nearly 70,000 residents as well as commercial and industrial zones. Each day this zone consumes an average of 32 million litres of water, but during times of peak demand, consumption may exceed 50 million litres a day.

The Low Level Zone is currently serviced by three key reservoirs: Macalister (20,000 m³), Carmichael (7,800 m³), and Aramoana (6,500 m³). Macalister, the largest, is fed directly from the Bulk Supply system. Its primary function is to supplement peak demand, as the Bulk Supply cannot meet peak demand in the zone.

¹ Head is a unit of liquid pressure above a particular datum.

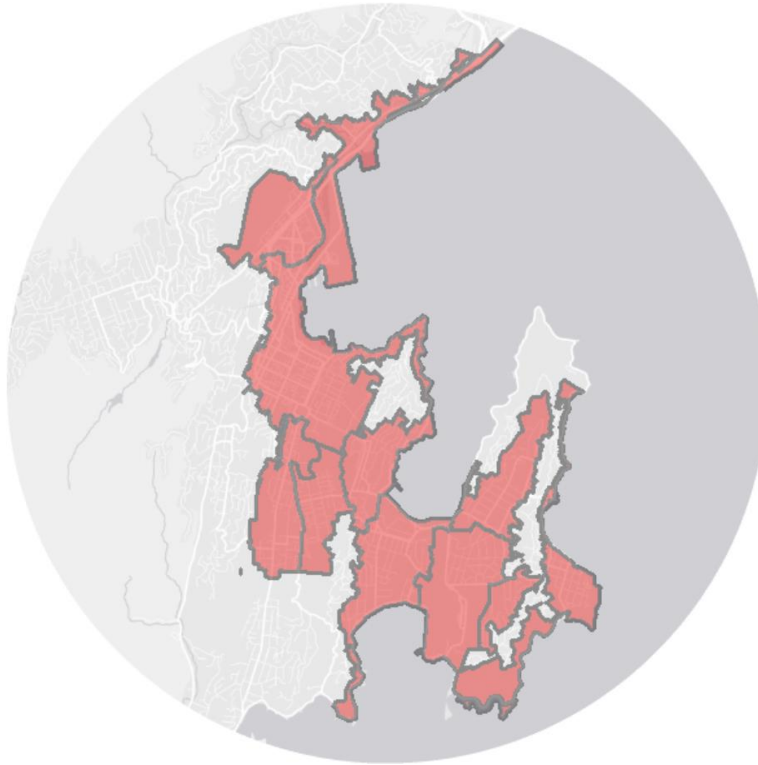


Figure 3: Wellington Low Level Water Supply Zone

The Low Level Network and these three existing reservoirs operate largely on a gravity-based water supply system.

Key critical customers in this zone include:

- | | |
|--------------------------|-------------------------|
| 13 civil defence centres | 8 aged care facilities |
| 4 hospitals | 4 university facilities |
| 7 medical centres | 16 lifeline facilities |
| 32 schools | |

In addition, a portion of the Bulk Supply is directly connected to the Low Level Zone reticulation network in Thorndon through several pressure reducing valves (PRVs). The Thorndon PRVs boost supply and pressure in the Thorndon area to mitigate hydraulic loss between Macalister and Thorndon.

Need for the Project

A hallmark of good water supply networks is that they:

- will cope with future population and business growth demands
 - are capable of providing reliable services to customers, including while undergoing maintenance, repair, and upgrade
 - are able to withstand, or be quickly repairable following natural disasters, such as earthquakes.
- The Prince of Wales/Omāroro Reservoir will significantly expand water supply within the Low Level Zone to provide for:

Network management and maintenance

Operational resilience
Disaster resilience
Growth and well-being.

These functions are critical to supporting Wellington's economy, the health of its communities, its ability to withstand temporary water supply disruption, and its ability to recover from significant events, such as a large earthquake.

Network management and maintenance

The additional storage capacity provided by the Prince of Wales/Omāroro Reservoir will improve network function, reduce risk of network failure (by allowing completion of maintenance activities), and enable WWL to better manage operational and safety risks and responses to water quality issues and network outages.

The existing storage capacity in the Low Level Zone places significant restrictions on WWL's ability to efficiently manage operations and maintenance of the network.

Macalister reservoir hasn't been taken out of service for inspection or cleaning since it was commissioned in 1992, because the current network storage capacity is insufficient to take this reservoir offline without requiring water restriction across the zone. The Prince of Wales/Omāroro Reservoir would enable WWL to undertake required maintenance and upkeep activities across the Low Level Zone without disrupting water supply to residents, businesses, or critical community facilities.

A lack of sufficient storage capacity also increases the risk that any contamination in the Bulk Supply cannot be isolated and managed before reaching the consumer. There is an inherent lag between water entering the Bulk Supply and any contamination issues being identified. The less time water spends in storage, the less time available to detect and isolate that water before it enters the local supply network. An increase in storage capacity reduces this risk.

Under the current network arrangements, a portion of the Bulk Supply is directly connected to the Low Level Zone reticulation network in Thorndon through several pressure reducing valves (PRVs). The Thorndon PRVs boost supply and pressure in the Thorndon area to mitigate hydraulic loss between Macalister and Thorndon. Without these PRVs, upper Thorndon would not receive sufficient water pressure.

PRVs are vulnerable to failure. Failure of the PRVs would introduce Bulk Supply pressures to the local supply network, which is designed to operate at much lower pressure. These PRVs bypass storage, increasing the risk that any contamination in the Bulk Supply Network cannot be isolated and managed before reaching the consumer and allowing fine sediments (that would usually settle in a reservoir) to enter the local network.

The Prince of Wales/Omāroro Reservoir is located closer to Thorndon than Macalister. This decrease in separation distance means there is less hydraulic loss and will be a subsequent reduction in reliance on the PRVs.

Operational resilience

The Prince of Wales/Omāroro Reservoir will double storage in the Low Level Zone to two days, meeting WWL’s targeted Level of Service and significantly enhancing the zone’s resilience in the event of temporary disruption to the Bulk Supply.

“Operational resilience” is the ability of a network to continue service in response to a reasonably predictable disruption event. For the Wellington Water Supply Network, this could include a pipe breaking or being severed, a water treatment plant breakdown, or an issue with water quality. For any event that could be reasonably anticipated to impact a modern water supply network, WWL’s customers should not notice a service interruption. The tap stays on.

WWL is targeting a Level of Service for operational storage of two days’ (48 hours) in-zone storage. Based on an average daily demand including sufficient provision for fire-fighting water supply, the minimum storage capacity required to provide this Level of Service is around 65,000 m³.

Currently, there is only 34,300 m³ storage in the Low Level Zone to manage a significant network event. This can provide for an average of 24 hours supply, which reduces to only 8 hours during peak demand while maintaining sufficient provision for fire-fighting demand. There is a clear need to increase (essentially double) the storage within the zone in order to meet the targeted Level of Service.

A 35,000 m³ Prince of Wales/Omāroro Reservoir will bring in-zone capacity to around 69,000m³, more than doubling existing storage, and meeting WWL’s targeted Level of Service. This will significantly enhance the zone’s resilience in the event of temporary disruption to the Bulk Supply.

Hazard resilience

The Prince of Wales/Omāroro Reservoir will allow WWL to meet their targeted Level of Service for supply of water to residents and Critical Customers from Day 8 to Day 30 after a large earthquake event.

“Hazard resilience” is the ability of a network to respond to a significant hazard event – in Wellington, this is most likely to be a large earthquake.

Wellington City and its water supply network are vulnerable to significant disruption following a seismic event, given that they are surrounded by sea, sitting above the interface of the Australian and Pacific tectonic plates, and at the southern end of a Bulk Supply that crosses the Wellington Fault in several locations².

In particular, the water supply network’s linear configuration combines with limited water storage in high demand areas. A significant outage would disrupt water supply to a large number of residents, businesses, and key regional facilities.

As the nation’s Capital and one of New Zealand’s largest financial, business, healthcare and educational centres, being able to withstand natural disasters is a key driver for improved bulk water storage. Wellington is recognised as one of New Zealand’s leading creative industry and arts capitals. The Wellington region has

² <https://wellingtonwater.co.nz/your-water/regional-priorities/water-supply-resilience>

the second highest GDP per capita, highest average income and highest portion of working age population of any region in New Zealand. As the centre of government in New Zealand, Wellington is expected to act as a command centre in the event of a national emergency. The smooth continuation of government functions through such an emergency is an important element of national resilience, and water supply security is part of this.

Resilience forms a key pillar of Wellington City Council’s Long-Term Plan; WCC is working to ensure infrastructure can deal with significant disruption following natural hazard events. Wellington City has also joined the Rockefeller 100 Resilient Cities programme and is one of 100 cities actively building and implementing a resilience strategy (Phase 1 June 2016).

The Wellington City urban area is also strongly linked to Porirua, Upper Hutt, Lower Hutt, Kāpiti, and the wider Wellington Region for jobs, health care and tertiary education. Together, this combined area forms New Zealand’s equal second largest urban and economic area.

WWL and GWRC have estimated it would take around 60-70 days to restore bulk water supply to parts of the Wellington metropolitan area following a significant seismic event³. It could take several years to fully repair damage to the network. In this situation, bulk storage reservoirs become critical in helping to lessen the economic, health, and well-being impacts of a disruption.

WWL’s long-term investment strategy is based on the network providing a certain Level of Service following a large earthquake affecting the Wellington Region, which is to provide 80% of users with at least 80% of their water needs within 30 days of a reasonable seismic event.⁴

Post-earthquake target level of service are summarised in *Figure 4* below.

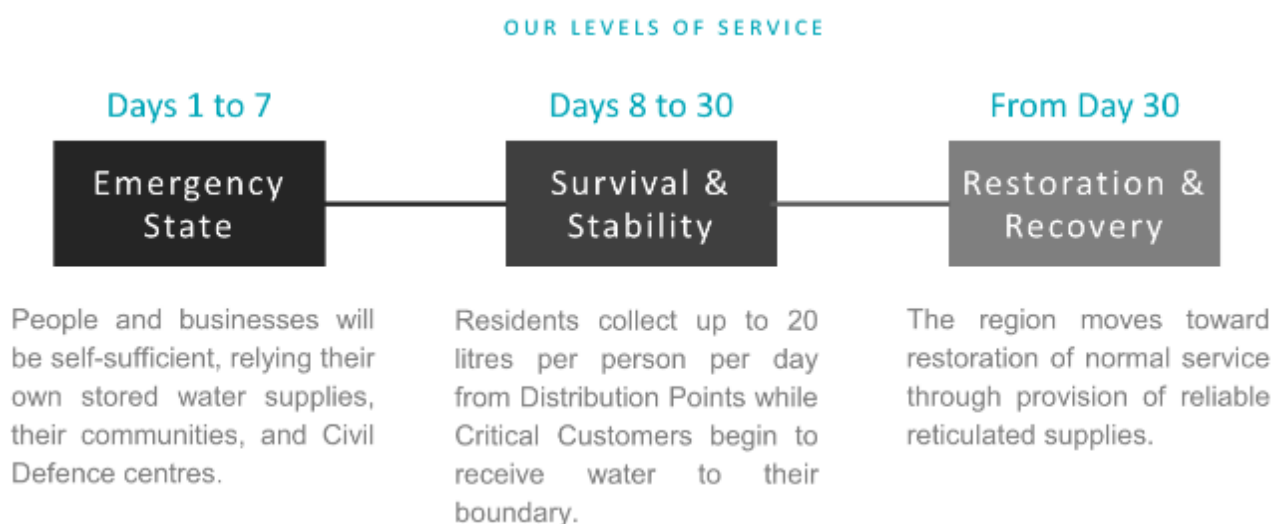


Figure 4: Wellington Water targeted level of service post-earthquake.

³ [GWRC \(2010\). Earthquake Risk Assessment – Wellington Region, Report 10.567](#)

⁴ Wellington Water Limited (2017). *Towards 80-30-80*

Maintaining a supply of generally potable water to residents and Critical Customers is the primary function of the Survival and Stability State (Days 8⁵ to 30). The minimum Level of Service consists of:

20 L of water per person per day to residents (via distribution points) from Day 8

Basic water supply to major hospitals and civil defence centres from Day 8

Basic water supply to aged care and medical services from Day 14

Basic water supply to educational facilities from Day 21.

However, current in-zone storage is only capable of providing this minimum Level of Service to Day 19 (ie a total of 11 days' storage at minimum levels of service). To reach Day 30 (a total of 22 days' storage at minimum levels of service), an additional 29,000 m³ is required. Overall, total storage of 63,000m³ is needed in the zone, and there is currently only 34,300 m³.

However, the reservoir won't always be full to 100% capacity. Based on an assumption that 85% of the reservoir capacity will be available for resilience purposes, this requires an additional storage volume of around 34,000 m³. As with operational resilience, discussed above, there is a clear need to increase (essentially double) the storage within the zone in order to meet the targeted Level of Service. The proposed Prince of Wales/Omāroro Reservoir will fully address this shortfall.

A gap will remain between Day 30 and the resumption of bulk water supply services to the zone (potentially 60-70 days). WWL is exploring a range of network resilience initiatives, working with the region's councils, to reduce the time to restore bulk or alternative water supply to Wellington's water reservoir networks.

The Prince of Wales/Omāroro Reservoir will be designed as an importance level 4 (IL4) structure⁶ with a high degree of reliability and serviceability in normal service and after an Ultimate Limit State earthquake event. It will have an operational continuity limit state design seismic return period of 1000-years – i.e. it will remain operational and require minimal repairs following a 1000-year return period earthquake. Seismic design criteria for the reservoir are outlined in more detail in Section **Error! Reference source not found..**

Growth and well-being

The Prince of Wales/Omāroro Reservoir will support existing economic activity and growth as well as community health and well-being.

The Prince of Wales/Omāroro Reservoir will directly contribute to supporting, sustaining, and growing Wellington's economy by improving water supply safety and reliability and increasing business and residential confidence in the quality and reliability of the city's water infrastructure.

⁵ From Day 0 - Day 7 after a significant seismic, residents are expected to be self-sufficient using their own personal storage of water, along with rain water, to get by.

⁶ The NZ Building Code defines the significance of buildings and structures by its "importance level" (IL). Importance level is a measure of the consequence of a building or structure's failure ranging from IL1 (structures presenting a low degree of hazard to life and property such as walkways, fences, and walls) to IL5 (structures whose failure poses a catastrophic risk to a large area or large number of people such as dams, nuclear facilities, and biological containment centres). The required level of seismic performance increases with each level of importance. Importance Level 4 includes buildings and structures that must be operational immediately after earthquake events and include emergency centres, hospital operating theatres, and other critical post-disaster infrastructure. These structures are designed for a greater level of earthquake shaking than ordinary commercial structures such as office buildings.

The development of a modern, seismically resistant reservoir with post-event functionality will directly assist city and community recovery after a disaster. Reducing the time taken to return to business-as-usual economic activity will contribute toward attracting professional and public services to the Wellington Region and retaining these services after a significant event.

By 2043, there will be 24,000 more jobs and 46,000 more people living in Wellington City⁷. The Wellington City District Plan allows for a significant increase in apartment living, business growth, and other development in and around the CBD. WCC has identified that as many as 10,000 new apartments and homes could be concentrated in and around the areas to be serviced by the Prince of Wales/Omāroro reservoir⁸.

Water use per person has been trending downward over the last decade; however, the predicted growth in Wellington is forecasted to result in an increase in overall water demand in and around the CBD. Without improvements and increased capacity, this growth will put the Bulk Supply and local supply networks under increased strain.

Project Objectives

For the purposes of section 171(1)(c) of the RMA, WCC and WWL's specific objectives with regard to the provision of an adequate and resilient water supply network to the Wellington Low Level Water Supply Zone are:

To enhance **network operations** by

- Improving functioning of the Wellington Low Level Zone water supply network (including reducing or removing reliance on the Thorndon Pressure Reducing Valves)
- Enabling required maintenance activities to be undertaken without disrupting water supply (including allowing for Macalister Reservoir to be taken offline for maintenance)
- Increasing the residence time of water in the network to allow for identification and isolation of contamination

To enhance **operational resilience** by providing sufficient storage to supply 48 hours of water to residents, businesses, and critical water users (including the fire service) under normal operating conditions

To enhance **disaster resilience** by providing minimum water supply for 22 days (days 8 to 30) following a significant disruption event

To integrate the chosen solution into the existing water supply network in a **cost effective** manner

Reservoir requirements

In order for the proposed Prince of Wales / Omāroro Reservoir to meet the Project Objectives, the following key requirements must be met:

Minimum capacity: 34,000 m³

Minimum top water level: 92 mRL to enable the local supply network to operate as a gravity fed system

Location: must be appropriate to service Low Level Zone

Seismic design criteria: Importance level 4

⁷ <http://getwellymoving.co.nz/the-problem/>

⁸ Growth plans and strategies available at www.getwellymoving.co.nz/about/documents/

A key requirement is for the reservoir to be appropriately sited to supply the Low Level Zone, in particular the Central Business District.

History of the Project

There has been a recognised need for additional water storage in Wellington for many years. This section briefly outlines the different investigations that have taken place. A complete assessment of alternatives is included in Section **Error! Reference source not found.** and the Site Selection Summary Report in **Appendix D.1.**

Reservoir investigations⁹

Investigations for a new CBD reservoir extend back to 1974. These were documented in a report on low-level water storage for Wellington City in 1987. The report recommended the provision of 30,000 m³ water storage in the central low zone.

Further investigations in 1988¹⁰ formed the basis for driving the subsequent development of the 20,000 m³ Macalister reservoir, which was commissioned in 1992.

By 2002, a combination of issues lead WCC to consider further options for adding additional reservoir storage to the Wellington low level water supply network.¹¹

These issues included:

population growth

identification of a need for emergency water supply for the Wellington Regional Hospital

an operational requirement for additional buffer storage, to reduce demand on the use of the PRV bulk water supply to Thorndon.

Several locations within the Wellington Town Belt were investigated including Government House, Fever Hospital, and Alexandra Park. The Bell Road Reservoir site was later included and identified as the preferred location from an operational perspective.

In 2004, SKM undertook a preliminary investigation¹² into the siting of a proposed new water reservoir near the existing Bell Road Reservoir in Brooklyn.

The purpose of the proposed reservoir was to fulfil three functions:

a terminal reservoir on the bulk water supply from the Wainuiomata Water Treatment Plant

a replacement for the existing Bell Road Reservoir

emergency storage for Wellington Hospital in the event of destruction of supply from the existing reticulation system.

⁹ This section outlines the history of the reservoir investigations. For an assessment of alternatives, see Section **Error! Reference source not found.**

¹⁰ Brickell Moss Ltd (1988). *Scheme Option Assessment for Water Storage Reservoirs in the Wellington City Low-Level Zone.*

¹¹ WCC (2003). *Emergency Potable Water Supply Storage for Wellington Hospital: Reservoir Location Assessment.*

¹² SKM (2004). *Greater Wellington Water and Wellington City Council: Proposed Central Business District Reservoir.*

This was the first investigation to identify the Prince of Wales site as a preferred option. The Prince of Wales site was identified as being significantly cheaper to construct and had better access both during construction and for ongoing operation and maintenance.

A full options assessment was undertaken by MWH in 2011,¹³ which confirmed the Prince of Wales site as the preferred location.

A 2013 concept design undertaken by CH2M Beca¹⁴ refined the location within the site.

The Preliminary Design¹⁵ prepared by CH2M Beca in 2013 forms the basis on which this report has been prepared. Changes and updates to the design since the preliminary design are outlined in the Preliminary Design Addendum in **Appendix C.2**.

Omāroro

The proposed reservoir has been referred to as the Prince of Wales Reservoir since the park was first identified as the preferred location in 2004.

The original name for the wider area, including the Prince of Wales Park, is Omāroro. Maori used the area for cultivation until the 1860s/1870s when the area was leased and then sold.

After discussions with Port Nicholson Trust, community stakeholders, and WCC, it was decided to adopt the name Omāroro for the reservoir. The name Omāroro enriches the story of the reservoir and links it to the area's pre-European history. Early Māori used the area for growing food, so in a way, the reservoir will continue the tradition of sustaining the community by providing life-giving water.

The name Prince of Wales/Omāroro will be used through consenting of the reservoir to avoid confusion. Once consent is granted, the reservoir will be called *The Omāroro Reservoir*.

¹³ MWH (2011). *Wellington City Council Proposed CBD Reservoir Options Assessment*.

¹⁴ CH2M Beca (2013). *Hospital Prince of Wales Reservoir Conceptual Design Options*.

¹⁵ CH2M Beca (2013). *Hospital Prince of Wales Reservoir Preliminary Design Report*.