

8 Topic: Water catchment and supply

8.1 What is included in this topic

The Preamble to the Waitākere Ranges Heritage Area Act 2008 (the Act) recognises that the Waitākere Ranges are a water catchment and location for a series of storage and supply systems that have sustained Auckland's water supply since 1902. The water catchment and supply system and its operation, maintenance, and development is also identified as a heritage feature (refer Appendix 3 s7(n)) and an objective of the Act is to protect the features of the area that relate to its water catchment and supply functions (refer to Appendix 3 s8(k) of the Act).

The 2013 Monitoring Report did not include a section on water catchment and supply although the Ecosystems and Ecosystem Service section (pg. 50, 51) provided some information on this topic including:

- the results of water quality monitoring upstream and downstream of reservoirs⁷⁶
- discussion on the recreational use of the dam catchment areas including tracks such as Exhibition Drive and the two small gauge trains that ran public excursions
- the requirement for visitors to stay on tracks within the water catchment area and the prohibition of people and dogs within 50 meters of the dams and contact with water in the dams
- the discretionary activity requirement for activities in the water catchment areas of the regional park to obtain Watercare's approval.

This section provides additional and updated information on the water catchment and supply system of the heritage area, including:

- the importance of the Waitākere Ranges water sources in the context of the greater metropolitan water supply system
- the history of the water supply catchments and how the Waitākere Ranges water catchment and supply system is a key driver for the high quality of the natural environment present today
- the activities and monitoring undertaken to enhance the environment, avoid the spread of kauri dieback disease and achieve the objectives of the Act, associated with the water catchment and operation of the water supply system
- the future development of the Waitākere Ranges water supply system.

⁷⁶ In this report reference to 'dam' refers to the water retaining structure and reference to 'reservoir' refers to the water body.



Upper Nihotupu Reservoir.

8.2 Key findings

Relevant heritage features (section 7 of the Act): 2(n)

Summary – state of water catchment and supply

- Establishing the Waitākere Ranges as a water catchment for Auckland’s water supply in the early 1900s was fundamental in allowing the natural regeneration of the Waitākere Ranges into forest and for the later incorporation of the reservoirs and catchments into the Waitākere Ranges Regional Park.
- The reservoirs are iconic features of the heritage area and contribute to its scenic beauty and the catchments within the regional park have high ecosystem and recreational values.
- The water catchment and supply system continues to sustain Auckland’s water supply and currently provides 19 per cent of Auckland’s drinking water.
- Many of the dam structures, water supply network and associated buildings have significant historic heritage values.
- Watercare ensures that treated water meets the required drinking water standards and is facing challenges from catchment and climate changes that affect water quality.
- The prevalence and influence of cyanobacteria and algae in reservoirs is increasing and water treatment facilities will need to be able to meet the future foreseeable water

treatment challenges and the regulatory requirements that these present.

- Both the Huia and Waitākere Water Treatment Plants are meeting the end of their operational life and are planned to be replaced to meet increasingly challenging water treatment requirements and the water supply needs of Auckland's rapidly growing population. The Huia Water Treatment Plant will be replaced within the next 5 years and the Waitākere Water Treatment Plant is likely to be replaced within the next 10 to 15 years.
- A number of monitored programmes are undertaken by Watercare to ensure that the dams do not result in the loss of downstream water quality or ecological values.
- A weed and pest management plan and programmes for land owned or leased by Watercare is being developed with council.
- Kauri dieback disease is located within Watercare's catchments and Watercare is complying with the present protocols agreed with council to prevent the spread of the disease within the heritage area or to the Hunua Ranges from Watercare's activities.

Progress made towards achieving the objectives:

- The objective to protect the water catchment and supply functions of the heritage area is currently being achieved. The Waitākere Ranges continue to be an important part of the public water catchment and supply system and Watercare is managing the water resources and the associated catchments to produce high quality water for the people of Auckland. However, replacement of the aged Huia and Waitākere Water Treatment Plants is considered necessary if the objective of supplying water from the heritage area to serve the people of Auckland is continued to be met.
- Active monitoring and management is being undertaken to protect the ecological values of streams downstream of dams.

8.3 What we measure changes against

In measuring changes for the next State of the Waitākere Ranges Heritage Area 2023 report the indicators used in this section will provide a baseline to measure changes to:

- the catchment, water supply infrastructure or in technology to improve the supply and quality of water
- the quality of water in reservoirs
- the quality of treated water
- the ecology and water quality of streams
- weed and animal pest management on Watercare leased and owned land
- protocols implemented, and any enhanced protection measures undertaken to prevent the further spread of kauri dieback disease within the heritage area or to the Hunua Ranges.

Auckland's drinking water supply

Auckland's growth and wellbeing relies on the supply of safe drinking water to its residents and visitors. The Waitākere Ranges water supply catchment and reservoirs are a vital part

of Auckland's drinking water system. The Upper Huia, Lower Huia, Upper Nihotupu, Lower Nihotupu and Waitākere Reservoirs together can supply up to 25 per cent of Auckland's drinking water demand and typically supply approximately 19 per cent of Auckland's demand.

The Upper Huia, Lower Huia, Upper Nihotupu, Lower Nihotupu Reservoirs supply water to the Huia water treatment plant. The Waitākere Reservoir supplies the Waitākere water treatment plant. Both of these facilities treat water from Waitākere Ranges reservoirs to produce safe 'A' graded drinking water that meets the requirements of Drinking Water Standards for New Zealand 2005 (Revised 2008).

A small water treatment plant was developed adjacent to the Lower Huia reservoir pump station to supply the Huia village township. This treats water from the Upper and Lower Huia dams to supply this community.

Watercare and its predecessors have placed a great deal of importance on the management of the water resources and the associated catchments to produce high quality water for the people of Auckland.

History of water catchment and supply

During the late 1800s ground water sources in the Auckland Domain, Lake Pupuke, Western Springs and Onehunga were used to supply residents.

Water from the Waitākere Ranges was first supplied to the city in 1902. Prior to this time extensive areas within the Waitākere Ranges were commercially forested and some areas converted to farmland. Auckland City Council purchased catchment land during the early 1900s following recommendations to develop water supply dams in these high rainfall areas. The construction of the dams and need to protect the surrounding water catchment was the initial driver for allowing regeneration of land leading to the present day forested catchments of the heritage area.

Five large dams were constructed to create drinking water supply reservoirs, each dam being named after the area or the stream that feeds it. Today the reservoirs are iconic features of the heritage area and add to its scenic beauty and the catchments within the regional park are highly valued areas for bush walking.



Waitākere Dam and Reservoir.

The dams are also recognised as being historically significant as their various forms of construction demonstrate the history of twentieth century engineering in dam building. Table 34 provides the history of the dam construction and water supply development in the Waitākere Ranges.

Table 34: History of dam construction and water supply development

Date constructed	Name of dam/reservoir	Construction material	Height (metres)	Water storage volume (000s m ³)
1900 -1902	Nihotupu Falls Dam	Wooden	39.6m	6,422
1900- 1902	Quinns Stream Dam	Wooden (settling tank at Titirangi and water discharged to Western Springs on February 19 1902)		

1906	Waitākere Dam	Wooden (collapsed during the construction of the concrete dam, but was able to provide the initial supply from Waitākeres to Auckland)		
1906 – 1910	Waitākere Dam	Stage 1 concrete (among the first large scale concrete dams in New Zealand)	25.3m	1,761
1926 – 1927	Waitākere Saddle Dam	Stage 2 concrete		
1926 - 1927		Earth-fill with concrete core		
1915 – 1923	Upper Nihotupu Dam	Concrete	50.3m	2,202
1919 - 1921	Nihotupu Auxiliary Dam	Concrete buttress dam		
1926 – 1929	Upper Huia Dam	Concrete dam	36.6m	2,225
1944	Huia Stream	Concrete weir		
1943 – 1944	Lower Nihotupu Stream	Concrete weir		
1945 - 1948	Lower Nihotupu Dam	Earth-fill dam (first scientifically designed earthfill dam in New Zealand)	24.7m	4,605
1967 - 1971	Lower Huia Dam	Earth-fill dam	39.6m	6,422

The Nihotupu Auxiliary dam was retired in 1985 and the reservoir basin seeded to allow regeneration of the site. In 1991 the council took over responsibility for the heritage dam structure.

Tramways, piping, tunnels, filter stations and other structures were built to provide access to the water catchment, to treat water and to deliver it through a gravitational supply to Auckland. In some cases the original water transmission infrastructure is still in use today and is some of the oldest functioning water supply infrastructure in Auckland.

Exhibition Drive was originally developed to form the initial weirs at Nihotupu Falls and for the water supply system connecting the Upper Nihotupu Reservoir to the Nihotupu Filter Station and later the Huia water treatment plant (built in 1928). Exhibition Drive was constructed by manual labour and was officially opened in January 1914. Today Exhibition Drive provides access to part of the Nihotupu water main and the combined tunnels and aqueducts for maintenance and upgrade purposes. Watercare enable its recreational use and it is also an extremely popular walking track.

Narrow gauge tramlines were used to construct the Upper Nihotupu and Waitākere Dams and portions of these two narrow gauge tramlines remain. Public sightseeing services were operated along the tramlines until 2014 but were discontinued due to significant geotechnical instability and regular rock falls. The tramlines have been retained for watermain repair and maintenance purposes only.



Nihotupu tramline and pipe route during construction of the Upper Nihotupu Dam, with locomotive used to haul construction material to the dam site (Source: Sir George Grey Special Collections, Auckland Libraries, 1-W1784).

Table 35 shows Watercare buildings within the heritage area that are also scheduled historic heritage places

Table 35: Heritage water treatment buildings

Heritage Building	Current use
Huia Water Treatment Plant (Huia Filter Station)	The Huia Filter Station building is part of the Huia Water Treatment Plant site producing up to 126 mega-litres a day (MLD)
Waitākere Water Treatment Plant (Waitākere Filter Station)	The Waitākere Filter Station building is part of the Waitākere Water Treatment Plant site producing up to 20 MLD
Nihotupu Filter Station	The Nihotupu Filter Station has been unused since the 1990s and is currently boarded up.

Water treatment and supply

The five dams in the Waitākere Ranges continue to make an important contribution to Auckland's fresh water supply.

Treated drinking water from the Huia and Waitākere Water Treatment Plants typically accounts for approximately 19 per cent of Auckland's present drinking water supply and is distributed to residents of west and north Auckland.

Both the Huia and Waitākere water treatment plants are approaching 100 years of age and have been upgraded several times to ensure compliance with Drinking Water Standards for New Zealand and other statutory obligations. Watercare plan to replace both of these treatment plants as they are reaching the end of their operational life, face new water treatment challenges (such as treating water with increasing levels of cyanobacteria) and need to function at maximum production capacity to optimise the use of available water.

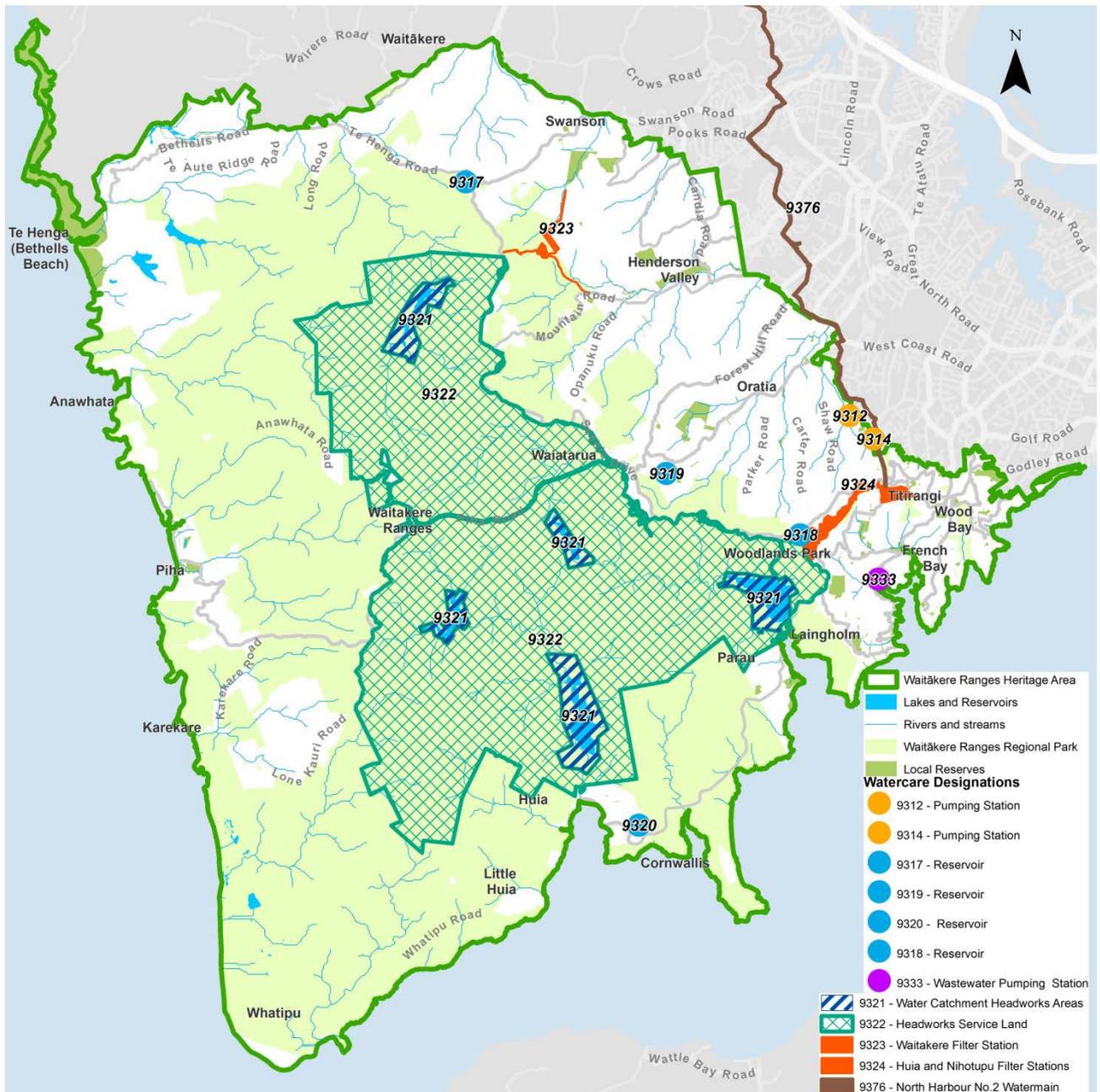


Image on left: Huia water treatment plant. Image on right: Waitākere water treatment plant.

Watercare designations

The catchments and reservoirs were incorporated into the Waitākere Ranges regional park under Regional Catchment Parkland (Local Government Act) on 1 July 1992 with their ongoing catchment and supply function protected by designations. Approximately 6,800 hectares of the regional park is designated for water catchment purposes. These designations are shown in Map 21 below.

Map 21: Location of Watercare designations within the heritage area



Eleven designations are held by Watercare for the provision of water and wastewater services. These designations have been established over time as the water supply system has developed to meet the needs of a growing city. A summary of water supply related designations held by Watercare in the Waitākere Ranges is contained in Appendix 17.

8.3.1 Stream ecology

The natural water flows of streams are stopped by dam structures that capture and hold the water for water supply purposes. The resulting lack of downstream water flows can have catastrophic effects to stream ecology, particularly migratory fish, eels and other stream life. To ensure that the ecology of streams within the water supply catchments is maintained a number of managed interventions are undertaken as discussed below.

Compensation flow release

Compensation flow release involves water being released from a dam at a rate that is sufficient to maintain downstream water flows and the ecological values of streams (refer to Table 36).

At the Upper Huia, Lower Nihotupu and Waitākere reservoirs this involves:

- water being released continuously at a set rate, regardless of operations or storage needs
- flow rates being changed seasonally to benefit the downstream environment
- the flow rate being constantly monitored.

Table 36: Compensation flow release rates

Total system storage (%)	Flow at toe of the dam in litres per second, inclusive of water discharged by discharge valves and water discharged via the spillway
Greater than 79	90
Less than or equal to 79 and greater than 59	80
Less than or equal to 59	30

Compensation flows are not released from the Lower Nihotupu and Lower Huia reservoirs as they are situated close to the sea and the downstream water courses experience tidal influences that enable natural ecological function of the stream.



Waitākere Reservoir compensation flow Installation (Watercare Services Limited).

Stream monitoring

The impact of dams on the downstream environment is measured by Watercare through its Environmental Source Monitoring programme. Under this programme the three catchments that supply the Waitākere Ranges reservoirs are assessed (Huia stream, Nihotupu stream and the Waitākere River) through discrete and continuous sampling at pre-determined locations for each of the three sources. One control site upstream of the dam is used as a benchmark and multiple locations downstream of the dam are measured against this control benchmark.

The sites chosen for monitoring are considered the optimal sites to measure stream health and the following factors are measured:

- water temperature
- suspended solids
- pH
- conductivity (at 25 degrees Celsius)
- turbidity NTU (Nephelometric Turbidity Units)
- black disc transparency
- dissolved oxygen
- dissolved reactive phosphorus
- total phosphorus

- ammonia nitrogen
- nitrate nitrogen
- periphyton.

The presence and abundance of macroinvertebrates (the insects, bugs and worms living in a stream) is a common way to assess water quality as certain species are sensitive to various pollutants and environmental stressors. Watercare undertake macroinvertebrate sampling to produce a Macroinvertebrate Community Index (MCI) and undertaken yearly monitoring to determine the ecological quality of streams.

Monitoring results have shown no significant downstream effects on water quality as a result of the dams. The water quality at the sites monitored is very high, and In the Auckland Council State of the Environment Monitoring: River Water Quality Annual Report 2013 (Auckland Council technical report, 2014) the Cascade Stream was rated as having excellent water quality. Watercare's 2015/2016 overall monitoring results were comparable with the council's regional reference site at Cascade Stream.

Migratory fish – trap and haul (fish/eel capture and release)

Native migratory fish and native freshwater eels make their way down streams to the sea to breed and adults return to freshwater streams. Dam structures in a stream prevent the natural migration in both directions (i.e. adult eels migrating to the sea or juveniles returning to their native water body). To ensure that the breeding cycles of native fish and migratory eels can continue intervention is required.

To ensure the continued breeding cycles of native fish and eels Watercare have a special permit granted by the Ministry for Primary Industries to undertake a 'trap and haul' programme that involves:

- **Trapping;** where a ramp with a constant flow of water with a trap at the end captures migrating juvenile native fish (whitebait) and eel (elvers) as they try to make their way upstream from the sea. Trapping is undertaken from August to March with traps being checked at least weekly and the trapped fish and elvers being transported to a safe release point within the reservoir.



Image on left: Waitākere Dam trap location (Waitākere compensation flow release point). **Image on right:** Waitākere Dam trap (fish path and trap).



Image on left: Juvenile Galaxias sp. trapped at the Waitākere Dam Fish trap. **Image on right:** Elver trapped at the Waite Dam Fish trap.

- **Hauling**; this involves the capture of adult eels to enable their transport and release so they can make their way to the sea and to a location near Tonga where they breed. Adult eels are captured using non-baited fyke nets in strategic positions. Non-migrating eels are released back into the reservoir and migratory eels are released into a stream where they can make their way to the sea.



Image on left: Adult eels captured in nets at the Waitākere Dam Fyke net. **Image on right:** Adult migratory eels being released downstream of the Lower Huia Dam.

Techniques for trapping and hauling fish species have evolved based on experience. This has resulted in increases in catch numbers over the five-year period. Juvenile species are released into protected catchments, and reservoirs, where no fishing is permitted. This is particularly important for species such as the Longfin eel *Anguilla dieffenbachii*, which is classified as "At Risk: Declining" by the Department of Conservation.

The results of the trap and haul programme are provided to the Ministry for Primary Industries in August each year. This programme has been very successful and over the past five years Watercare has trapped and hauled approximately:

- 9,553 juvenile *Galaxias sp*
- 5,731 elvers
- 38 migratory adult eels Longfin and Shortfin species.

Environmental flushing flow programme

Heavy rainfall washes out the accumulated debris in streams and contributes to biodiversity by 'flushing-out' dominating flora and fauna that can be 'overtaking' and inhibiting less competitive organisms.

As dams interrupt this natural flushing process Watercare implement an environmental flushing programme that is designed to simulate a natural flood event between December and March when the dams are not over-spilling water. This involves leaving discharge valves at 15 per cent open for three hours to discharge water into streams that are not situated close to the sea.



Waitākere Reservoir Free Discharge Valve in operation (WSL).

8.3.2 Water quality

Reservoir water quality

The management of water quality for water supply purposes is subject to Drinking Water Standards for New Zealand 2015.

A number of factors are measured to confirm the quality of the water stored in the Waitākere Ranges Reservoirs, these include pH, metals, total organic carbon, temperature, dissolved oxygen, taste and odour compounds, *E.coli*, protozoa tests for other microorganisms.



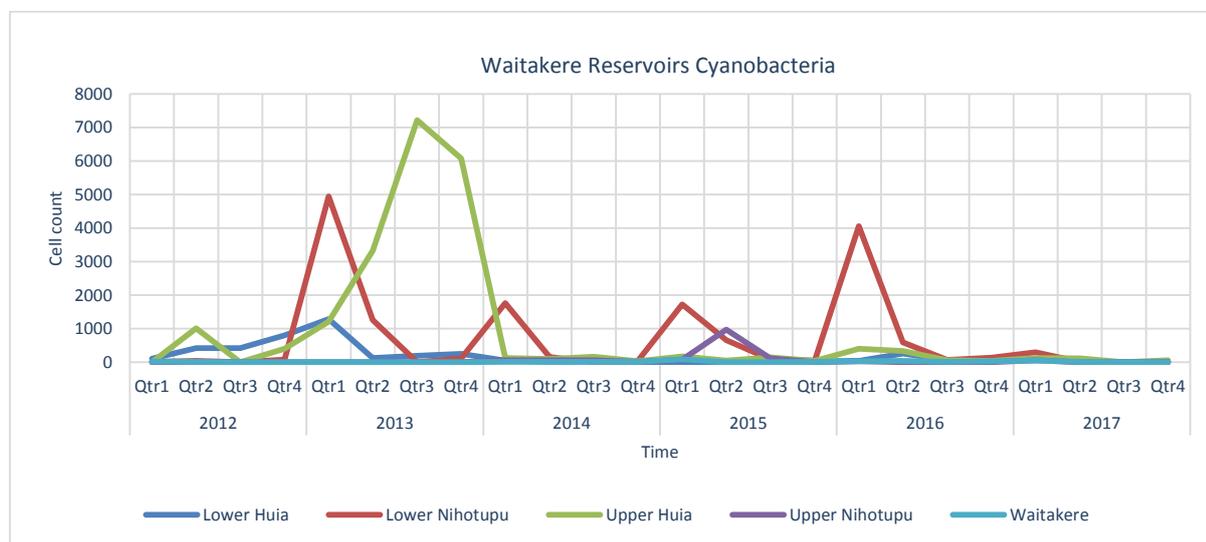
Water quality testing at the Lower Nihotupu Reservoir.

The analysis data shows that pH, temperature, dissolved oxygen and microbial pathogen indicators have remained relatively stable over the past five years. This indicates that the catchment protection measures (such as the 50 meter buffer zone and prohibitions on water contact) that are in place are effective in minimising the likelihood of water source contamination.

There have been notable changes in the levels of iron, manganese and naturally occurring organic matter in the reservoirs which is likely to be associated with seasonal weather patterns and lake level reduction given water supply system demand. It is expected that the quality of the water stored in the Waitākere Ranges reservoirs will change over time as the catchments evolve and other factors such as climate change take effect. Increased

nutrient and naturally occurring organic matter may encourage cyanobacteria/algal growth. Evidence of this has been observed over the last five years (refer to Figure 9 below).

Figure 9: Cyanobacteria/algal growth 2012 to 2017



Cyanobacterial/algal growth has been observed in all of the Waitākere Ranges reservoirs. These microorganism can generate compounds that can cause the water to smell (earthy, musty, or like a fish tank) and in extreme cases (depending on the species and the conditions), can produce cyanotoxins which can be harmful to human health.

Catchment management

The protection of the water catchments and reservoirs during the early 1900s was a fundamental driver in allowing the regeneration of land to native forest that was later incorporated as part of the Waitākere Ranges Regional Park (originally named Auckland Centennial Memorial Park established in 1940).



Lower Nihotupu Reservoir

The water catchments within the regional park contain a number of bush walking tracks and the reservoirs are the destination of some walks. To protect the water in the reservoirs from contamination people and dogs are prohibited within a 50 meter buffer zone around the dams and contact with water within a reservoir is prohibited. Discretionary activities in the regional park that are within water catchment land are required to obtain Watercare's approval.

8.3.3 Biosecurity management on designated land

Weeds and animal pests

Watercare works with the council to manage weeds on both its leased and owned land. Comprehensive weed mapping was undertaken in 2012 and was used as the basis for the development of a weed management plan. An assessment against the plan objectives will be undertaken in 2018 and will form the basis of a subsequent weed management plan.

Kauri dieback disease

Kauri dieback disease is discussed in the Terrestrial and aquatic ecosystems topic and presents a significant threat to the kauri forest ecosystem of the ranges. Kauri dieback disease has infected kauri trees within the water supply catchment areas (refer to Map 5 in Section 2: Terrestrial and aquatic ecosystems topic). Watercare staff are aware of the risk of spreading kauri dieback disease and its implications for the heritage area.

To prevent further spread of the disease Watercare operates in accordance with the Standard Operating Procedures for Kauri Dieback (August 2017). All staff and contractors working for Watercare in these water supply catchment areas are required to work in compliance with the approved procedures. Watercare ensures that all footwear, vehicles, tools and equipment are adequately cleaned, and that staff are vigilant in management practises to ensure that risk of spread to areas both inside and outside of the Waitākere Ranges, particularly to the Hunua Ranges, is avoided.

8.4 Suggestions for the future

As Auckland grows water resources will need to be sourced to meet demands but the water supplied from Waitākere Ranges will remain an important part of the city's water supply system.

The five dams in the Waitākere Ranges, and the Huia and Waitākere Water Treatment Plants are amongst the oldest water supply assets in Auckland. The water treatment plants are approaching the end of their operational life and are planned to be replaced in the near future. These treatment plants have to be robust, efficient and meet regulatory requirements in the face of increasing water treatment challenges (such as cyanobacteria) if they are to continue to meet the objective of the Act and supply water for the people of Auckland.