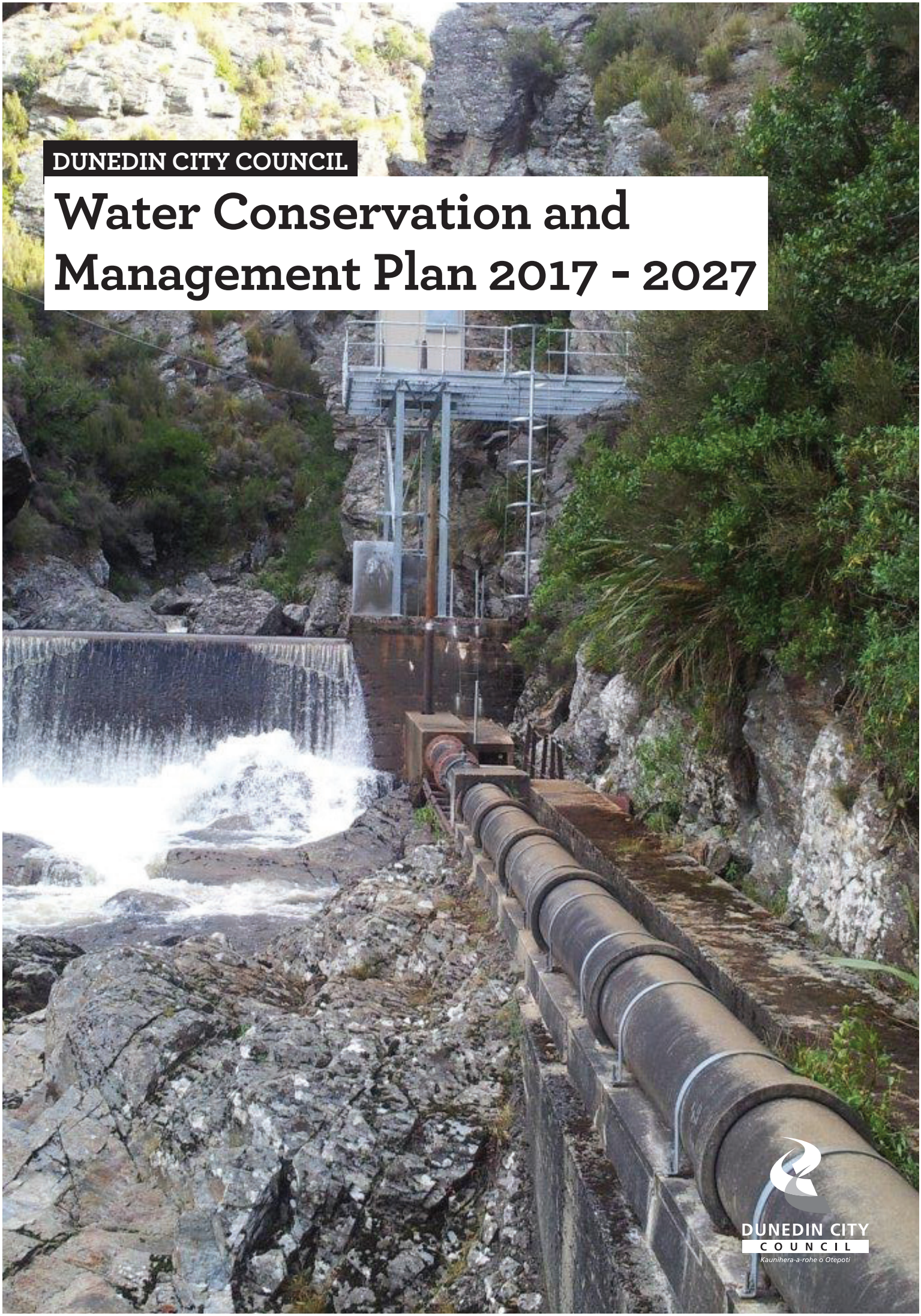
DUNEDIN CITY COUNCIL

Water Conservation and Management Plan 2017 - 2027



DUNEDIN CITY COUNCIL
Kaunihera-a-rohe o Otepoti

Executive summary

Water is a taonga (treasure). Otago's lakes, rivers, wetlands and estuaries are important to the pride and identity of communities. Along with our aquifers, they support healthy ecosystems, provide recreational opportunities and provide us with drinking water, water to grow food and water to generate electricity.

The Regional Council is responsible for developing and implementing management frameworks to ensure these waterbodies are maintained and enhanced. In areas of Otago, water allocation is at or even beyond capacity from both groundwater and surface water sources. This is most evident during dry conditions when flows in rivers decrease and aquifer levels drop.

The Dunedin City Council (DCC) takes water for the purpose of community supply, and has a responsibility to ensure that water is used efficiently, particularly during times of water shortage. Dunedin's population is anticipated to slowly increase with time, so there will inevitably be an increase in the demand for water. Reductions in water consumption may result in less water being taken from source, which can be beneficial to ecosystems, other uses of the water source, and ratepayers. It may also avoid future need to seek new water permits to cater for population growth in catchments already under pressure.

The DCC holds 31 resource consents to take approximately 146,000 m^3 of water a day, from various rivers and streams, and the Taieri Aquifer. The water supply network includes 21,000 hectares of water catchment, 1,383 km of pipeline, 30 pumping stations, 57 reservoirs (raw and treated) and 11 operational treatment plants, and serves approximately 48,000 residences and 3,800 commercial properties. Not all water taken from source makes it to its final destination – an estimated 19% was lost in transit during 2016/2017.

As one of the largest water users in the city, the DCC has made a commitment to demonstrate good water conservation practice. The DCC is managing network water loss through renewals, water pressure management and a proactive leakage detection programme, since 1994. Mandatory reporting measures to the Department of Internal Affairs (DIA) aim for network water losses of at or below ≤ 20%.

The DCC also has a range of community wide initiatives that cover education and promotion, to regulation. Educational activities include providing online information, supporting school education programmes, and providing tours of water treatment plants. Regulatory activities include requiring customers to fix leakage on their private plumbing, encouraging the use of water efficient fixtures during the consents process and imposing water restrictions during periods of short supply.

This Water Conservation Management Plan records the DCC's goals to encourage reductions in water consumption. These are:

- Goal 1: Improve efficiency of the distribution system
- Goal 2: Water restriction management
- Goal 3: Provide education and promotion to the community
- Goal 4: To continue monitoring water conservation activities

The DCC intends to measure the success of reducing network water loss through meeting or improving the DIA target of at or below ≤ 20%. This measure is reported in the Councils Annual Plan. The overall consumption for commercial and residential properties in 2016/2017 was around 12,700,000 m^3. The DCC monitors consumption monthly to ensure the goal of providing water needs to the city from existing water sources efficiently and effectively is being met. This Water Conservation Management Plan is intended to be reviewed and updated as necessary every five years.

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1 Introduction

1.1 Background

Water is a precious resource, without water life would not exist. Dunedin's lakes, rivers, wetlands and coastlines are a source of pride for Dunedin, and form part of the city's identity. As kaitiaki (guardian) of Dunedin's natural environment the DCC have two responsibilities: protecting life supporting capacity and passing the environment to future generations in a state which is as good as, or better than, the current state.

Dunedin's water has many uses, and in some areas of Otago the supply of water is at, or even beyond capacity for both groundwater and surface water sources. As a result the DCC needs to safeguard water supplies, and strive to improve the health of the raw water sources.

Reducing water demand is particularly important during dry periods, and in areas that are experiencing population growth or development. Water conservation ensures that DCC can:

- Mitigate potential effects on the flow regime of rivers and streams, contributing to conservation and protection of in-stream flora and fauna including the protection of catchment and river health.
- Mitigate potential effects on groundwater reserves and other natural features such as wetlands and lakes.
- Make the most of the existing source of raw water supply and avoid the need for additional raw water sources and developing new infrastructure.
- Reduce energy consumption and expenses associated with the treatment and distribution of water; which can lower both short and long term operation and maintenance costs, and therefore costs to consumers and rate payers.

1.2 Strategic framework

The Dunedin City Long Term Plan (LTP) highlights that contributing to safe and healthy people means ensuring the efficient and continuous provision of safe high quality drinking water that meets customer requirements. The provision of high quality potable water is, to a large extent, dependent on the efficiency of the water supply scheme and the associated water conservation activities.

The 3 Waters Strategic Direction Statement 2010-2060 (3 Waters Strategy) aligns current and future management of water, wastewater and stormwater with the City's sustainability principles, and recognises the long term effects of management decisions on affordability and service delivery. The 3 Waters Strategy specifically identifies water conservation as playing an important role in meeting '*the water needs of the city for the next 50 years from existing water sources'* by reducing system losses to economic levels and educating and incentivising consumers to waste less water.

The Infrastructure Strategy 2015-2045 is a requirement under the Local Government Act 2002, introduced in 2014. Its aim is to provide improved long-term infrastructure planning over 30 years. The Strategy includes a planned approach for renewals of the water network, with focus on areas of high leakage. The Long Term Plan 2015-2025 identifies $124m for water supply

renewals. The draft Infrastructure Strategy 2018-2028, yet to be ratified by Council, proposes an increase capital spending for water supply renewals.

Dunedin City's vision is to be one of the world's great small cities, and the natural environment is recognised as one of Dunedin's greatest strengths. The Council's Environment Strategy details how the community will enjoy the natural environment whilst mitigating impact on the environment and adapting to adverse effects, to pass the environment on to future generations in a state which is as good as, or better than, the current state. This Water Conservation and Management Plan contribute to the goals of the Environment Strategy by:

- Ensuring the infrastructure supports positive environmental outcomes.
- Ensuring natural resources are used with future generations in mind.
- Implementing appropriate climate change mitigation and adaptation responses.

1.3 Regulatory framework

1.3.1 The Resource Management Act (RMA) 1991

The purpose of the RMA is sustainable management of natural and physical resources. Sustainable management is an important concept as it directs local authorities to account for, amongst other things, environmental, cultural, social, and economic well-being, and health and safety issues when managing the use of natural and physical resources. This plan plays a significant role in ensuring the efficient use of Dunedin's natural water resources and consequently, is aligned with the concept of sustainable management.

The Otago Regional Council is responsible for the management of the taking and use of water and it implements this through the Regional Policy Statement and Regional Plan: Water for Otago. The DCC hold 38 consents to take and use water for community supply, and it is a requirement of some of those consents that a Water Conservation and Management Plan is developed and implemented.

1.3.2 The Local Government Act (LGA) 2002

The LGA (2002) imposes requirements on a territorial authority to assess and maintain its water services. It is an offence to waste water, and powers to enter a land to determine water wastage or misuse are granted. The LGA also allows for a bylaw to be made for the purpose of '*managing, regulating against, or protecting from, damage, misuse, or loss, or for preventing the use of, the land, structures, or infrastructure associated with … water supply*'. If a person commits an offence, or breaches a bylaw, water supply to a person's land or building may be restricted (subject to provisions of the Health Act).

1.3.3 Water Bylaw

The DCC has a Water Bylaw to protect its drinking water supply headwaters, and to manage customer connections and expectations. The Bylaw requires the customer to prevent water running to waste, including through deterioration of plumbing. It also requires customers to comply with any restrictions imposed to manage high seasonal or other demands.

1.3.4 Regional Policy Statement

The Otago Regional Policy Statement seeks to manage water to maintain and enhance ecosystems, habitat, amenity, landscape and water quality, while recognising Kai Tahu's values,

interests and customary resources. It strives for water to be used efficiently and encourages management measures during water shortage.

1.4 Purpose of the Water Conservation Management Plan

The purpose of this plan is to provide the DCC with a series of actions to ensure the efficient use of water in line with its strategic and regulatory framework, thereby facilitating a sustainable approach to water management.

More specifically, this plan can support the achievement of a higher standard of service delivery as identified in the LTP, as water conservation is one of the best mechanisms to:

- Manage water demand within existing supplies;
- Avoid the cost of developing additional supplies;
- Provide better security of supply;
- Ensure potential future demands are recognised; and
- Promote the sustainable use of water.

This version of the Water Conversation and Management Plan has been updated to include the three original Water Conservation and Management Plans[1] developed in 2007 and 2009 and the key findings of two reviews undertaken in 2012 and 2014.

2 Dunedin's water supply

2.1 The water supply network

Dunedin has had a water supply since it was first settled. The first settlers drew their water from the creeks and springs in the area below the town belt. The private Water Works Company (WWC) was formed in 1864 and, after many trials and tribulations completed the Ross Creek reservoir. The reservoir was opened on 9 December 1867. The Ross Creek reservoir only supplied the area below the town belt. However, with increasing demands above and below the town belt, the city's water supply needed further expansion.

In 1877, the DCC proceeded with a new supply from the Silverstream Catchment. This system was officially opened in 1881. However, the Southern Reservoir did not supply water to the higher hill suburbs of Dunedin. By 1904, the main tributary of the Leith had been tapped and water was piped so that the Maori Hill, Roslyn and Mornington suburbs could be reticulated. Sullivans Dam at the headwaters of the Leith was completed in 1916.

Dunedin's water supply system was expanded again in 1936, to take water from Deep Creek, approximately 64 km from Dunedin. In the late 1940s, the water supply position was precarious, so the Taieri bores system was developed and completed in 1956. The Silverstream race (an open channel) was piped in two stages - in 1951 in anticipation of the Taieri bores installation, and later in conjunction with the development of the Wingatui supply.

[1] Dunedin, Waikouaiti and Mosgiel

By 1967, it was apparent that Dunedin's water supply system would soon be unable to cope with increasing demands. The construction and commissioning of the Deep Stream water supply scheme followed in 1977.

Today the water supply network includes 21,000 hectares of water catchment, 1,383 km of pipeline, 30 pumping stations, 57 reservoirs (raw and treated) and 11 operational treatment plants supplying water to approximately 48,000 residences and 3,800 commercial properties. The DCC operate five main schemes, outlined in sections 2.1.2 to 2.1.6.

A small percentage 2% or approximately 1000 residences[2], generally those in rural areas, are not serviced by a reticulated public water supply and use bore-water, surface water, tankered water or roof water to meet their water needs.

The DCC has 31 resource consents to take approximately 146,000m^3 from aquifers and streams each day. Presently, all these permits provide for an adequate amount of water to meet the demands of Dunedin under normal operating conditions.

2.1.1 River and aquifer management

The Regional Council impose minimum flows on rivers, and aquifer restriction levels, in order to manage those resources when water is scarce. Community water supplies identified in the Regional Plan: Water is not subject to minimum flows, in recognition of the importance of those supplies to human health and safety. The majority of DCC takes are identified. However all takes, including those for community supply, are subject to aquifer restriction levels.

All of the DCC surface water takes are subject to the maintenance of a 'residual flow' being left in the stream to provide for aquatic ecosystems and natural character. Residual flow requirements can limit the availability of water to be taken during significant dry spells. Details of the residual flow for each of the schemes are listed in the tables in the following sections.

The DCC has facilities for both raw and treated water storage. Should a period of prolonged drought occur, water conservation and management measures become crucial.

2.1.2 Metro water supply scheme

The metropolitan Dunedin City water supply (Metro) is the largest of the five main water schemes. The Metro scheme services 89% of Dunedin's residential water customers covering Dunedin and other areas as far as north Mosgiel (south of Dunedin) to Seacliff, (north of Dunedin) as illustrated in in dark green in Figure 1. The water supply is unrestricted (i.e. 'on demand') with exception to Warrington, Evansdale, Waitati and Doctors Point who are on a limited supply.

A prolonged drought in Dunedin could put significant pressure on the ability of the DCC to provide safe, high quality drinking water. With the completion of the raw water reservoir at Mount Grand in 2006, the city's total useable raw water storage capacity equates to about 21 days average demand. However, the number of days can vary and can be reduced significantly depending on the level of demand.

[2] Includes vacant sections

The storage capacity in the outlying areas of Dunedin is much less than that available to city residents and although a smaller population is served in these areas, effective water conservation and management in these areas is equally important.

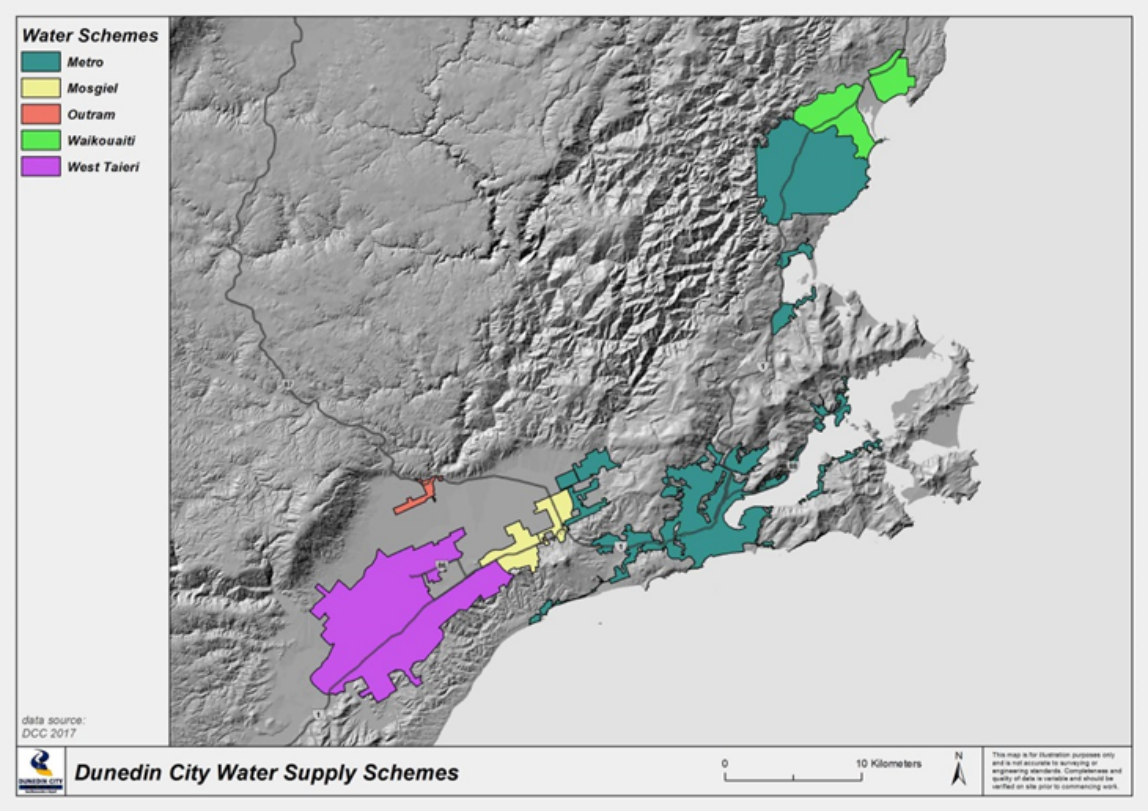


Figure 1: Dunedin City water supply schemes

Figure 2 illustrates how the Metro water supply operates. The Deep Stream catchment and the Deep Creek catchment provide around 60% of Dunedin's water, largely supplying the upper suburbs of Dunedin including Wingatui, West Harbour, Taieri Industrial Estate and North Taieri. The Deep Creek and Deep Stream pipelines were installed during the period 1930-1970 constructed primarily of steel and/or combination of concrete lined steel and put into services in 1975. The design of the pipeline does not allow the flow to be regulated into Mount Grand Water Treatment Plant (WTP). The pipes are either on, or off. There is a project underway in 2035-2040 to replace this pipework, during which time one of the options to be explored is how the design could incorporate regulating the flow.

The Deep Stream catchment (consent 2001.362) comprises 10,640 hectares of tussock with a small area of lightly farmed pasture. Water is gravity fed downstream through a gravelly streambed upstream and rocky streambed downstream of the intake. The pipe intake land area is 103.5 km^2; the pipe itself is 825mm in diameter and 424 m above sea level. Around 42,000 m^3 of water (unless resource consent conditions restrictions are in place then this is reduced to 39,774 m^3 per day) travel via gravity a substantial 58 km across a variety of landscapes including the Taieri River to the WTP.

The Deep Creek catchment is smaller of the two takes, providing approximately 9% of the total daily inflow to Dunedin City. The catchment (consent 2001.364) is 5,420 hectares in area, rising to 645 metres above sea level on the eastern slope of the Lammermoor Range. The water flows in a deep, native bush-clad valley that is gravity fed downstream. It is mainly tussock country with some grassland with a rocky streambed up and downstream of the intake. The majority of land is administered by the Department of Conservation (DOC) who can help regulate the impact from stock grazing, pests and unsustainable land use. The pipe intake area at the DCC pipeline is 58 m^2 and the pipe is 450mm in diameter. The pipeline to the treatment plant is 64 km in length with an original yield of approximately 11,000 m^3, unless resource consent conditions restrictions are in place then this is reduced to 8,640 m^3 per day.

Water from the Deep Creek and Deep Stream catchments is generally considered to be of good quality with moderate colour, low alkalinity, and low turbidity. However, during the winter period when water freezes up causing low temperatures and low colour, making the water difficult to treat.

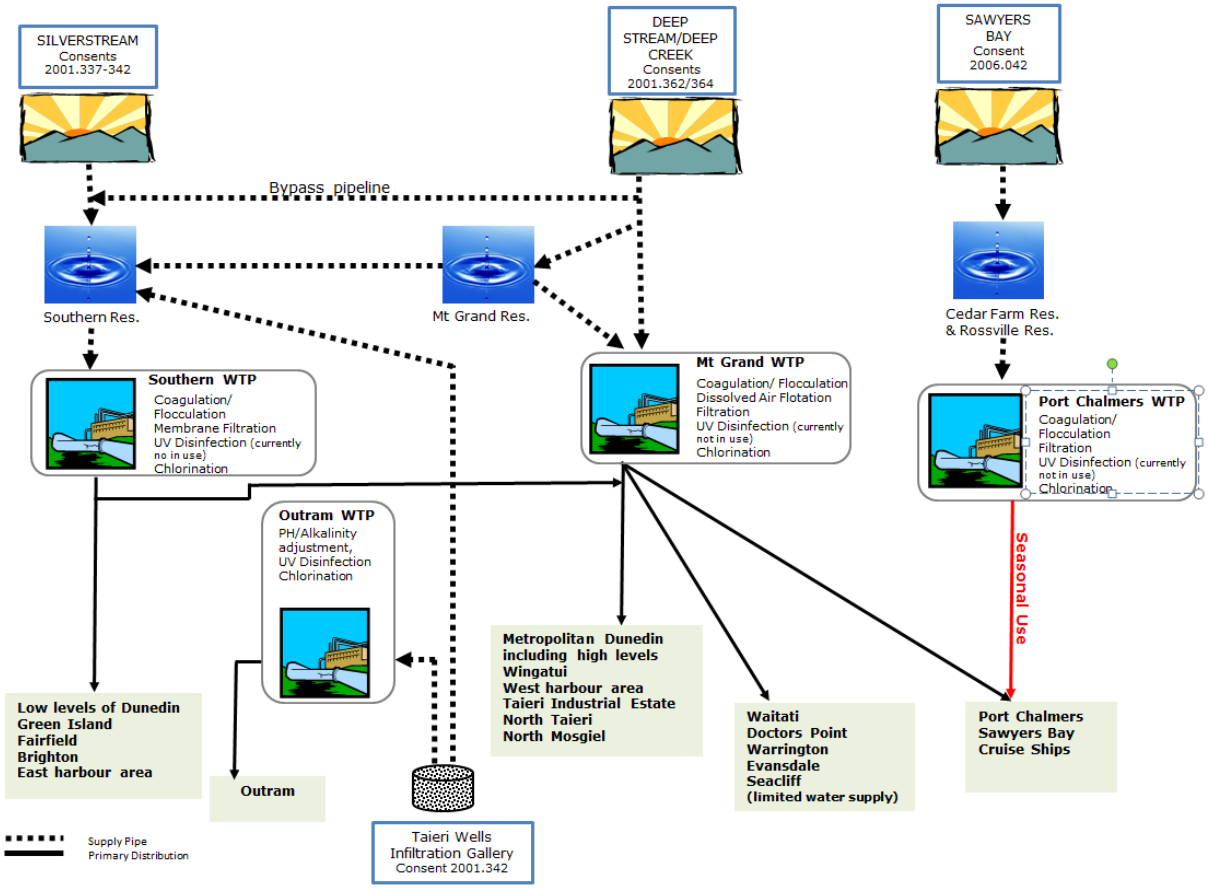


Figure 2: Metro Water Scheme

The Silverstream catchment can provide about 46% of the total daily inflow to Dunedin City, working in conjunction with the Deep Stream and Deep Creek catchment to help supplement the city's supply. The catchment provides water to the lower levels of Dunedin, including Green Island, Fairfield, Brighton and the East Harbour Area.

McQuilkans Creek (consent 2001.337), Whare Creek (consent 2001.339) and Sligos Creek (consent 2001.338) all supply the Silverstream catchment. The Silverstream catchment (consent 2001.341) consists of 3,880 hectares of land, consisting of mainly native forest, some tussock and some exotic forest. The raw water is considered to be good with minimal farm and domestic activities that would pose any major treatment problems. The abstraction systems are "run of the river" and elevated levels of turbidity and colour do occur during times of heavy rainfall. Consent conditions for residual flows combined with low river levels mean water cannot be abstracted for periods during the summer months.

The Silverstream (gravity) water supply intake is located at approximately 100 m above sea level. Water from all four intakes is gravity fed 16.3 km to the Southern Treatment plant.

The Silverstream catchment is also one of the major tributaries of the Taieri River. Water from this catchment either comes in from higher gravity-fed pipelines that intercept some of the side creeks or is pumped from the Silverstream pumping station.

In times of drought all pipelines only draw enough water so as to leave the required residual flow rate in the stream. Table 1 summarises all of the Metro system water permits.

Table 1: Metro water take permits

Consent	Source	Maximum rate (l/s)	Maximum volume (m^3/day)	Residual flow (l/s)
2001.362	Deep Stream	460	39,744	55
2001.364	Deep Creek	100	8,500	50
2001.337	McQuilkans Creek	90	5,000	5
2001.338	Sligos Creek	150	9,000	5
2001.339	Whare Creek (McKenzie's)	150	9,000	5
2001.341	Silverstream	127	11,000	23

Mount Grand WTP receives raw water under gravity feed from the Deep Stream and Deep Creek pipeline. As Mount Grand WTP is the highest in elevation, it is the only plant able to gravity feed the high levels of Dunedin, and the Wingatui Reservoir. Excess water goes into the overflow pipe via gravity fed to the Mount Grand Water Reservoir. The reservoir can store 375,000m^3 of raw water. Raw water can also be gravity fed to the Southern Reservoir. The Southern Reservoir can hold up to 204,000m^3 of raw water. Both reservoirs can store enough water to supply Dunedin City for about 12 days of average peak week demand. Excess raw water is spilled into Frasers Creek, a tributary of the Kaikorai Stream under consent 2000.016.

Mount Grand WTP was commissioned in 1977. Average daily output ranges between 15,000 to 25,000 m^3 per day with production volumes scaled to match demand from a minimum treatment of 8,000 m^3 per day to its design capacity of 44,000 m^3 per day.

Southern WTP, as well as receiving overflow from Mount Grand, also receives raw water from the Silverstream catchment and if required water from the Taieri Well field at Outram. The new Southern WTP was commissioned in 2005. Average daily output range from 12,000 to 21,000 m^3

per day with production volumes scaled to demand, from a minimum treatment of 1,000 m^3 per day to its design capacity of 40,000 m^3 per day.

The Raw Water Lifelines Strategy Project (completed in 2010) provided an approach to addressing the risk of interruption to water supply from a disaster event. The Deep Creek and Deep Stream pipelines cross the Taieri River, and this was identified as the single most critical point in the Dunedin Metro supply. These pipelines convey the only source of water to supply high-levels of Dunedin. The risk of interruption to supply is therefore of concern, particularly as there is only approximately 20 days of storage currently available. Since that time, a comprehensive assessment has been carried out which has resulted in a modified approach to addressing risk on interruption of supply; and proposes an increase to resilience of the entire supply. It is therefore important as part of the strategy to keep the out of service consents to ensure continuity and security of supply.

To increase security of supply, a treated water pump station between Southern and Mt Grand was completed in 2014, effectively linking the high levels and low levels of the City and providing greater flexibility to treatment plant or raw water supply outage.

Approximately 1000 residences in Port Chalmers are also supplied by the Metro system via two treated water storage reservoirs. During the summer season (October – April) when demand increases during the cruise ship docking at Port Chalmers, the water demand is then supplemented from the Cedar Farm catchment take. This catchment feeds into Cedar Farm and Rossville Reservoirs. The water is then treated at Port Chalmers WTP. The maximum daily take for this consent is 5,000 m^3, as shown in Table 2.

Table 2: Port Chalmers water take permit (seasonal)

Consent	Source	Maximum rate (l/s)	Maximum volume (m^3/day)	Residual flow (l/s)
2006.042	Cedar Farm Catchment	60	5000	1 l/s[3]

2.1.3 Mosgiel water supply scheme

The Mosgiel water supply services approximately 9% of the City's residential water customers. The water supply is unrestricted.

The Mosgiel bore-field has been in operation for more than 20 years. These bores source water from the Lower Taieri – East Aquifer and range in depth from 30-40 m. The primary source of recharge to the aquifer is the Silverstream. The remaining sources come from direct rainfall infiltration in the small confined part of the aquifer, as well as underground leakage from the Mill Stream catchment, Waipori and Taieri Rivers and other water sources as a result of movement of groundwater down the plain from north-east to south-west.

There are nine permits altogether, representing the nine abstraction bores as shown in Table 3. All permits are operated concurrently for a total take not exceeding 7,600 m^3 per day. Further to

[3] As per Cedar Farm Creek Condition 3 – Report to ORC Residual Flow Investigations dated 5/1/2012

this, the combined take is not to exceed 161,200 m^3/calendar month or 450,000 m^3 in any consecutive 90-day period. The total annual cumulative take shall not exceed 1,825,000 m^3. This maximum take is considered adequate for the future predicted demand of Mosgiel. The permits also allow for the additional provision of an emergency supply to the North Taieri Industrial Estate and the North Taieri Rural Water Scheme.

Bore water from the Taieri Aquifer is subject to aeration and soda ash dosing to correct the pH levels before being pumped directly to the reticulation system. This system is controlled by the Quarry Hill reservoir level. This reservoir acts as a 'balancing tank' whereby any water not used is sent back into storage at the Quarry Hill Reservoir. The storage capacity of the Quarry Hill Reservoir is 4550 m^3. The nature of the bore system and the capacity of the aquifer are able to meet any short-term peak requirements. If these bores are unable to supply the required amount of water, treated water from the Mount Grand WTP can be transferred to the Mosgiel system.

Table 3: Water take permits Mosgiel

Consent	Bore	Maximum volume (m^3/day)	Maximum rate (l/s)
2006.128	Cherry Drive 1	1296	15
2006.129	Old Borough	720	8.3
2006.130	Ayr Street	1296	15
2006.131	Cherry Drive 2	1344	15.6
2006.132	Eden Street	1296	15
2006.133	Battleaxe	530	6.1
2006.134	Watt Street	2200	25.5
2006.135	Severn St	750	8.7
2006.136	Reid Ave	750	8.7

2.1.4 Outram water supply scheme

The Outram water supply scheme provides an estimated 750 people with on-demand supply. Water is taken from the Taieri River, via a series of shallow wells that act as an infiltration gallery to improve water quality (consent 2001.342, shown in Table 4). This raw water can also provide supply to the Southern Reservoir when turbidity is high in the streams, as illustrated in Figure 2.

Table 4: Outram water take permits

Consent	Source	Maximum rate (l/s)	Maximum volume (m^3 /day)
2001.342	Taieri Wells (Taieri River)	382	33000

2.1.5 West Taieri water supply scheme

The West Taieri scheme, illustrated in Figure 3, is designed to supply approximately 150 rural properties for both domestic and commercial use (including Dunedin Airport). The water supply is restricted, and consumers purchase water in units (1 unit being 1 m^3/day).

The West Taieri scheme sources water from the Waipori River which is then pumped into the West Taieri Raw Water Reservoir. The West Taieri Reservoir can hold up to 1700 m^3.

Consent 2002.323 enables the DCC to take and use up to 3,024 m^3/day as primary allocation and up to a further 518 m^3/day as a supplementary allocation from Waipori River.

The water is then treated at West Taieri WTP on a stop start basis according to demand. As a restricted water scheme, it is likely that water conservation in these areas is practiced and implemented more actively than other areas of Dunedin city, where use is unrestricted.

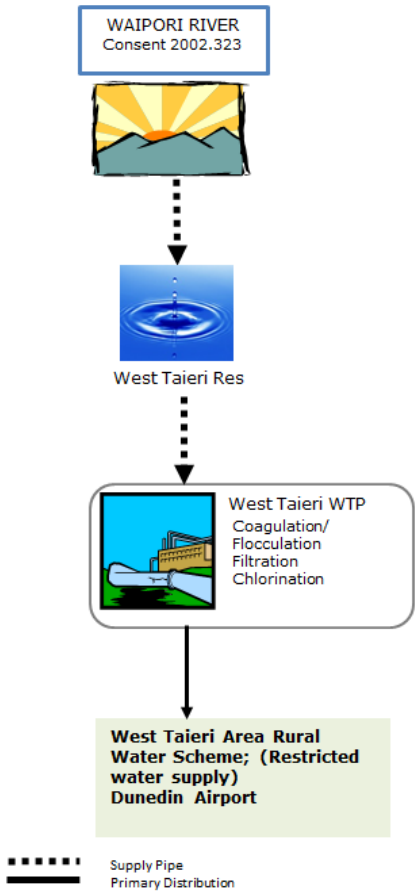


Figure 3: West Taieri water scheme

2.1.6 Waikouaiti water supply scheme

The Waikouaiti River comprises two main branches – the North and South branches. These two branches combine about 8km upstream of the river mouth to form the main stem of the Waikouaiti River, having a total catchment area of 425m^2. The catchment is used for sheep and beef farming and also has areas of native vegetation.

Up to 3500 m^3 a day of raw water is sourced from the Waikouaiti River under consents 2006.002 and 2006.075, as shown in Table 5. Water treatment at Waikouaiti operates on a stop start basis according to demand, providing approximately 50% properties in Karitane on a restricted supply scheme, the balance 50% in Waikouaiti on a non-restricted scheme.

The water is taken from the Waikouaiti River via one of two pumps with a capacity of 40 litres per second. The Waikouaiti WTP is designed for a maximum capacity of 3000m^3/day. A 3500m^3 raw water reservoir and a 3500m^3 treated water reservoir, when added to the Kiatoa reservoir gives a total storage capacity of four days.

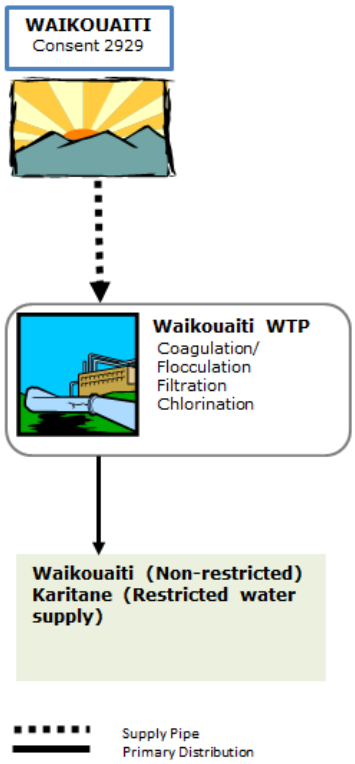


Figure 4: Waikouaiti water scheme

Table 5: Water take permits Waikouaiti

Consent	Source	Maximum rate (l/s)	Maximum volume (m^3/day)
2006.075	Waikouaiti River	40	2400
2006.002	Waikouaiti River	20	1100

2.1.7 Water supply schemes not in service

Presently, there are two existing storage supplies available that are not used in the day to day operation of the water supply system. These are the Ross Creek Reservoir (consent 2001.352-356) and Sullivans Dam (consent 2001.351); details of the consents are listed in Table 6.

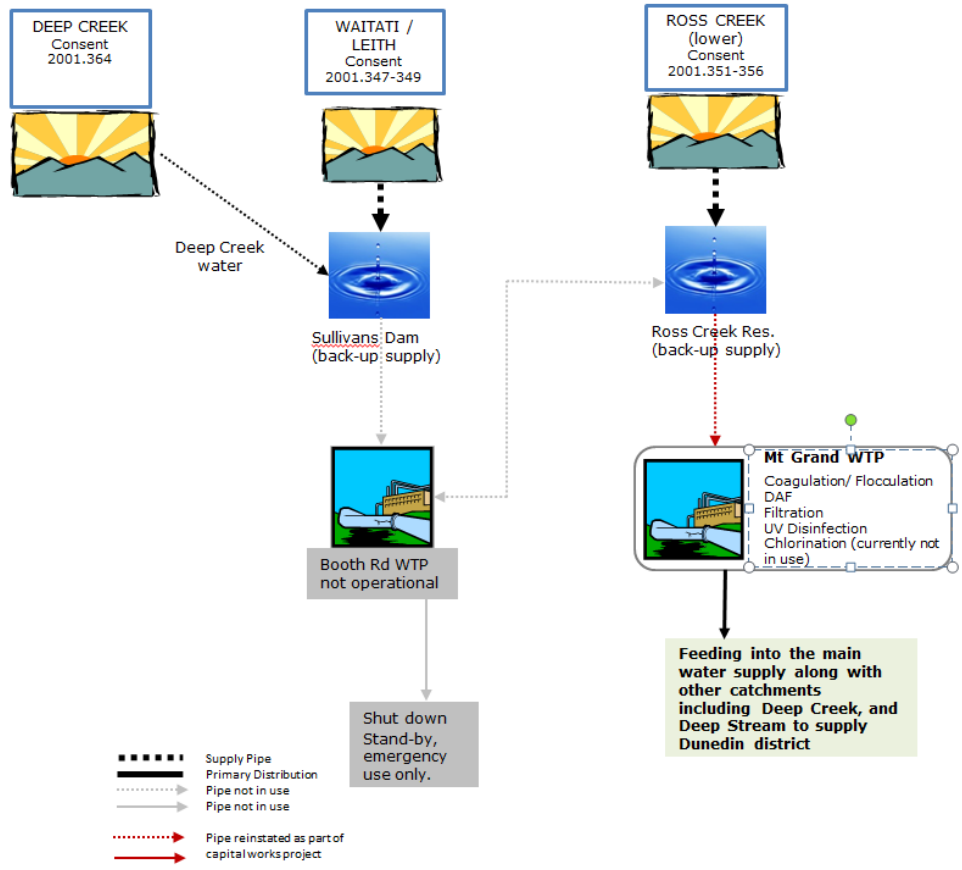
Table 6: Water takes for Ross Creek and Sullivans Dam

Consent	Source	Maximum rate (l/s)*	Maximum volume (m^3/day)**	Residual flow (l/s)
2001.351	Sullivans Dam	100	5000	-
2001.352	West Creek Branch	24	1500	2
2001.353	Morrison's Burn (upper)	64	3800	2
2001.354	Morrison's Burn (lower)	51	3000	2
2001.355	Nicols Creek	24	1400	2
2001.356	Ross Creek	40.5	3500	2

The next project planned to enhance Dunedin city's security of supply will be the reinstatement of the Ross Creek Reservoir and an additional pump station supplying water from the reservoir to Mount Grand to further protect the city from raw water supply outage.

Figure 5 illustrates the new water supply once Ross Creek is reinstated in 2019/2020. Sullivans Dam will continue to be out of operation. Investigation undertaken as part of the Security of Supply Strategy determined that additional water supplied from Sullivans Dam would be insufficient to make a material difference in drought conditions.

Figure 5: Water schemes not in service



In addition to the Ross Creek and Sullivans Dam consents listed in Table 6, there are four further water take consents not currently in service, shown in Table 7.

Table 7: Consents currently not in use

Consent	Source	Maximum rate (l/s)*	Maximum volume (m^3/day)**	Residual flow (l/s)
2001.347	Weatherston Creek	30	2000	2-5
2001.348	Weatherston Creek	23	1400	2-5
2001.349	Weatherston Creek	60	3500	2-5
2001.367	Warrington Springs	Surrendered consent 24th June 2013		

The Weatherston Creek (consent 2001.347-349) and Warrington Springs (consent 2001.367) that previously provided water supplies to Waitati and Doctors point and Warrington and Evansdale respectively, are currently out of service in favour of supply through the main Metro system on a limited reticulation system through the northern water pipeline.

As part of the future development of the Raw Water Lifecycle Asset Management Plan further work will be undertaken to ascertain whether these raw water sources are required as part of the City's future demand or emergency supply.

2.2 Current water consumption

Water is used for a wide range of uses. Residential water use accounts for about 57% of total water taken in 2016 as illustrated in Figure 6.

Commercial and industrial use, which will include such diverse water uses as industry, farming, retail, restaurants, hospitals, university and schools account for another 24% of total water taken. The balance 19% is "unaccounted water, which includes public and private leaks, fire-fighting, unauthorised connections, theft, and un-metered commercial usage and network operations)[4].

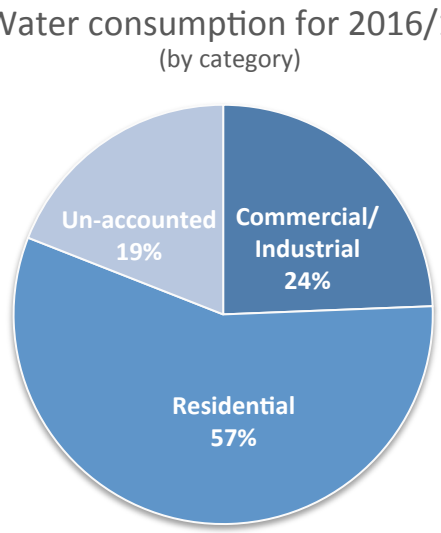


Figure 6: % split of water consumption for 2016/2017

Confidence in the overall data is relatively low. In Dunedin, water meters are only present on commercial/industrial sites (including some farm/irrigation activities), or residential properties if they have an extraordinary usage of water, for example, boarding houses. There are, however, some residential properties in Dunedin and Mosgiel that are metered, but this is only for water modelling/monitoring purposes. The majority of urban residential Dunedin is therefore not metered. As all the commercial properties are metered, commercial consumption figures can be viewed with more certainty.

[4] Water losses are described further in section 2.3

To provide data on residential household water consumption, the DCC has installed approximately 100 survey meters on residential properties across the city. Residential use is then estimated based on the metered properties. To improve the credibility of the data there is a programme in place to install bulk meters on the outlets of the service reservoirs, which will serve as a tool to assist understanding water demand. Using the data from the current bulk water meters and residential survey meters it is estimated that the average household uses approximately 530 litres per day.

Alternative methods to improve the measurement and monitoring of water flows within the network, so as to better understand water use and ensure unaccounted for water remains within acceptable limits, are under consideration.

Figure 7 shows total water consumption for Dunedin City since 2008. Increases in water production peaked in 2010/11 and 2015/2016 as a result of dry, hot and long summers but the general trend in water production has been in gradual decline since 2008.

Figure 7: Water production 2008-2017

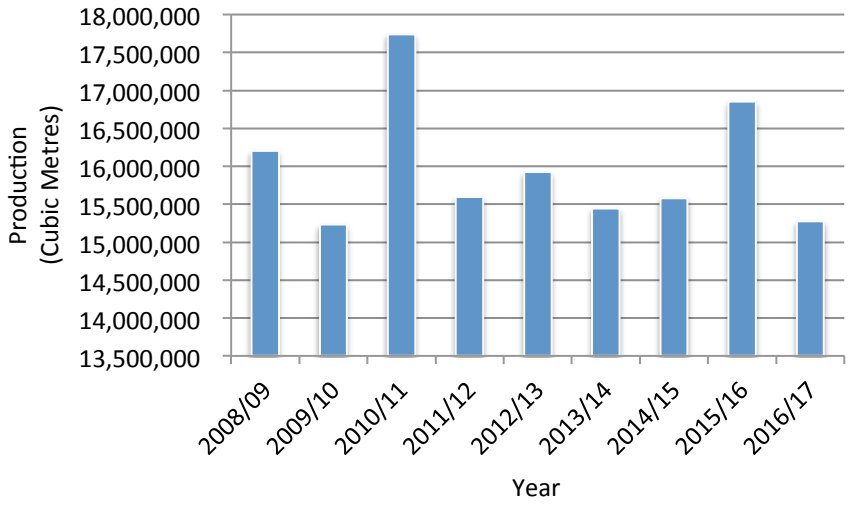
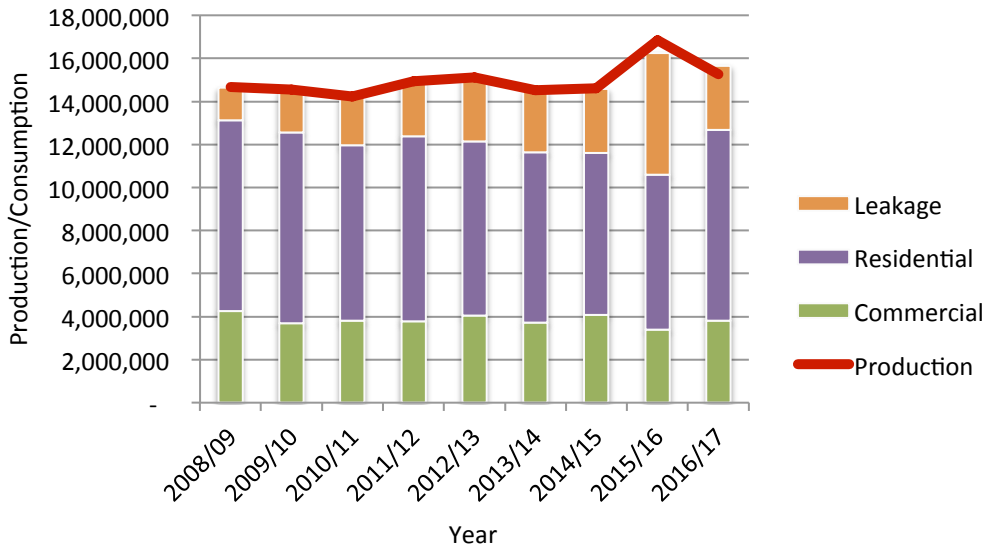


Figure 8 shows categories of consumption and production since 2008. In 2015/16 consumption and production figure calculations were updated to include all treatment plant production and all properties served by the reticulated water system. Previously some properties had not been included when calculating demand figures while all production plants had been included potentially causing leakage statistics to be artificially inflated. The increase in leakage in 2015/16 (along with the drop in residential and commercial usage) is most likely due to compromised meter reading figures, an issue that has since been resolved.

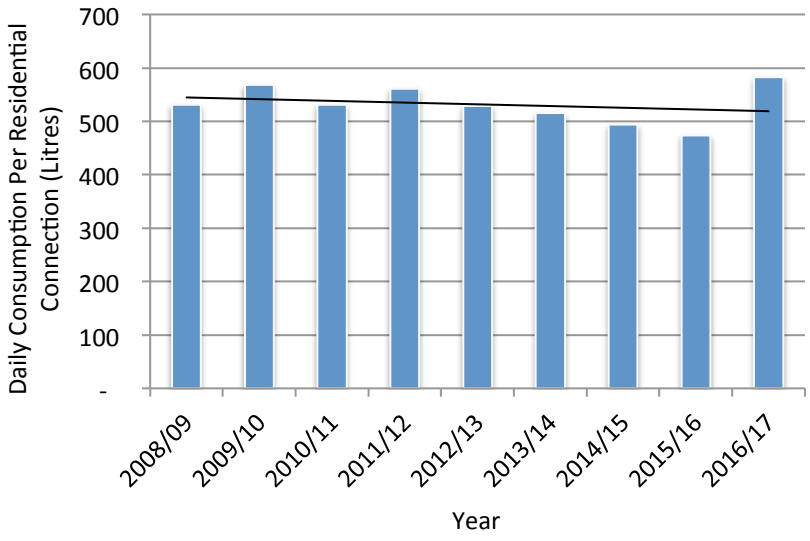
Figure 8: Water Production and Consumption from 2008 - 2017



Overall, the data indicates that since 2008, Dunedin has seen a gradual decline in both production and consumption of water. This is attributed to the continuing decline in 'wet industry' i.e. the closure of large manufacturing industries. The DCC has also seen a minor reduction in residential use as illustrated in Figure 9. This could be driven by:

- Increased community awareness, through the consultation carried out during the development of the Three Waters Strategy and education;
- Promotional initiatives developed through the original Water Conservation and Management Plan; and
- Water saving appliances being used in private residences.

Figure 9: Residential water use trend 2008 - 2017



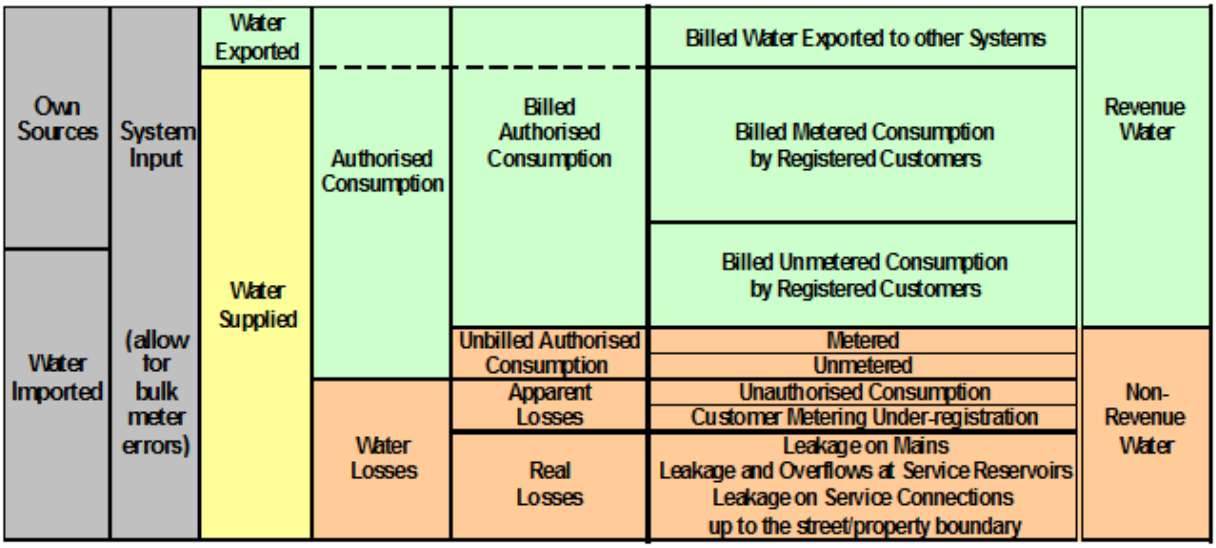
2.3 Water loss

2.3.1 Water balance calculations

For more than a decade, water suppliers have been implementing investigations and estimation of water balance in water supply systems. Water balance components presented in Figure 10 were proposed by the International Water Association (IWA) Water Loss Task Force and are widely accepted by water suppliers.

The Department of Internal Affairs (DIA) has introduced mandatory reporting measures for water suppliers, and in 2010 Water NZ assembled the Water Loss Guidelines for water loss management (based on IWA methodology), to assist water suppliers in DIA reporting. Water NZ also undertakes a voluntary national performance review to benchmark water suppliers' performance, including leakage indices.

Figure 10: The IWA 'best practice' annual water balance



The standard IWA terminology is as follows:

- **System input volume** is the annual volume input to the water supply/system.
- **Authorised consumption** is the annual volume of metered and/or non-metered water taken by registered customers, the water supplier and others that are implicitly or explicitly authorised to do so.
- **Water losses** are the difference between system input volume and authorised consumption and consists of apparent losses and real losses.
    - **Apparent losses** are water that is consumed but is not properly measured, accounted or paid for. These losses cost suppliers revenue and distort data on customer consumption patterns. It is water that is consumed but is not properly measured, accounted or paid for. These losses cost suppliers revenue and distort data on customer consumption patterns.

- **Real losses** are the physical losses of water from the distribution system, including leakage and storage overflows. These losses increase the water suppliers' production costs and stress water resources since they represent water that is extracted and treated but never reaches beneficial use.

- **Non-revenue water** is water from the system which is not directly supplied to customers. It is a mix of apparent and real losses, and may include water used within treatment systems and processes.

- There are various methods of calculating losses once water leaves the treatment plant:

  - **Unavoidable Annual Real Losses (UARL) –** represents the lowest technically achievable annual real losses for a well maintained and managed system. It takes account of length of mains, number of service connections and average operating pressures. The nature of this calculation is such that length of the network, overall network pressure, and the number of connections are the main drivers for reported water loss. The only way to reduce the UARL in an existing network is to reduce pressure in the network.

  - **Current Annual Real Losses (CARL)** – are volumetric losses between water treated and water delivered. The accuracy of CARL calculation relies on a good estimate of average domestic water usage.

  - **Loss per Connection per Day** - is the traditional basic performance measure with the greatest range of applicability. However, individual values of leakage may still be influenced by operating pressure, location of customer meters and low density of connections. It is calculated by dividing the UARL divided by the number of connections.

  - **Infrastructure Leakage Index (ILI) -** is the ratio of CARL to UARL. It is used for international benchmarking.

2.3.2 Dunedin water losses

Bulk flow monitoring carried out during the development of the Three Waters Strategic Direction Statement reported (with a low-medium data confidence) a UARL of around 8% and a CARL of 22% with high variability between supply zones. The results of bulk flow monitoring have helped to focus attention on zones of the city with higher estimated levels of leakage. In the 2015/16 year, the Dunedin-wide UARL and CARL were not reported. This is because of the issues with inaccurate meter readings during 2015/16 have resulted in a low level of confidence in this measure. Due to the sample size inaccuracies exaggerate their associated figures as given in Table 8

Changes have been implemented to ensure that meter reading data is accurate for the 2016/17 year. Currently, the DCC is aiming for a goal of ≤20% water loss as per the DIA guidelines. This is monitored through monthly internal reporting. Table 8 illustrates the real water losses or 'CARL' over a five year period. The data illustrates that water loss (with exception to 2015/16 where there was an issue with the credibility of the data) has remained stable.

Table 8: Percentage of 'real water loss over a five year period

	2012/13	2013/14	2014/15	2015/16	2016/17
Percentage of 'real water' loss	16%	20%	20%	35%	19%

It is possible that this data represents a genuine reflection of real water losses through improvements of the network integrity; however, universal residential water metering is limited in Dunedin, as mentioned in Section 2.2. In 1999 the DCC adopted a policy on domestic water supply charging, that *'water meters will not be introduced for domestic customers for charging purposes'*. As a result, only commercial/industrial customers are metered, this leads to low confidence in available residential use data.

More accurate metering of residential connections would likely assist in reducing the CARL calculation. However, the costs associated with this are significant - estimated at $25m for installation (including manifolds). There would also be ongoing costs for the monthly reading of those meters and 10 yearly meter renewal. Therefore, the benefit of residential metering for leak management purposes is not considered to outweigh the costs. As an alternative the DCC is pursuing a 'bulk' or 'zone' metering programme to better manage data accuracy and subsequently real water losses. A recent improvement in this part of the water system is the commencement of a programme to install meters on all of the service reservoirs to accurately measure and record the out-going flow from these to consumers, discussed in more detail in Section 3.

2.4 Predicted future changes

Currently, water supplied from the primary catchments is thought to be sufficient to meet demands under normal operating conditions for most of the time. A growing population will inevitably be accompanied by an increase in the demand for water. Coupled with residual flow requirements, managing the demand for water becomes even more important.

Dunedin has a population of around 125,000. After a period of relatively slow growth between 2006 and 2013, there are now signs of stronger population and economic growth. Statistics New Zealand projects Dunedin's population to be somewhere between 109,900 and 152,000 but 'most likely' to be 130,700 by 2048.

In addition to population increases there are other factors to consider that will influence demand on the City's water supplies:

- **City's changing population structure**: With an aging population family households are less common in Dunedin – changes in population structure will impact on the density of population and the type (e.g. style and size) of house required.
- **Quality of life:** Dunedin residents have a lower median income than New Zealanders. For the DCC this means that water efficiency measures must be weighed against community affordability.
- **Housing growth:** The rate of housing growth over 30 years is almost double the rate of population growth. The number of dwellings is projected to grow from 52,090 in 2018 to 58,070 in 2048.

- **Housing quality:** One in five Dunedin houses was built prior to 1920. Older houses are less likely to have modernised water efficiency features such as low-flow showerheads and dual flush toilet cisterns.
- **Inconsistent growth across the city:** Planning needs to acknowledge the variations in growth across the city. Some parts of the city are expected to grow and some decline in population over the next 30 years. For example, the predicted annual growth rate for Mosgiel is slightly higher than Dunedin at 0.34%.

Across the Dunedin region, the effects of climate change are predicted to increase the seasonality of rainfall, with longer dry periods, and more frequent localised heavy rainfall. The water supply will need to be managed accordingly. The decreasing summer rainfall is more pronounced in some catchments more than others. For example the Taieri and high country catchments that supply Mount Grand and Southern Reservoirs are likely to show significantly greater seasonal variation than the Leith catchments that supply Ross Creek and Sullivan's Dam. This means that the Leith catchments are likely to have more reliable year round water supply in the future. Additionally, groundwater recharge to the Taieri bores is likely to be less affected than run of the river systems.

It is also possible that increasing dry periods will attract further pressure from other water users and regulatory bodies to ensure that all water is being used efficiently. This will put further pressure on the system to reduce leakage and improve raw water efficiency elsewhere.

When combined with extreme temperatures longer dry periods also significantly increase the risk of uncontrolled fires in the high country catchments, leading to more demand on water supplies for firefighting.

Furthermore, rainfall intensity in the catchments is a significant driver of raw water quality. The heavy rainfall leads to increases in the amount of sediment carried in the water. This 'dirty' water puts greater pressure on costs in the treatment plant process, which is why the actual water intake can be shut-off during periods of heavy rainfall.

3 Water conservation and management actions

There is a wide range of water conservation measures, the relative effectiveness and cost of which varies widely. The DCC has identified four goals which it considers provide a balance between potential benefit in terms of water saved, with cost and ease of implementation.

The first strategy targets water reduction by focusing on improved efficiency of the water supplies relative to demand. The two goals associated with this strategy are:

- Goal 1: Improved efficiency of the distribution system
- Goal 2: Management of water during water shortage events

The second strategy is focussed on reducing consumer demand. The two goals associated with this strategy are:

- Goal 3: Community education and promotion of water conservation measures
- Goal 4: To continue monitoring water conservation activities

3.1 Supply strategy; addressing network losses

There are nine actions that the DCC can undertake to avoid high and increasing volumes of leakage from the system.

Objective 1: Improve the efficiency of the distribution system

Action 1.1 Continue the analysis and implementation of an active leak detection and pipeline renewals programme

The DCC has a proactive leakage detection programme which has been in place since 1994. Leaks are located and remedied through consumer complaints, operational observations, detecting pressure loss, and analysis of water metering data. Leaks within the network are fixed promptly, and the DCC also requires customers to promptly fix leaks found within private plumbing systems. Methods of leak detection are detailed below:

- **Pipeline meters** - Network flows are measured by magnetic flow meters. Flow trend data is recorded and stored for analysis to determine whether leakage is occurring or increasing. An increasing flow trend would trigger a ground inspection of the pipeline.
- **Ground inspections** - Ground inspections involve driving or walking along the route of the pipelines looking for signs of leakage.
- **Aerial inspections** - An aerial inspection is carried out annually on Deep Stream and Deep Creek raw water pipelines. This gives the opportunity to see leakages that are not always apparent from the ground.
- **Specialist leak detection surveys** - When signs of leakage are detected from the air, the source of the leak has to be pin pointed accurately. The Specialist Leak Detection Team is utilised by the operators, if required, to use electronic acoustic equipment to accurately locate a leak.
- **Leaks reported by the public** - In some circumstances, leaks are reported by a property owner to the DCC, which initiates a ground survey.

- **Response time** - The time taken to attend to a leak is an important part of the leak detection process. Attendance to leaks is prioritised based on the information received. If the information indicates a large loss of water, a crew will be dispatched immediately. If the indications are that it is of minor nature, the investigation will be put on a task list. For the supply mains of Deep Stream, Deep Creek, Silver Stream and Taieri Bores, all reports of leaks are inspected immediately and assessed for minor, moderate or catastrophic effects.
- **Technology** - Use of technology assists with the time involved in finding and fixing a leak. Technology utilised by the DCC includes leak noise loggers, portable magflo meters, leak correlator, electronic listening stick, electronic ground microphone and meters on outflow from reservoirs.
- **Other** - When there is a known leak, but it is unable to be accurately pinpointed by any of the above means, excavation along the pipeline may be required to find the leak. Small portable "V" notch weir dams have also been used to monitor flows in gullies below the pipeline trench where suspected leaks may be. These work well in dry conditions or when the pipeline is shut off for a few days. This shows if there is any change to the flow and whether or not it is coming from the pipeline.

Maintenance of the water supply network is a key DCC priority. The water supply network is programmed for maintenance and renewals as required. An estimated $432 million is expected to be spent over the next 30 years.

Action 1.2 Reduce pressure in the supply system

Pressure management is an important aspect of the water supply system, particularly given Dunedin's hilly topography. Management of water pressure is primarily controlled through:

- The placement of service reservoirs at strategic elevations; and
- Installation of pressure reducing valves on primary water mains to reduce and control pressures at present optimum levels.

Without pressure management, water in lower lying areas would experience excessive pressure due to the difference in height between the supply point and the customers tap. This could result in high leakage rates and excessive wear on private plumbing fittings such as tap washers. This could potentially result in an unacceptably high water loss from both the network and customer's systems. Therefore, the implementation of pressure management actions helps the DCC to target a reduction in water loss from the system. This provides an important contribution to scheme efficiency.

High pressures occur in a number of places across the network, as demonstrated through hydraulic modelling. These areas include Green Island; Brighton; Wingatui; Kaikorai Valley; Ellesmere; and North East Valley. In parallel with this modelling exercise a first-cut pressure management investigation has now been completed; the next step will be to model options for economic viability, comparing potential cost savings with capital cost of pressure management.

Recent significant renewals work in the Andersons Bay is expected to reduce UARL caused by high pressure in that area as shown in Table 9.

Table 9: Unavoidable annual real losses Andersons Bay

	Number of properties	Length of mains (km)	Average pressure (m)	UARL (m^3/day)
Before renewals	1332	42.07	92.61	169
After renewals	1332	42.18	78.30	143

The areas of Pine Hill, North East Valley and Signal Hill are also known to have high pressures due to the nature of the landscape and the way the water is supplied to these zones. An operational report has been completed, indicating how the pressure within these three zones could be managed and reduced; this project is currently awaiting prioritisation.

Action 1.3 Adopt the International Infrastructure Management Manual (IIMM) (IPWEA, 2015) asset management framework.

A proposal has been prepared for DCC approval to develop a series of Lifecycle Asset Management Plans (LAMP). This will enable the DCC to have a greater understanding of water supply assets and identify areas of potential failure and target investment. The LAMP's would include:

- Metro raw water supply;
- Metro water treatment;
- Metro water distribution; and
- The rural (restricted) water supplies.

The intention of LAMP is to present a summary of the actions and expenditure lines (both capital and operational) for each asset group in one place. They will contain:

- A summary of the existing asset strategies currently spread across other individual reports, assessments and plans, with further development to ensure the entire life cycle of each asset group is covered.
- Capital programmes, high-level maintenance programmes, and summarised operational expenditure programmes.
- Significant compliance-related milestone dates for each group, such as consent expiry dates, raw water testing requirements (such as cryptosporidium monitoring and radiological testing), and Water Safety Plan reviews for individual water systems.

Action 1.4 Enable better use of existing water supplies to off-set the need to source new water supplies and establish associated infrastructure.

Capital works continue to significantly improve water storage capability and supply flexibility. Progress on delivery of the Security of Supply Strategy has proceeded as planned. Construction of the pump station for the treated water pumping line between Southern Water Treatment Plant and Mt Grand Water Treatment Plant is completed.

Action 1.5 Maintain a flow management programme

Flow monitoring contributes to supply management, consent compliance, and fundamental operational requirements. Flow monitoring also contributes to the pool of information available for analysis of how water is used in Dunedin and provides an indication of demand on the system and potential target areas where demand and/or supply management improvements can be made to gain better efficiency of water use. The DCC currently monitors the flow for many of

the water takes, such as rainfall, stream/river levels, turbidity and the volume and rate of water taken at the intake.

Flow monitoring carried out from 2009-2011 focussed attention on zones of the city with higher estimated levels of leakage. The areas with the highest losses are Central City Beta Street Reservoir in Roslyn, Mount Grand water supply feed into the high levels of Dunedin, Green Island, Brighton, and Port Chalmers. These areas are prioritised for further investigation and zone management. However, there is also a need to gather more information on flows within the water system to provide better accuracy for effective planning, operation and management of Dunedin's water system.

A 'bulk' or 'zone' metering programme which endeavours to meter each of the distribution reservoirs located around the city with high accuracy magnetic flow meters linked to the real-time SCADA control system is being implemented. Installing meters on the outlets of the service reservoirs will serve as a tool to record the out-going flow from these reservoirs to consumers.

This practice effectively divides the city into discrete measurable distribution zones, enabling more accurate estimation of losses within each zone.

The programme of flow monitoring within the treated water network has progressed well since 2006. The number of bulk meters installed on distribution reservoirs increased from 15 in 2012 to approximately 40 in 2016.

Objective 2: Management of water during water shortage events

Action 2.1 Review the Water Bylaw

The Water Bylaw is a useful tool to manage customer connections and emphasise customer responsibilities. Primarily it is used to provide a clear framework for management of the water supply network and to inform the general public of their responsibilities.

Bylaw enforcement can be problematic. In the absence of regulations specifying infringement offences, the only option available for a breach of Bylaw is full prosecution through the District Court. Education of responsibilities is currently the primary focus.

The Bylaw is due for review by June 2018.

Action 2.2 Water Conservation Notices

Any water leak identified is investigated through a pressure test. If the leak is from a private property, a "water conservation notice" is served to the customer. This notice requires the leak to be fixed within a specified time period. If no response is received, a follow-up letter is sent providing a further 10 working days for resolution. If the problem is still not resolved the customer is advised their water supply will be restricted in five working days.

Over 300 notices were issue for the period of 2016 – 2017, most of which were resolved within five working days.

Action 2.3 Enable property and business owners to become more aware of the amount of water they use and charging for its use

Water metering can offer significant benefits with respect to water conservation. Consumers are more aware of the amount of water being used as they are being charged for it, and may tend to use less of it compared to a water consumer who is unrestricted. All non-residential customers are subject to water metering.

Action 2.4 Review restriction guidelines and develop a drought management strategy

During water short periods the DCC advices and enforces water restrictions. The restrictions focus on non-essential uses, initially impacting discretionary uses such as use of garden sprinklers and car washing. Should there be a serious event that requires demand reductions in excess of 20%, the DCC's policy provides for a situation-specific demand management plan to be produced which incorporates more stringent water restrictions such as pressure management or water rationing. This is discussed in more detail in Section 3.3.

3.2 Demand strategy; managing customer demand

As residential users make up 57% of all water used there is a great deal that the community can do on an individual level to reduce their water use in the home and garden.

Objective 3: Provide education and promotion to the community

Action 3.1: Promote water conservation message to the community

Education and promotion are critically important to implementing successful water conservation. Education and promotion enables the public to make better-informed decisions that result in behaviour changes to consciously reduce water demand.

Some consumers' waste water by not maintaining dripping taps and leaking toilet systems or leave taps running. More water is used than is needed for tasks around the house. Outside taps and pipes are sometimes damaged in frost, resulting in unnecessary water wastage. Pipes between hot water cylinders and taps are often not lagged, also resulting in water being wasted until the hot water runs through.

Garden watering accounts at least 25% of total domestic usage, with significant increases during hot and dry periods. Many gardeners choose exotic plants, which often require more watering than native plants. Some gardeners are unaware of techniques such as mulching and long-lawn mowing techniques that reduce garden watering requirements.

Education and promotion are achieved by:

- Provision of information online and through social media;
- Provision of information through DCC publications such as FYI; and
- Through wider publicity campaigns during water-short periods.

Action 3.2 Promote water conservation to children through schools

The DCC works with local schools to promote water conservation activities through the Enviroschools programme. The programme has around 60 members in the Otago region, 33 of

the schools are located in Dunedin, and eight of those are secondary schools. The education programme includes information about water sources, treatment and water conservation activities. Schools receive an Enviroschool resource kit and handbook when they join. A DCC Enviroschools facilitator works with staff and students to choose a range of activities to meet the schools sustainable goals.

Some of the benefits of the Enviroschools programme to schools include action-based learning, deepening knowledge about ecological sustainability and community resilience, creating genuine leadership opportunities for students and cost-savings through more efficient school-wide practices.

Action 3.3 Provide tours of water treatment plants
Educational water supply treatment tours of the two largest water treatment plants, Mount Grand and Southern, are available. The tours ultimately give attendees a more holistic view of how the water is supplied, treated and delivered. The DCC offer this service on demand throughout the year carrying out up to 12 tours annually.

Action 3.4 Encourage the use of water efficient plumbing fixtures
Applicants are advised through the resource and building consent process to install water conservation devices, such as dual flush toilets and low-flow shower heads.

All activities associated with the four goals and associated actions are listed in Action Table Appendix A.

3.3 Drought management

Preparing for a water shortage requires strategies to supplement available water supply whilst reducing the city demand. The optimal mix of strategies is determined by the timing and volume of shortage and the time required to boost the water supply.

3.3.1 Identification of water short periods

Drought is generally defined as a severe moisture deficit below expected levels that restricts some type of activity. Around 90% of the DCC's water supply is a "run of the river system" with virtually no drought storage. The raw water storage that is in place is only large enough to cover pipeline or pump station failures as opposed to the rivers drying up.

The remaining 10% represented by the Mosgiel groundwater system, while not being so susceptible to immediate obvious drought depletion, still has a limited capacity as it relies on the re-charge from the Silverstream which is usually one of the earliest surface water systems to dry out.

The DCC must also maintain residual flows downstream of the surface water takes in many of the watercourses to comply with Otago Regional Council (ORC) consent conditions in order to provide for the aquatic ecosystem and natural character of the source water. For the Taieri Aquifer, the ORC may impose restrictions when groundwater is at or below specified levels.

The ORC reports that groundwater restriction levels can be useful for protecting an aquifer from over-depletion due to extended periods of low recharge, or in managing localised areas of high

demand. Groundwater restriction levels can assist in avoiding land subsidence, aquifer compression, reduced outflows to surface water, and sustaining the life supporting capacity of the aquifer. Schedule 4 of the Regional Plan: Water for Otago sets out restrictions that apply to the take of groundwater from aquifers. When the aquifer reaches the maximum height the restriction will take effect.

The early warning signs of drought normally come from NIWA-based modelling water temperatures in the Pacific Ocean. The other drivers which could require water restrictions to be imposed are:

- Supply not keeping up with demand i.e. diminishing flows in rivers in stream reported through the ORC website.
- Rural Fire Authority website which tracks the fire risk in rural areas based on data from the network of water stations in New Zealand.
- Water levels in the Deep Stream Deep Creek peat bogs - In November/December the DCC undertakes a catchment flyover to visually inspect the bog water levels.
- Rainfall based indicators provide a practical, general index because rainfall is a dominant driver of drought.
- The localised treated water network becoming overloaded.
- Reservoir status and water demand.
- Asset failure.
- Algal blooms.

In the event of water restrictions being required, the approach will be maintaining continuity of supply while minimising inconvenience to customers as far as possible.

This will mean that restrictions will target in the first instance to the area of greatest need rather than defaulting to "Citywide" coverage. As a drought intensifies, the coverage can be expected to extend to wider areas of the city.

3.3.2 Public notification

In the first instance water efficiency will be encouraged by helping customers understand how to prepare for shortage and the impact of not following the restriction guidelines. Public notice is required (via newspaper and other traditional forms of media) before any restrictions can lawfully be imposed.

3.3.3 Voluntary and compulsory restrictions

The DCC must manage the system to extend the period for which water supply is available. This is achieved through the early identification of water-short periods, and through a public request to conserve water voluntarily, prior to formal restrictions being imposed.

In the early stages of a drought, more pressure (consumer demand) on existing water reserves and treated water distribution and reticulation system ('overloading') typically occurs. The DCC may make a call-to-action for voluntary reduction measures. In general, voluntary reductions promote short-term restrictions of discretionary water uses. Voluntary reductions do not require enforcement. Following this, the DCC may choose to establish more control of demand by shifting as much domestic demand from daytime usage to night-time usage. This helps to reduce hourly peaks in demand and therefore reduce loading on the system as a whole.

If conditions become worse, the DCC has to put in place tighter restrictions. This is achieved by progressively restricting discretionary demand in the first instance, followed by a request to industry to reduce daily demand.

Assessment of the conditions is monitored through the use of the water restrictions calculator that takes into consideration 10 criteria such as: the levels of raw water in the reservoir, the stream flows including residual flows returned to the river and rainfall.

Water audits of properties and/or buildings and facilities help customers reduce demand. The results of a water audit will typically include detecting leaks or waste, identifying inefficient devices that may be upgraded and discovering wasteful behaviours or water management practices that can be improved upon. Water audits can be performed at any property and often focus on both indoor and outdoor water use. Water audits can also be conducted by property owners with guidance from the DCC.

Current actions taken to restrict the use of water consist of four levels (including normal operation) as outlined below. The actions taken to restrict water use can act as either a city-wide restriction or a scheme by scheme concept. The city-wide approach is useful when parts of the treated water network starts are struggling to meet demand.

Normal Operation	**Restrictions only on domestic plumbing systems or any water use that wastes water or creates a nuisance.** *(A nuisance can range from water flowing onto a neighbouring property to illegal use of a fire hydrant by a contractor).*
Level 1 Restriction	**Restrictions to reduce hourly peak demand, especially in the late afternoon/early evening.** This tool is used to: ▪ Minimise supply outages in parts of the reticulation system that are prone to overloading during short dry periods. ▪ Restrict the use of sprinklers between 8.00 am and 8.00 pm. ▪ Restrict use of irrigation between 8.00am and 8.00pm. ▪ Restrict use of hand held hose filling of private ponds between 8.00am and 8.00pm. ▪ Restrict use of private fountains and filling ponds between 8.00 am and 8.00 pm. ▪ Restrict use of car washing and water blasting or washing cars, windows between 8.00 am and 8.00 pm.
Level 2 Restriction	**Restrictions to reduce daily demand.** This tool is used to: ▪ Minimise supply outages in parts of the reticulation system that are prone to overloading during short dry periods. ▪ Restrict the use of sprinklers between 8.00 am and 8.00 pm. ▪ Restrict use of watering private gardens with hand held hose between8.00 am and 8.00 pm.

	▪ Restrict use of watering private gardens with hand held hose between8.00 am and 8.00 pm. ▪ Restrict use of irrigation between 8.00am and 8.00pm. ▪ Restrict use of private fountains and filling ponds (that support fish) between 8.00 am and 8.00 pm. ▪ Restrict use of car washing and water-blasting or washing cars, windows between 8.00 am and 8.00 pm.
Level 3 Restrictin	**This restriction places a total ban on sprinklers and all hoses for both domestic and metered consumers.** This level is used to: ▪ Prohibit the use of sprinklers, hose's and irrigation, commercial nurseries and sports amenities to use hand-held hose only. ▪ Prohibit the use of irrigation, hand held hose only. ▪ Prohibit use of filling private fountains and ponds with exception to filling ponds (that support fish) between 8.00 am and 8.00 pm. ▪ Prohibit filling swimming pools and restrict topping up commercial swimming pools between 8.00 am and 8.00 pm. ▪ Restrict private car washing to bucket only. ▪ Prohibit water-blasting or washing private assets e.g. windows, roof and boats.

During a supply shortage the DCC will monitor projected supply and demand for water on a daily basis. Restrictions shall remain in effect until such time as applicable restrictions are removed.

In the event of non-compliance, restrictors may be fitted on connections to limit the supply of water to that required for household health and safety.

4 Measuring success

The DCC intends to measure the success of measures outlined in this Water Conservation Management Plan by demonstrating that the percentage of real network water loss is maintained at or below ≤ 20%. Results are reported in the DCC Annual Report.

The DCC will also monitor actions associated with the Water Conservation Management Plan in relation to both network and demand management, and review and update the plan as necessary.

Appendix A: Water Conservation and Management Action Plan

Action	Impact	Activities	Outcomes	Timeline
Objective 1: Improve efficiency of the distribution system				
Action 1.1 Continue the analysis and implementation of an active leak detection and pipeline renewals programme	Council All Residents Commercial users	Agree the current draft budget indicated $154K for 2018/2019 and $158k for 2019/2020. Continue current investment in routine inspections, network maintenance and the water main replacement programme. Carry out condition assessment of critical pipes and utilise Hansen database to help better target pipe renewal programme Document process in Promapp	Active leak detection programme is place to the point where economic return is maximised	On-going
Action 1.2 Reduce pressure in the supply system	Council All Residents Commercial users	Prioritise the North East Valley and Signal Hill project. Continue current investment in pressure testing and where issues are identified provide operational reports for approval and prioritisation. Document process in Promapp	Reduction in UARL	On-going
Action 1.3 Adopt the International Infrastructure Management Manual (IIMM) (IPWEA, 2015) asset management framework.	Council	Approval of the Lifecycle Asset Management Plan framework. Development of the Lifecycle Asset Management Plans.	Nine Lifecycle Asset Management Plans that feed into: Individual Work Plans, Capital Programme; Maintenance Plan and routine operations.	Short - Medium Term?
Action 1.4 To enable better use of existing water supplies to off-set the need to source new water supplies	All water users in the Port Chalmers water scheme	Port Chalmers Water Supply. Decommissioning of Port Chalmers WTP and two supply dams.	Reducing operating costs	Short Term

Action	Impact	Activities	Outcomes	Timeline
and establish associated infrastructure.	All water users in the metropolitan Dunedin water scheme	Ross Creek to Mount Grand - security of supply. Renewal of the Ross Creek Reservoir Dam Embankment.	Mitigate risks to water supply Increase storage capacity of raw water supply	Short Term
	All water users in the metropolitan Dunedin water scheme	Construction of the raw water pumping line between Ross Creek and Mt Grand Water Treatment Plant.	Mitigate risks to water supply Increase storage capacity of raw water supply	Short Term
	All water users in the Northern water scheme	Renewals of township and rural water network pipes to improve water supply fire flows	Meet fire service code of practice	Short Term
Action 1.4 To enable better use of existing water supplies to off-set the need to source new water supplies and establish associated infrastructure cont.	All water users in the North East Valley	North East Valley Network Renewals. Renewal of mostly wastewater and water network assets to reduce inflow and infiltration in the wastewater network (results in wastewater overflows) and improve water supply fire flows	Reduces risk of public health during heavy rainfall events Meet fire service code of practice	Short Term
	All water users in the Kaikorai Valley	Kaikorai Valley Network Renewals. Renewal of mostly wastewater and water network assets to reduce inflow and infiltration in the wastewater network (results in wastewater overflows) and improve water supply fire flows	Reduces risk of public health during heavy rainfall events Meet fire service code of practice	Short Term
	All water users in the metropolitan Dunedin water scheme	Deep creek/deep stream renewal (2036)	Provides security of main water supply Increases expected life of these assets	Long Term
	All water users in the metropolitan Dunedin water scheme	Mount Grand WTP upgrade was completed around 2000; therefore significant renewals are coming due. In addition the original 1970's areas of the plant require condition assessment and refurbishment.	Provides security of main water supply	Long Term
Action 1.5 Maintain a flow management programme	Council All Residents Commercial users	Reticulation Development - Zone Metering. Identify priority reservoirs without bulk meters and install over three year period. Review whether Reservoir Management Plans are required	To provide better accuracy for effective planning, operation and management of Dunedin's water system.	On-going

Action	Impact	Activities	Outcomes	Timeline
Objective 2: Water restriction management				
Action 2.1 Review the Water Bylaw	Council All Residents Commercial users	Review Water Bylaw in 2018	Reduced demand by initiating behaviour changes	10 yearly
Action 2.2 Water Conservation Notices	Council All users	Provide water conservation notices when leaks identified are to be resolved by the resident.	Increased knowledge and awareness of water issues	On-going
Action 2.3 Enable property and business owners to become more aware of the amount of water they use and charging for its use	Council Commercial users	Continue to meter commercial users Document process in Promapp	Increased knowledge and awareness of water use and conservation opportunities	On-going
Action 2.4 Review & implement (as required) the drought management strategy	Council	Prepare draft response plan and review policy for non-compliance in the Water Bylaw. Document process for managing demand during various stages of drought in Promapp	Effective management of water during	Medium term
Objective 3: Provide education and promotion to the community				
Action 3.1: Promote water conservation message to the community	Council All Residents Commercial users	Revise and update council website and social media to include detailed information on water conservation activities annually. Consider developing factsheets and flyers on water conservation and what residents can do at home Review the sustainable living programme Consider developing campaigns to raise awareness of water conservations activities .e.g. turn the tap off week	Increased knowledge and awareness of water issues and conservation opportunities Increased participation in water conservation Reduction in demand for water	On-going
Action 3.2 Promote water conservation to children through schools	Council All Residents Commercial users	Maintain full subscription as per funding limits on the Enviroschools programme	Increased knowledge and awareness of water issues and conservation opportunities Increased participation in water conservation	On-going

Action	Impact	Activities	Outcomes	Timeline
			Reduction in demand for water	
Action 3.3 Provide tours of water treatment plants	Council All Residents Commercial users	Maintain current numbers of water tours annually	Increased knowledge and awareness of water issues and conservation opportunities	On-going
Action 3.4 Encourage the use of water efficient plumbing fixtures	Council All Residents Commercial users	Recommend the installation of water conservation devices when building and resource consents are received	Reduction in use over time Increased awareness of water conservation actions that the community can do to help.	On-going