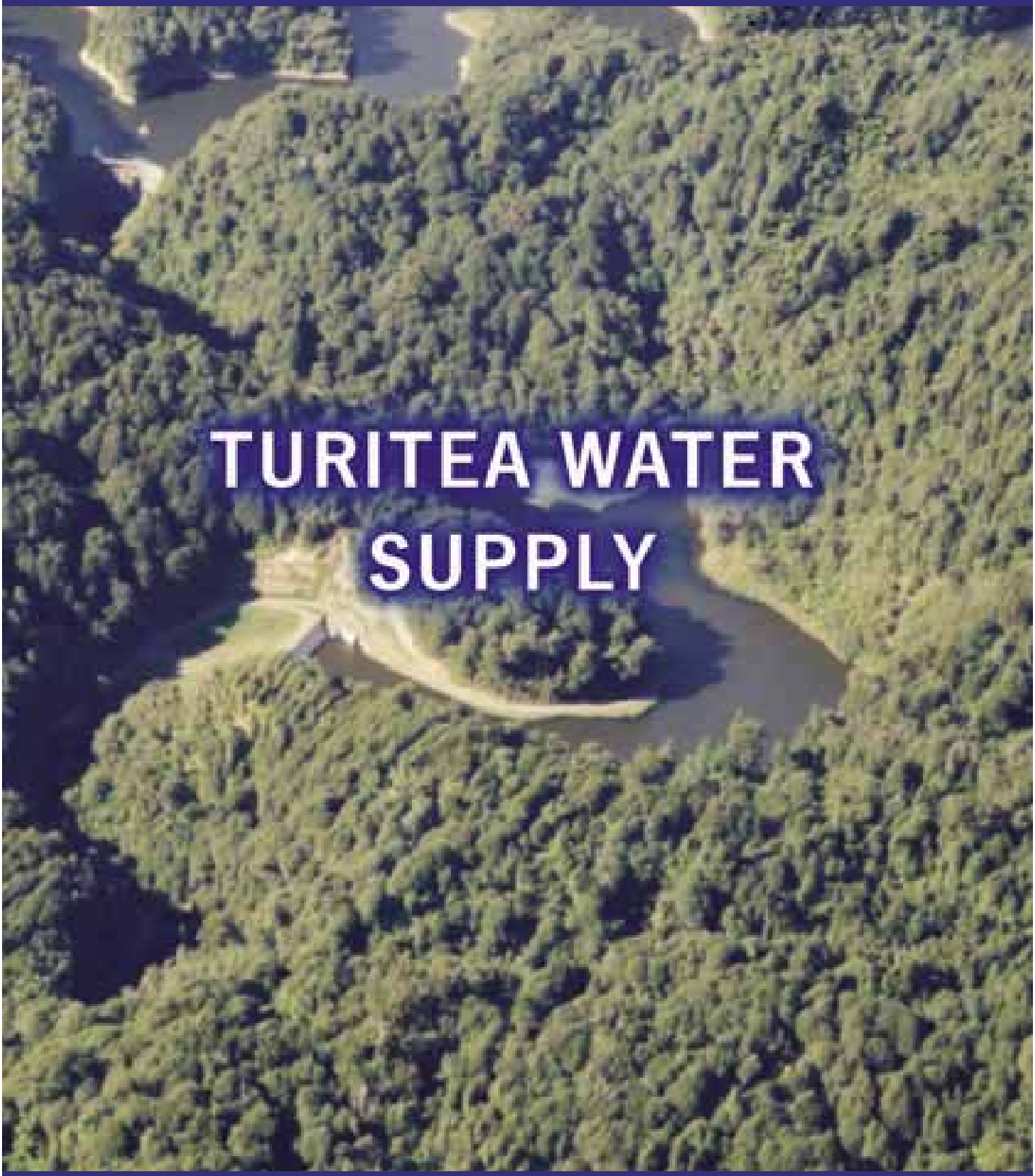
PALMERSTON NORTH CITY COUNCIL



TURITEA WATER SUPPLY

YOUNG HEART
EASY LIVING
MANAWATU

In 1864, when the Government purchased a large area of land around the Manawatu River, the whole region was covered in bush. A natural clearing in the bush, known as Papaioea, was recommended as a good site for a township and by 1866 it had been surveyed and the first land sales had been made. The name Palmerston began to be used.

Many of the initial settlers came as a result of the central Government's public works and immigration scheme of the early 1870's. Life was hard, but most families endured and carved a living for themselves from the land. To avoid confusion with Palmerston in the South Island, in 1871 the Post Office added North to the name of the growing town. Sawmills, small businesses and hotels sprang up; a tramway joined the settlement to Foxton and ultimately beyond.

In 1877 Palmerston North became a borough with an elected Council - a body with the ability to raise loans to supply civic amenities such as water supply and sewerage disposal systems. A supply of water for drinking, washing, flushing away waste and for fighting fires, was of primary concern to the new borough.

Thanks to far-sighted town planning, with provision for wide streets and a large central square the town was well serviced for transport. Yet early settlers still obtained their water where they could, mainly from private wells or rainwater tanks.

There were no safeguards as to the quality of the water, and with hotels and boarding houses burying their night soil in their backyard cesspits, and a high water table, pollution was a real problem. With the increasing demand, wells were drying out and during hot summers had to be deepened. An attempt by the Council to sink an artesian bore in the Square was a complete failure, yielding no water at all, even after a stick of dynamite had been dropped down the hole.

The Council put forward two options. The cheapest and most obvious was to sink artesian bores, but the Council's ambitious proposal to use windmills to pump the water from these bores into a storage reservoir and then pipe it throughout the town was decisively rejected by the ratepayers on the grounds of cost: £10,000.

J. P. Armstrong

However, farsighted people saw the Tararua Range as the source of an almost unlimited water supply. In 1885 the Council began to look at the Turitea Stream. The flow of the stream was measured by a local engineer, J P Armstrong, and was found to be sufficient to supply the township's growing needs. A loan proposal was put forward, which, although more costly - £20,000 - was approved, perhaps because it offered an improvement in both supply and quality.

A competition was launched for the design of a suitable water supply scheme and eventually a contract was awarded to the experienced Hamilton firm of Coates & Metcalfe. The successful scheme design was simple and elegant. All that was needed was some means of regulating the flow and a way of trapping the water and conveying it to the town. A 4m intake weir was to be constructed on the streambed to do the former. Eleven kilometres of 225mm pipes between Turitea and the town and a network of 25mm and 100mm pipes around the town centre would do the latter. There would be a storage reservoir on Fitzherbert Hill.

The original intake weir on the Turitea Stream, constructed in 1889.

Photo circa 1905

This scheme would deliver 1300 cubic metres (300,000 gals) of water per day, compared with over 35,000 cubic metres (7.7 million gals) today. The catchment area was mainly owned by the Crown and the Council was able to purchase the land for the pipelines, reservoir and weir from the Wellington and Manawatu Railway Company and local farmers. Work was begun in 1888 and the official opening of the new waterworks was celebrated on 12th August 1889 with a grand civic luncheon and a display by the Fire Brigade.

Once a regular supply of water was available the Council could proceed with providing such health amenities as sewers and public toilets. Householders could install waterclosets. Connection to the sewer was compulsory for those living along the streets serviced by the pipes, although it was 1952 before the network became completed throughout the city and the night-soil collector could cease to operate.

The town continued to grow. Between 1889 and 1904 the population doubled, but no increase was made to the size of the pipes supplying the Fitzherbert Hill reservoir. Consequently it was unable to obtain or store sufficient water to meet peak demands. Eventually the Council resorted to shutting off the supply at night during the summer months.

This dangerous practice nearly led to a tragedy in January 1904, when the Clarendon Hotel in Rangitikei Street caught fire. Fortunately no lives were lost but, with no water to fight the fire, the hotel and a block of adjacent shops were destroyed. Upgrading of the water supply was long overdue when the new Borough Engineer, Samuel Jickell, arrived to take up his appointment in 1904.

The original weir overflowing in 1911

He immediately set out to improve the water supply. His proposal for a 15m dam holding 90,000 cubic metres (20 million gals) of water, was comprehensive, long-term and inevitably expensive. It had the support of the Council, but in a February 1905 loan poll to raise £56,000, the proposal was rejected by ratepayers. A more gradual expansion was undertaken after a loan of £26,000 was approved later that year to finance a 7m dam containing 4,500 cubic metres (1 million gals), and the construction of 43km of new water mains varying in size between 100mm and 375mm. The pipe laying was done by local contractors, but the dam construction was undertaken by the Council, using day labour.

Mr Jickell selected a site for the dam a short distance downstream from the 1889 weir. There was a massive boulder at this point and, rather than try to shift it or destroy it, he built the dam on top of it.

Samuel Jickell

The Second Dam on the Turitea Stream in 1907. Samuel Jickell stands (on the left) atop his new dam. Note the fish ladder bywash.

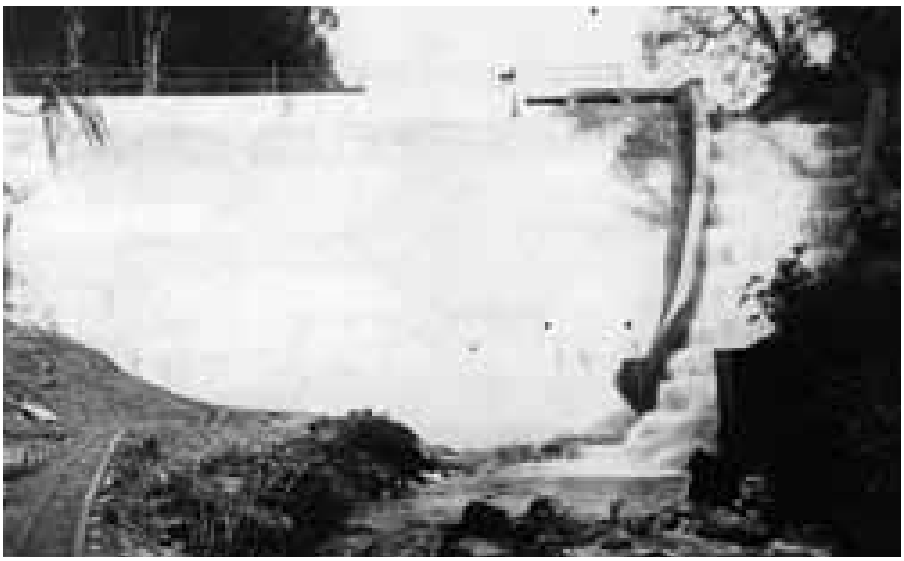
The dam was made of a mass of concrete forming a straight bar across the stream, with a bywash at the side of the dam rather than a spillway over the centre. This bywash rose in 2m steps from the streambed, with 600mm hollows in the top of each step to allow fish,

swimming upstream to spawn, to get above the dam. The structure was benched, rather like upside-down weatherboarding, to allow for future expansion. The stream was diverted through a wooden channel during construction.

Work proceeded well, in spite of a cement shortage, a rise in labourers' pay from 5 shillings to 9 shillings per day and, in January 1907, the biggest flood on the Turitea Stream for twenty-one years. Damage was slight and on August 1907, just ten months after work had begun, the Mayor, Mr Cohen, turned on the new water supply. Water pressure was significantly better at 545k Pa (79 psi), reaching 900kPA (130 psi) after the scheme was fully commissioned. The dam was intended to supply a population of 10,239.

The official opening of this stage was delayed by bad weather. Plans to get the Prime Minister to open the works also fell through, but on 2nd March 1909 the new Mayor, Mr J A Nash, revived the annual Council outing, combining a picnic along the beautiful, bush-surrounded Turitea Stream, with the long deferred ceremony.

The money to complete the next stage of Samuel Jickell's proposal was raised in several small loans over the next few years. By 1911 funds were available for raising the dam to its full height of 15m. Farmers living adjacent to the stream, worried that the flow might cease at certain times, sent a deputation to the Council to express their concern. It was decided to allow them to be connected to the town waterworks as compensation.



Opening Day 1913. In 1912, the second dam (built in 1907) was raised in height.

The work of raising the height of the dam proceeded smoothly throughout 1912. One reason for this was an ingenious tramway devised by Mr Jickell, with one line leading to the top of the dam and the other to the bottom. All the sand, gravel, cement and other materials were carried in horse-drawn skips along this line. The addition to the dam was tied to the original structure by iron rails, each weighing 7 kilos/m. The by wash was also extended to 15m.

The raised second dam from the upstream side. Photo circa 1913.

The new dam was officially opened on 17th February 1913. The original weir was now submerged under ten feet of water and the capacity of the dam increased to 140,000 cubic metres (33 million gals). It was supposed to be able to maintain enough water to supply the town's needs for up to 2-3 months of drought. The Evening Standard proclaimed, "The fear of water shortage will now be a thing of the past, for yesterday's ceremony has officially given Palmerston one of the most copious supplies in the Dominion".

The filter plant was opened later that year. Work on it had begun at the same time as work on the dam, but there had been delays in the delivery of the six mechanical filters needed. Then, when they finally arrived from England, there were no day labourers available and the firm of S Luke and Co. was contracted to install them.

Water from the Turitea watershed has always been of a very good chemical quality. The land is a reserve and predominantly covered in native bush. It is carefully managed to avoid pollution from livestock, people or fertilisers, while the bush structure helps reduce erosion and the silting up of reservoirs. The exception is a small area of private farmland, which feeds a tributary of the Turitea.

The commissioning of this mechanical filter plant in April 1913 coincided with the completion of stage two of the lower dam. This building still stands today.

Despite its purity, the water has a natural taste and brownish tint due to soil leachates, tannins and algae. Before the filter plant was built, a high proportion of complaints to the council concerned water colour and taste. The old filter shed still stands (privately owned) about 1.7 km downstream of the low dam on Turitea Road and the adjacent house, once occupied by treatment plant operators is also in private ownership.

Palmerston North continued to grow. Immediately after the First World War, there was significant population increase in population from 12,829 in 1916, to 15,649 five years later. Although Jickell's scheme aimed to supply 340 ltrs per head per day, slightly more than the national average the quantity being used was nearer 450 litres/head. Water pressure was dropping as low as 180kPA (26 psi) by 1921. This meant that almost as soon as the new supply was finished, the people of Palmerston North began seeking ways to augment it. Between 1921 and 1952 the major topic of debate in the Council Chamber was the water supply.

The filter plant was the real bottleneck. Over a twenty-four hour period it could filter the town's needs for that time, but the demand was uneven and the amount of water the plant could deal with in one hour was limited. The Fitzherbert Hill reservoir provided a holding tank for treated water, a useful reserve for periods of peak demand, but it was not really large enough to ease the situation and the filter plant was operating on overload much of the time. Although a loan had been raised in 1917 to purchase another eight filters from Bell Brothers in England, to supplement the six already operating, it was 1929 before these were installed.

John Hughes

A detailed investigation made in 1923 by the Borough Engineer, John Hughes and a consulting engineer, H F Toogood, showed that the Turitea Stream could provide ample water for many years to come if it could be stored. In a report to the Council in 1924 they proposed a scheme to upgrade the town's water supply to cater for 25 years growth and a population of 28,000 people. The scheme envisaged a new dam on the Turitea, a new pipeline to the town and large feeder mains in the principal streets as well as the additional filters.

Unfortunately the ratepayers remained unconvinced by the reports of the experts and the Council found it impossible to secure approval to raise the necessary finance. Loan proposals were rejected by the ratepayers in 1924, 1925 and again in 1928. The Council was forced to adopt a less expensive scheme whereby in 1930 an artesian bore was sunk in Heretaunga Street, with water being delivered into an adjacent concrete reservoir and then pumped into the mains. By 1932 the flow from the bore had decreased by over 50 percent and a second bore was sunk adjacent to the first, but by 1934 the flow from this well had also reduced.

The first successful artesian bore sunk for the Council, Heretaunga Street, 1930.

During the long summer of 1934-35, one of the driest on record, severe water restrictions had to be imposed. The 1924 proposal was dusted off, recosted, but again failed to get ratepayers approval. Instead, during 1936-37, a further well was sunk in Vogel Street and the pipeline

between the Turitea Dam and the town was enlarged. The Heretaunga and Vogel Street artesian bores could supply a quarter of the quantity of water supplied by the dam and provided good service until they were closed off in 1964.

Yet another period of severe water shortage was experienced in the summer of 1943-44, when the level of the lake at Turitea fell 3.5m below the bywash of the dam and the Council had to hastily sink a soak well on the south bank of the Manawatu River, near the Fizherbert Bridge. This well had a useful capacity of 4,500 cubic metres (1,000,000 gals) per day, but the only way of getting the required pressure from the river was by pumping.

It might seem odd that when the early settlers were looking for municipal water supply, the Manawatu River was not seen as a suitable source. However the quality of the water was not good, for when the river was in flood the water became so choked with silt that it was unusable. Because of this contamination, the water from the riverbank soak well had to be carefully chlorinated.

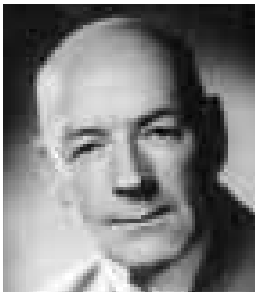
In spite of this, several Councillors were in favour of developing further soak wells. After considerable debate, a panel of three consulting engineers from Wellington was engaged to make an extensive investigation of the city's water supply. In 1945 Messrs. H Vickerman, R A Campbell and F M Corkill presented a detailed report of their findings to the Council, stating that the most economic way of obtaining an adequate water supply for the next 30 years was by upgrading the Turitea scheme to include the construction of a new dam, a new filtration plant and the laying of a new pipeline into the city. Artesian bores and soak wells were considered to be inadequate and uneconomic for the main source of supply, while the development of the Kahuterawa Stream and the Pohangina River would be too costly.

After months of debate, the Council proposed to raise a loan of £92,000 to finance the first stage of the upgrading. However, when the loan poll was held in February 1947, vigorous opposition by supporters of the soak well scheme resulted in the proposal being rejected. During the following year the Council reaffirmed its support for the recommendations made by Vickerman, Campbell and Corkill, and

embarked on an extensive publicity campaign to inform the ratepayers of the necessity of the development and the urgency of the matter. Their efforts were rewarded in February 1949, when the ratepayers finally gave approval for the raising of two loans, the first of £100,000 for the new filtration plant and supply main and the second for £71,000 for a new dam, 23m in height.

However, the amount approved in 1949 did not allow for the rapid inflation of prices and wages in post-war New Zealand and by 1951 it was apparent that the total cost was going to be much greater than estimated. The newly-appointed City Engineer, Mr George Hogg, had the unenviable task of breaking the news to the Council - and to the ratepayers! He reported that the growth rate of the city since the end of the war was nearly three times greater than anticipated. A population of 27,410 in 1951 had been predicted; in fact it was 32,907.

Mr Hogg pulled no punches. At one public meeting he stated, "Had the ratepayers in the past authorised the various Councils to carry out the extension of the water supply headworks and distribution mains when the loan proposals were placed before them, the burden which you and your children will have to carry would have been reduced by at least £100,000. Prices and the urgency for the works are increasing every year. The longer the delay, the greater the ultimate cost."

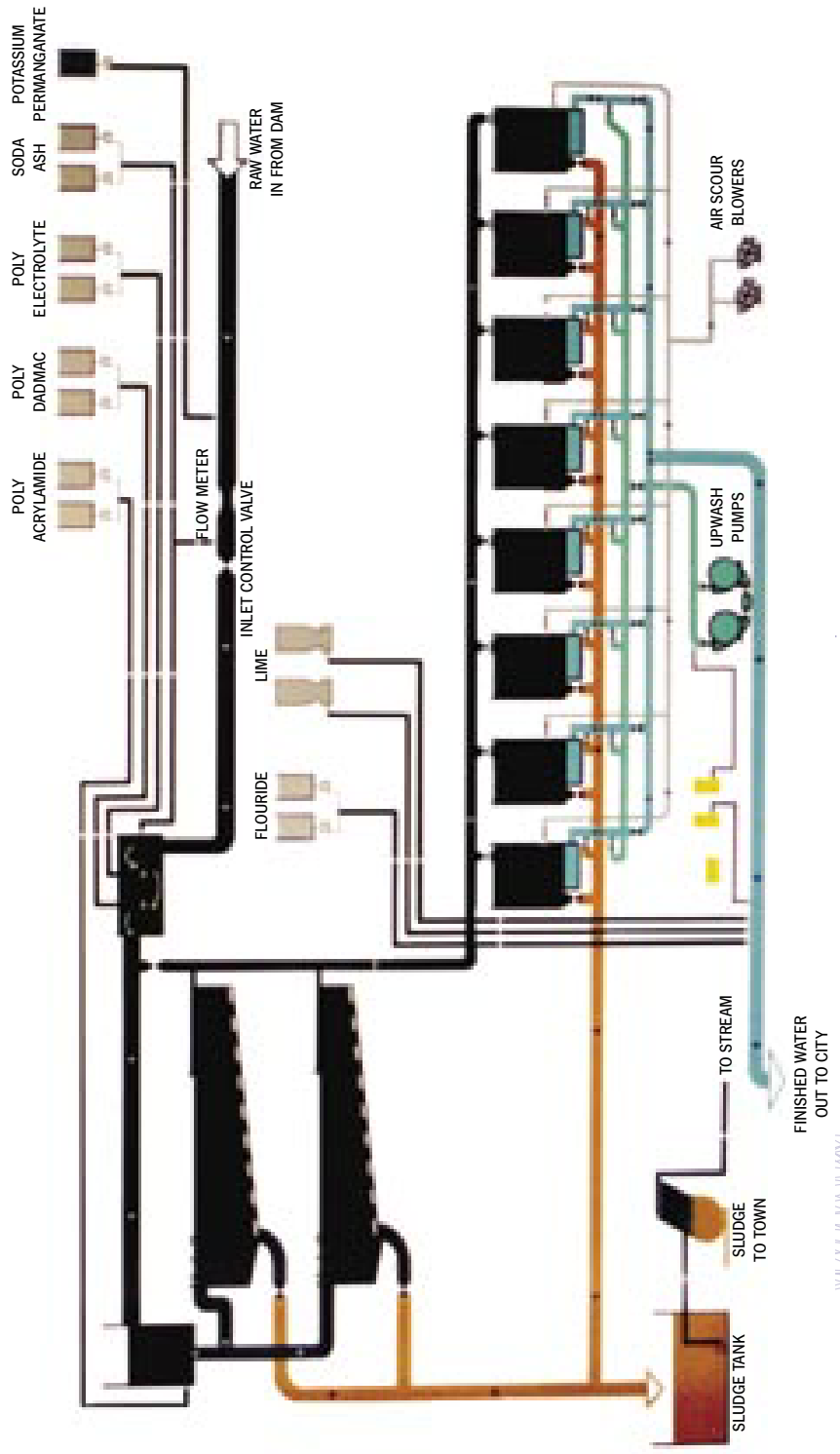


George Hogg

His warning was heeded and a further loan of £267,600 was approved in November 1952 - the largest sum of money yet raised by the Council. A 30m high dam was to be built instead of the proposed 23m dam, together with additional filters and new distribution mains to the outlying suburbs of the city. The height of the dam was the most important of these recommendations as it would increase the storage capacity from 635,000 cubic metres (140 million gals) to 1,680,000 cubic metres (370 million gals). Just as the top half of a bowl holds more than the lower half, so the increased height of the dam gave it a significantly greater capacity.

In 1951 work began on replacing the old cast iron pipeline to the city with new 525mm steel pipes. Approximately 6.6 km had already been

completed between Palmerston North and Kilsby's Bridge, near Hart's Road, to Turitea.



Flow Diagram of the water treatment process at Turitea.

A site was cleared for a new water treatment plant, and construction began in 1951. The old-fashioned pressure filters, capable of handling only 9000 cubic metres (two million gals) of water per day, were replaced by six modern filters of the rapid sand gravity type, capable of filtering over 22,000 cubic metres (five million gals) per day. These filters, combined with a new coagulating plant and a series of settling tanks, successfully eliminated the discolouration of the city's water.

This weir was built in 1953 as an intake for pumping water to five 4500 litre tanks used for gravity water supply.

In 1953, with the water treatment plant completed and the 525mm main in place, the Council was able to start work on the 30m dam. The Council advertised widely offering a bonus if the work was done on time. Unfortunately, even the cheapest tender was £30,000 more than the Council's estimate so, in spite of a public outcry, it was decided that the Engineers' Department should do the work.

Location or Map Refs	NZMS 260 T24 367 827
Nearest City	Palmerston North
River	Turitea
Purpose	Water Supply
Catchment area sq km	23
Years of construction	1953-1956
Type and Foundation	Arched, rock
Height and Crest length m	39 x 85
Volume of dam cu metres x 1000	9.12
Spillway type	Uncontrolled
Spillway max. discharge capacity cumecs	140
Reservoir capacity cu metres x 1000	1682
Reservoir area sq metres x 1000	120
Owner	Palmerston North City Corporation
Engineering by	Palmerston North City Corporation
Construction by	Palmerston North City Corporation

Work began on the dam in September 1953, but it was 1957 before construction was completed, at a net cost of £302,000 - four years dogged with frustrations.

The new dam site September 1953.

The present upper dam was completed here in 1957.

The terrain had been closely examined by geologists and the rock drilled to ascertain what lay below the surface. Everything seemed fine until the actual excavation began when Mr Hogg and his engineers found that under the surface much of the rock was fractured and unstable. Further extensive grouting - forcing cement into the fissures in the rock - was essential before the rock could support a dam. Whole rock faces had to be peeled away and replaced by concrete. The foundations had to be sunk much deeper than anticipated, while the shattered and cracked nature of the rock made rock falls a constant danger. On the southern side particularly, where the fissures were less easily detectable, a geologist often had to be called to determine whether the work was safe.

Long spells of wet weather, when no work could be done, added to the delays and the rain further weakened the rock structure by penetrating the fissures. Pieces would crash into the valley at the slightest provocation. Amazingly, there were no serious accidents. On one occasion, even after a rock-face had been scaled back as far as was practicable, 400 cubic metres of rock crashed down - just before the men started work for the day.

The upper dam under construction September 1954.

A monorail system was built to assist in the construction

The cost of many thousands of extra man-hours and thousands of cubic metres of extra concrete began to mount. By 1955 the Council had run out of funds and had to raise a further £125,000. A private contractor would have faced the same problems, but all the same it was an embarrassing situation for the Council.

Work on the massive project proceeded. A camp had to be built, complete with cookhouse, for the day labourers, as well as huts, equipment stores and unloading depots. Toilets were built beside the tributary, which soon became known as Shithouse Creek. Cement was mixed in a tall tower - the batching plant - the ingredients going in at the top and mixing as they worked their way down.

The batching plant and buildings, upper dam construction 1954.

The upper dam progresses June 1955.

An elevator system moved concrete skips from the monorail to the top of the dam.

Sections of railway track were used to construct a monorail with two separate tracks running from the cement plant to a huge girder gantry, 45m tall - well above the rim of the dam. The gantry lifted the railway trucks from the ground to another short monorail on top of the level then under construction.

The dam was formed in wide bands of concrete squares separated by narrow vertical strips. These strips were the cooling slots; left to allow the heat to escape as the concrete cured. The slots also allowed the stream to pass through the dam, so the water only had to be diverted in the final stages while the cooling slots were filled in. The dam is 73m wide and has a spillway at 30m high. It is a variable radius arch structure, its strength lying in its curved shape rather than in the thickness of the concrete.

The upper dam nearing completion 1956.

The Upper Turitea Dam began overflowing in August 1957. For almost the first time in its history, Palmerston North had a water supply sufficient for its needs. The dam stands today as one of the most impressive achievements of municipal engineering in the Manawatu.

The upper dam in the 1990's.

The upper and lower dams remain in use today. Water for the treatment plant is drawn from the lower dam, which is kept full at all times. During winter the normal flow of the stream accomplishes this, while in the summer months water is automatically drawn from the upper dam to meet the extra demand.

Over the years, the treatment plant has undergone some renovations, but the water treatment process remains largely unchanged. The colour removal process occurs in the four settling tanks and particle removal in the eight rapid gravity sand filters. These processes are followed by pH control, fluoridation and chlorination before the treated water enters the 330km network of pipes in the city.

To assist areas in the city where pressure might be low, there are four artesian bores. The original bores in Heretaunga Street and Vogel Street were retired when the new dam came into service, but were kept in running order in case of emergency. In 1964 a new bore was sunk at Papaioea Park, on Featherston Street, and another at Takaro Park, on Botanical Road in 1965. These are operated by pressure or flow control, triggered when mains pressure falls below a pre-set level. A third bore was sunk on Roberts line in 1986 to service the Kelvin Grove area. The fourth bore was constructed at Keith Street adjacent to the Electropower Building.

Following 25 years of service and at least one major overhaul, the bore at Papaioea Park was replaced in 2001. The new bore was sunk adjacent to the existing bore to a depth of 347m, tapping into what is known as the very deep confined aquifer. At the time of commissioning, this new bore was the deepest in the Manawatu and had a positive artesian head of 44m.

In 1975 two 4500 cubic metres (1,000,000 gals) low level storage tanks were built 3km downstream from the treatment plant. These have proved their worth on two occasions. The first was in May 1977 when a boulder fell off the cliff during a storm and struck one of the pipes, causing a leak, which was not discovered until the next day.

The Roberts Line bore pumping station. Photo circa 1990

The second occasion occurred in 1991, when a connection blew out of the mains supply pipe to the water treatment plant. The water flow was stopped and the break repaired. The engineers were carefully feeding water back into the main when suddenly they lost all pressure. They discovered water pouring out of one of the pipes at the bottom of the hill from the treatment plant. Again the water was shut off and a steel tourniquet applied, but when the water was turned on again another part of the pipe blew, this time at the foot of the lower dam. A 20m fountain spouted into the air and within a few minutes the lower dam had been emptied. The city lost its entire water supply from Turitea and had to rely on the artesian wells, which worked overtime meeting the demand. The resulting increase in pressure caused a number of burst mains in the city.

The original water treatment plant supply pipe gives up, January 1991.

In 1978 a pressure-boosting pump station was installed on Summerhill Drive and another in 1989 near the site of the old Fitzherbert Hill reservoir. These pumping stations differ from bores in that they do not draw on a water supply of their own, but boost the water pressure of the existing supply.

Since most of Palmerston North's water is piped across the Manawatu River, the safety of the bridge, which carries the pipe, has always been of concern to the Council. The opening of the new Fitzherbert Bridge in 1987, makes a break in the supply at that point much less likely. Not only is the new bridge stronger than the previous structure, but flexible expansion joints made of reinforced rubber between the pipes allow for seismic movement.

The improvements made to the bulk water supply also improved the available pressure within the city. This high pressure, especially at night also caused problems with pipe bursts and high leakage rates in the network. To reduce or eliminate these problems a new pressure management station consisting of 3 pressure-reducing valves (PRV's) was constructed in 2002. This Pressure Management System also incorporated a booster pump so that water could be fed back to the Ngahere reservoirs if the need arose, without over-pressurising the city reticulation.

Thanks to the building of the upper dam and the new treatment plant, the quality of the water is equal to the best in the world. Under the

national standards for water supply, which grade both facilities and water quality, Turitea has an AA grading.

The construction of the seecond Ngahere Park Reservoir, 1998

Construction of the second Ashhurst Reservoir, 1990.

Over the past ten years the plant has continued to make upgrades to maintain the water and safety standards. In 1992 core samples were taken from the lower dam, as there were few construction records- The samples assessed the strength of the concrete and the foundations between the 1908 and 1913 structure. The stability was found to be unsatisfactory, but not hazardous.

In 1996 modifications began to prolong the life of the lower dam. Putting new on top of old was seen as a brilliant way of solving the dam's stability issues and remaining within budget. Contractors worked twenty-four hours a day without interrupting the cities water supply.

The modifications took around two years to complete, as the dam was found to be potentially more dangerous than first thought due to rotten and unstable rock in the area. It was officially opened by Mayor Paul Rieger on 1 February 1997. He described the dam's history as 'dogged by controversy and penny pinching' as many at the time saw it as an 'expensive pile of rock-fill'.

Begining the second enlargement of the lower dam, May 1995.

The dam shifted from a concrete wedge to a concrete faced rock-fill structure, the first for a New Zealand site. This innovative design has often been labelled the 'cake' structure, as the concrete wedge constitutes the icing and the rock-fill the cake inside. 37,000 cubic metres (19 tonnes) of concrete grout and 900 cubic metres of concrete were sorted, graded and recycled for the walls and spillway faces. The amount of rock and earth excavated was enough to fill the council civic administration building.

Opening Day; the lower dam's second enlargement completed in 1998.

The new concrete platform extends at a 30° angle from the top of the old dam to a height of 140.5 metres, an extension of the previous 137.5 metres. The extra height has increased pressures through the water treatment plant removing the need for year round pumping.

The lower dam spillway.

The first weir built on the Turitea stream was four metres high and its aim was to supply 1300 cubic metres of water a day to the town. Today the plants capacity is 35,000 cubic metres per day. In 1889 the city only needed 1,363,800 litres (300,000 gallons), as compared to today's average daily needs of 28,800 cubic metres. The increased height doubled the storage capacity of the old dam, giving the city another week's water supply. During summer when the demand for water is high, water is automatically drawn from the main dam to keep the lower dam full. A continual residual flow of 25 litres/sec must be maintained below the bottom dam.

In 1999 Mainzeal were commissioned to undertake substantial upgrades to the Treatment Plant (originally constructed in 1953). Most of the plant functions are now automated, however human input is required to clean and calibrate equipment, as well as replenish chemical stocks. A continual supply is now ensured through only one eight hour shift per day. The treatment plant now provides greater protection against harmful protozoans such as Cryptosporidium and Giardia. Although these diseases have never been present in the past, this will further ensure an outbreak does not occur in the future.

This allows the plant to maintain its current AA water grading, Turitea now produces water quality equal to the best conventional plants in the world with final water turbidity typically 0.04 Turbidity Units (Standards are 0.1). As one of her first official duties as Health Minister, Annette King officially recommissioned the Treatment Plant after its four year upgrade on 24 February 2000. She was presented with a bottle of the AA rated water by the then City Manager, Michael Willis.

The Turitea water treatment plant after its upgrade in 1999.

This upgrade was one of a number of major projects undertaken by the PNCC. Another of these was the commissioning of the Keith Street artesian bore in October 1999, which provided a 25 percent increase in our source capacity. The bores are between 300 mm and 450 mm in diameter and are up to 350 metres deep. The quality of the water is excellent, the only treatment required being chlorination to neutralise hydrogen sulphide that is present naturally. For the 2002/03 year these pumps provided about 59 percent of the City's supply. Subsequent testing of the Keith Street bore has proved that the water is in the region of 4,000 - 6,000 years old.

In 1998 the PNCC commissioned the construction of a new reservoir in Ngahere Park alongside the existing one. The new reservoir has a capacity of 6,000 cubic metres and increased the city's treated water storage by 66 percent. This storage helps provide additional water for peak demand, as well as emergency situations. A total of 15 million litres of treated water storage is now available.

In the same year six kilometres of cast iron mains that were laid at the turn of the century were re-lined. The 472 km of distribution system conveying the water from the Treatment Plant to the customers consists of the 525 mm diameter pipeline originally laid in 1951 and a new 600 mm diameter MPVC pipe laid in 2001/2002 which branch out into smaller mains of 375 mm, 300 mm and 225 mm diameters. The service mains in most streets are 100 mm in diameter and a network of these connect with the larger feeder mains.

All of these projects originated from a comprehensive water supply development plan produced in 1995 and reviewed in 2001. The most recent project undertaken is the completion of the mini-hydro power station at the base of the upper Turitea Dam.

The powerhouse below the upper dam. June 2002. Photo Phil Burt

The hydro power station cost $209,000 to complete and was funded by the CentralPower Electricity Trust. The construction involved the installation of modified water pumps which operate in reverse as turbines generating up to 200 kilowatts of power. The turbines power

conventional electric motors which act as induction generators. Water that would otherwise spill over the dam is diverted to drive the power station. The mini-hydro power station was designed to make the Turitea complex self sufficient in electricity useage. This in turn lowers water supply costs to the community and pumps an estimated 1.2GWh of electricity a year back into the power supply network; enough to power 100 homes.

Mayor Jill White officially opened the station on 2 October 2001 after Civil Defence Team Leader Jock Robinson abseiled 30 metres down the dam's face with some of the water. Ms White was the first to power the station by turning four keys and pressing four buttons. A model demonstrating how the power station worked was also on display.

The water supply is under tight security. The council's laboratory maintains a close check on the water quality of all five sources. Samples are collected daily and their quality tested. There are also some less obvious measures taken, such as the special requirements created for people issued with hunting permits. If they travel overseas and return with a notifiable disease their hunting privileges are revoked to protect the water supply.

The road entrance to the water reserve. Photo circa 1990.

The water reserve also has biological conservation values, as it is the home of some of New Zealand's rarer native birds, such as the Dabchick, Scaup, Kaka, Kakariki and the Whitehead. These birds have been spotted on several recent occasions.

In the last hundred years Palmerston North has grown from a clearing in the bush to a thriving city and its water supply from a simple weir on the Turitea Stream to a complex system providing pure, safe water to its citizens. It is a success story that pays tribute to the work of men like J.P. Armstrong, Samuel Jickell, John Hughes and George Hogg and to the achievements of the Council.

The upper dam in full flow.

TURITEA OR TIRITEA?

The correct spelling is TURITEA (turi = water, tea = bright or clear), an apt description of the quality of the water in the stream. However, during the 1880's the Palmerston North Borough Council misspelled the name and the incorrect version (Tiritea) passed into common useage. In 1991 the matter of the correct spelling having been raised by the Tangatawhenua, the PN City Council requested that the correct spelling be restored by the New Zealand Geographic Board - the Government agency responsible for determining the official spelling and location of place names.

The lower dam in flood, August 1988.

SOURCES

Minute books, report books and correspondence files of Palmerston North Borough Council (1877-1930) and Palmerston North City Council (1930-1990) held in the City Archive.

Newspaper files (Manawatu Daily Times and Manawatu Evening Standard) held in the Public Library.

Unpublished manuscripts on "The Water Supply of Palmerston North" and "Sewage Disposal in Palmerston North" by IR Matheson (1977) held in the City Archive.

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