

IPENZ Engineering Heritage Register Report

Korokoro Stream Dams, Lower Hutt

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Date: 19 March 2014



Korokoro Dam, Belmont Regional Park, Wellington. Karen Astwood (IPENZ), 28 August 2013.

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A. General information

Name: Korokoro Stream Dams

Alternative names: Corporation Dam; Former Wellington Woollen Mill Manufacturing Company Dam; Korokoro Stream Dam; Koro Koro Dam; Korokoro Dam; Lower Korokoro Stream Dam; Petone Borough Waterworks Dam; Petone Woollen Mill Dam; Upper Korokoro Stream Dam

Location:

Belmont Regional Park
Korokoro and Maungaraki
Lower Hutt

Geo-reference:

Former Wellington Woollen Manufacturing Company Dam

Latitude -41.212, Longitude 174.860

Korokoro Dam

Latitude -41.197, Longitude 174.874

Legal description:

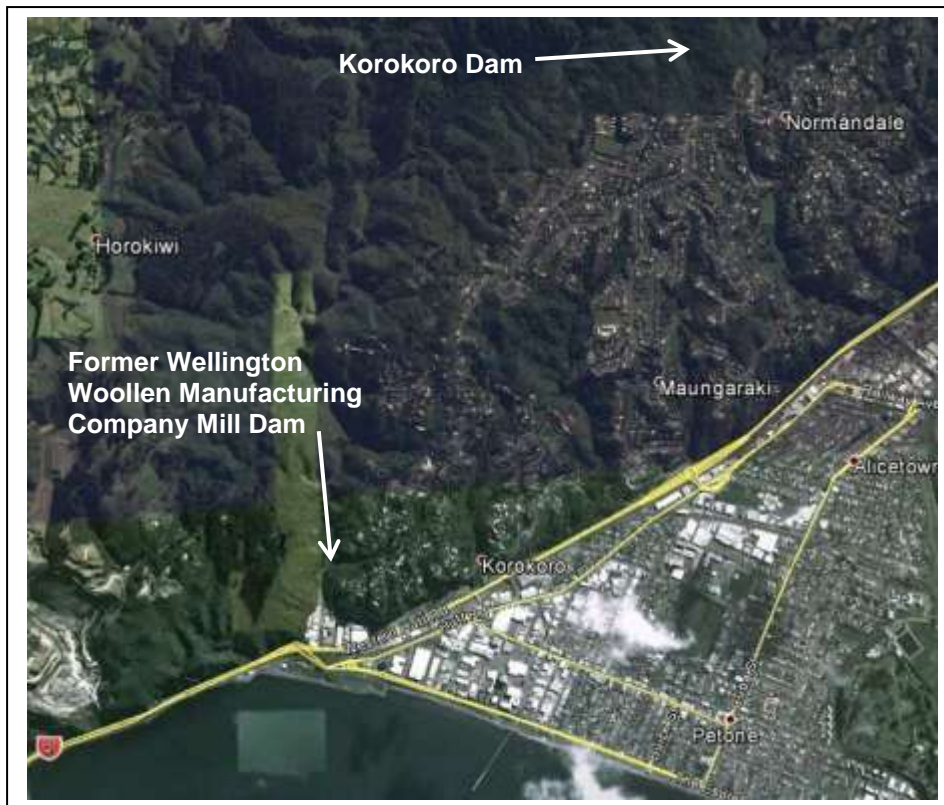
Former Wellington Woollen Manufacturing Company Dam

Pt Sec 78 (CTs WN911/42, WN148/438), Wellington Land District

Korokoro Dam

Secs 1, 4, 5, 7, 8B, 29, 39 and Pt Secs 3, 8A Maungaraki (CT WN45D/380), Wellington Land District

Access information and location maps:



Former Wellington Woollen Manufacturing Company Dam

The closest Belmont Regional Park entrance to the Former Wellington Woollen Manufacturing Company Dam is at the west end of Cornish Street, Korokoro. A return walk from the carpark takes approximately 30 minutes.



Korokoro Dam

The closest Belmont Regional Park entrance to the Korokoro Dam is at the corner of Oakleigh Street and Maungaraki Road, Maungaraki, and it takes approximately one hour to complete a return walk to the dam along the signposted track. From the Cornish Street entrance a return walk to the dam is approximately three hours.



Maps courtesy of Google Maps

City/District Council: Hutt City Council

IPENZ category: Engineering Work

IPENZ subcategory: Infrastructure

IPENZ Engineering Heritage number: 105

Date registered: 13 May 2014

Other IPENZ recognition: N/A

Other heritage recognition:

- *Local Authority District Plan:* [Korokoro Dam] Hutt District Plan, operative (updated 1 November 2005). Heritage Buildings and Structures, Appendix Heritage 2, Map no. R3

B. Description

Summary

The Korokoro Stream Dams in Belmont Regional Park, Lower Hutt, include the Korokoro Dam, a 1903 public waterworks structure; and downstream the Wellington Woollen Manufacturing Company Dam (1904), which provided water for their mill's manufacturing processes. Designed by Petone Borough Engineer, Samuel Jickell (1856–1939), these are New Zealand's earliest mass concrete gravity dams.

In the 1890s and early 1900s the Petone Borough Council explored establishing a water supply system sufficient in quality and quantity to meet the household, sanitary and fire fighting demands of the local population. The Petone Borough Council determined to proceed with tapping into the Korokoro Stream as their water source after numerous engineering reports and an aborted collaboration with Hutt Borough Council using the Belmont Stream. However, the Wellington Woollen Mill Manufacturing Company, whose mill was located near the stream mouth, took legal action against the Council over riparian rights. After several years the Council eventually succeeded in initiating a waterworks scheme, including constructing the Korokoro Dam, but had to compensate the mill by constructing a dam downstream for them too. Both dams were decommissioned by the late 20th century. The woollen mill was demolished in the early 1970s. The dams provide points of historic interest in the Belmont Regional Park, created in 1989.

The upper and lower Korokoro Stream Dams were completed in December 1903 and June 1904 respectively. These are relatively small dams, the Korokoro Dam being eight metres (m) high and the mill's former dam is six m high. Each has an uncontrolled chute spillway, with the Korokoro Dam's being curved and stepped. The first in a series of early 20th century mass concrete gravity dams, the Korokoro Stream Dams have a high level of original integrity compared with other contemporary dams of this type.

As New Zealand's first mass concrete gravity dams, the Korokoro Stream Dams have special engineering significance, marking an important transition in dam technology and construction. The Korokoro Stream Dams were designed by, and constructed under the supervision of, notable engineer Samuel Jickell, who pioneered New Zealand mass concrete dam construction and later was the foundation President of the Institute of Local Government Engineers of New Zealand.

Historical narrative

The need to provide a piped water supply to growing urban populations was an objective of many town boards and councils throughout New Zealand during the mid to late 19th century. For the small borough of Petone, located on the northern side of Wellington Harbour, the issue of supplying and removing water was a problem. Although Petone was conveniently situated to take advantage of the Hutt artesian aquifer it proved unsatisfactory for the purposes of fire fighting and flushing drainage systems. This matter was highlighted by the *Evening Post* in 1900, concluding that “[no] attempt has been made to provide permanent water supply, and the absence of a reticulation scheme is felt to be a serious drawback to the health and comfort of the community”.¹

However, the Council had been considering the issue for many years. On 5 July 1888 Petone Borough was formally established and the first matter the new Council considered was the water supply issue. The Council proposed taking a £10,000 loan for this, but ratepayers were against it believing the artesian water supply was adequate.² Over the following decade, the Petone Borough Council continued to try and initiate water supply schemes, including a joint venture with the Lower Hutt Borough Council using the Belmont Stream as its source. The unsupportive stance of local ratepayers meant that earnest water supply planning stagnated for several years.³ This attitude, however, changed on 10 June 1900 when a disastrous fire occurred at the corner of Petone’s Victoria and Jackson Streets. The inferno destroyed the Victoria Hotel and six other buildings, causing £7,000 in losses and damage.⁴ At a meeting of the Petone Borough Council the following day, the Mayor addressed the Council at some length on the need of establishing the municipal waterworks.⁵

Three months later it seemed that progress was being made with a Petone and Lower Hutt Borough joint venture, but disagreements meant Petone decided to proceed alone.⁶ The matter of financing a Belmont Stream water supply scheme was not raised until April 1901 when the Petone Borough Council conducted a ratepayers’

¹ ‘The Sanitary Conditions of Petone,’ *Evening Post*, 6 February 1900, 7.

² Susan Butterworth, *Petone: A history* (Petone: Petone Borough Council, 1988), 106.

³ William Brinsley Nicholson (ed.), *Petone’s First Hundred Years: A historical record of Petone’s progress from 1840 to 1940* (Wellington: L T Watkins, 1940), 68. URL: <http://mebooks.co.nz/clients/library.huttcity/text/Petone100/t1-front-d3-d1.html> (accessed 13 January 2014).

⁴ *Evening Post*, 11 June 1900, 5.

⁵ *Evening Post*, 12 June 1900, 2; Butterworth, *Petone: A history*, 131.

⁶ *Evening Post*, 17 October 1900, 5.

poll about raising a sizeable loan of £23,500.⁷ The majority of ratepayers now supported it, but some Councillors persisted in promoting the Korokoro Stream for the waterworks.⁸ Division over a water supply source meant the Council continued to conduct site visits to the Belmont and Korokoro Streams and a number of engineering reports were commissioned in 1901.⁹ In early 1902, engineer R. R. Richmond's report, in favour of the Korokoro option, was considered by the Council.¹⁰ This was also the Borough Council Engineer Samuel Jickell's (1856–1939) preferred choice.¹¹ However, a drawback was the possibility of Wellington Woollen Manufacturing Company litigating over riparian rights. The company had established a mill near the stream mouth in 1885 and was commercially reliant on water supplied from the stream. The mill was an important local employer with approximately 200 workers.¹² Therefore, despite engineering advice the Belmont Stream option was chosen.¹³

At the beginning of 1902 planning for Petone Borough's Belmont Stream waterworks was underway.¹⁴ However, the Council then discovered that Hutt Borough had purchased the water rights.¹⁵ Consequently, the Petone Borough Council was forced to pursue the Korokoro Stream which, as anticipated, resulted in legal action by Wellington Woollen Manufacturing Company. In an extraordinary oversight, the Council failed to file its defence in time and subsequently lost the case by default.¹⁶ The company could then dictate terms.¹⁷ The importance of the water supply issue meant that the Council agree to fairly stringent conditions from the company in order to proceed with the Korokoro Stream scheme, including constructing a concrete

⁷ *Evening Post*, 12 April 1901, 4.

⁸ *Evening Post*, 15 April 1905, 5.

⁹ *Evening Post*, 31 May 1901, 6; 12 October 1901, 2.

¹⁰ 'Petone's Water Supply,' *Evening Post*, 4 February 1902, 5.

¹¹ *Evening Post*, 11 January 1902, 4.

¹² Tony Walzl, 'Belmont Regional Park History', Greater Wellington Council, 29. URL:

http://www.gw.govt.nz/assets/council-publications/Belmont_Regional_Park_History.PDF (accessed 13 January 2014). By 1940 the company employed around 900 people with nearly 350 working at the mill. Nicholson, *Petone's First Hundred Years*, 211; Brian Cross, 'The Wellington Woollen Manufacturing Company, Petone Mill,' Suite (27 September 2010), URL: <https://suite101.com/a/the-wellington-woollen-manufacturing-company-petone-mill-a290069> (accessed 21 January 2014)

¹³ 'Petone's Water Supply'.

¹⁴ *Evening Post*, 19 March 1902, 2.

¹⁵ Butterworth, *Petone: A history*, 132; Nicholson, *Petone's First Hundred Years*, 69; *Evening Post*, 6 March 1902; 19 March 1902, 2.

¹⁶ Nicholson, *Petone's First Hundred Years*, 69-70.

¹⁷ Robert E. Offer, *Walls for Water: Pioneer dam building in New Zealand* (Palmerston North: Dunmore, 1997), 45; Nicholson, *Petone's First Hundred Years*, 69.

gravity water supply dam for the company further downstream from the municipal waterworks dam (Figure 1).¹⁸



Figure 1: Former Wellington Woollen Manufacturing Company Dam, lower Korokoro Stream, 17 January 2014. K. Astwood, IPENZ.

Jickell, Petone's Borough's Engineer from 1901, designed the Korokoro Stream Dams and supervised their construction. The Borough's dam was New Zealand's first mass concrete gravity dam.¹⁹ The Wellington Woollen Manufacturing Company structure, completed in June 1904, supplied water to power the mill's machines and for scouring and dyeing fabric.²⁰ Four of the first five New Zealand dams of this type are associated with Jickell.

¹⁸ 'Petone's Water Supply,' *Evening Post*, 23 February 1904, 2.

¹⁹ Offer, *Walls for Water*, 45. At the time this book was published in 1997. Offer noted that the Korokoro Dam was, "as far as is known, New Zealand's first concrete gravity dam". A February 2014 PapersPast search by Karen Astwood for articles with the phrase 'concrete dam', from 1839 and 1903, came up with no results that contradict the statement that this was New Zealand's first mass concrete gravity dam. The search results and notes are on file at IPENZ National Office, Heritage Promotion/Item and site information/Register/Stored/Korokoro Stream Dams. 'New Zealand Dam Inventory' Department of Internal Affairs, URL: [http://www.identity-services.dia.govt.nz/Pubforms.nsf/URL/Daminventory.pdf/\\$file/Daminventory.pdf](http://www.identity-services.dia.govt.nz/Pubforms.nsf/URL/Daminventory.pdf/$file/Daminventory.pdf) (accessed 10 February 2014) was also cross-referenced, and none of the dams listed that date before the Korokoro Stream Dams are mass concrete structures. Note: the inventory only lists structures which are over 3 m high.

²⁰ 'Petone Borough Council,' *Evening Post*, 11 June 1904, 2; 'Clatter of looms to be revived,' *Hutt News*, 8 January 2013. URL: <http://www.stuff.co.nz/dominion-post/news/local-papers/hutt-news/8152261/Clatter-of-loom-to-be-revived> (accessed 21 January 2014).

Jickell was born at Stockton-on-Tees, England in 1856 and immigrated to New Zealand in 1883. Five years later he moved to Melbourne where he may have become aware of Australia's first mass concrete gravity dam, Edward Dobson's (1816–1908) Lower Stony Creek Dam (*circa* 1873) in the Brisbane Ranges, just over 100 kilometres away. Jickell returned to New Zealand within a few years, taking up the position of Nelson City Engineer in 1890.²¹ He began developing a plan for a Brook Stream concrete dam, but he left for Petone before the project was started. Jickell's successor in Nelson, John Henderson, took up the concept and a mass concrete dam was completed in 1904.²² That same year Jickell moved to Palmerston North to be their Borough Engineer after staying at Petone for only three years. Water supply was a key focus for the Palmerston North council too and he designed another mass concrete gravity dam on the Turitea Stream. Jickell continued as Palmerston North Borough Engineer until 1919, when he left to practice as a consulting engineer. This stage of his career saw his involvement in a number of projects including the construction of a road through the Manawatu Gorge, and works undertaken by the Makerua Drainage Board.²³ Jickell retired in 1931.

During his career Jickell also played an important role in the affairs of New Zealand's engineering profession. He was the foundation President of the Institute of Local Government Engineers of New Zealand in 1912, which was the genesis for the New Zealand Society of Civil Engineers (NZSCE, now IPENZ) established in 1914.²⁴ Jickell was an early member of the NZSCE's Council.²⁵ Jickell Street in Palmerston North is named after him, commemorating his services to the city and New Zealand engineering profession.²⁶

Jickell was present when the foundation stone for the Korokoro Dam was installed in April 1903 and the structure was completed in December that year.²⁷ However,

²¹ 'Our New Engineer,' *Manawatu Times*, 4 December 1903, 2. Edward Dobson, 'The Geelong Water Supply, Victoria, Australia,' *Minutes of Proceedings of the Institution of Civil Engineers, 1878-79*, 56:2 (London: Institution of Civil Engineers, 1879) 94-133; BCS Harper, 'Edward Dobson and the Mass Concrete Gravity Dam on Stony Creek for the Geelong Water Supply,' *9th National Conference on Engineering Heritage: Proceedings* (Melbourne: Institution of Engineers, Australia, Victoria Division, 1998), 97-106.

²² Offer, *Walls for Water*, 44.

²³ Peter Lowe, 'Jickell, Samuel,' *Te Ara – the Encyclopedia of New Zealand*, URL: www.teara.govt.nz/en/biographies/3j5/jickell-samuel (updated 30 October 2012).

²⁴ Offer, *Walls for Water*, 48.

²⁵ *Proceedings of the New Zealand Society of Civil Engineers* (Wellington: New Zealand Society of Civil Engineers, 1915), 65.

²⁶ Lowe, 'Jickell, Samuel'.

²⁷ *Evening Post*, 27 April 1903, 2; 'Our New Engineer'.

before the second dam was completed, Wellington Woollen Manufacturing Company took legal proceedings against the Petone Borough Council again. The Council was split over how to proceed, which caused a “Municipal Sensation” in May 1904 when five councillors resigned over the issue.²⁸ It seems that the Council had not adhered to the terms of the original agreement, leading the company to claim £317,000 for “present and prospective damage caused by interference with its water rights to the Korokoro stream...”.²⁹ In 1905, the dispute between the Petone Borough Council and the Wellington Woollen Manufacturing Company was effectively resolved through the passing of the Petone Corporation Waterworks Act. The Act formalised the original terms between the two parties and prevented any further chance of litigation.³⁰



Figure 2: Korokoro Reservoir [26 December 1912]. Godber, Albert Percy, 1875-1949: Collection of albums, prints and negatives. Ref: APG-0632-1/2-G. Alexander Turnbull Library, Wellington, New Zealand. <http://natlib.govt.nz/records/22880948>. Permission of the Alexander Turnbull Library, Wellington, New Zealand, must be obtained before any re-use of this image.

Considering the struggle to establish the Korokoro Stream water supply, the Council and residents would have hoped for an easier time from 1905 onwards. However, the Korokoro Stream supply soon proved insufficient in terms of quality or quantity.³¹ Within three years of completion, an underground settling tank was built to allow

²⁸ ‘A Municipal Sensation,’ *Auckland Star*, 11 May 1904, 3.

²⁹ *Evening Post*, 13 December 1904, 2.

³⁰ *Evening Post*, 4 July 1905, 4.

³¹ L.D. Smith, ‘History of New Zealand Public Water Supplies,’ South Pacific Water and Sewer Technology Exhibition and Conference, 1988. Quoted in Offer, *Walls for Water*, 47.

foreign matter in the stream water to filter to the bottom, allowing cleaner water to flow into the water supply.³² Another problem was that during dry periods the Council was compelled to release water from its reservoir to meet its obligation to the mill. Of course, this reduced the amount available for the municipal water supply.³³ By the end of the 1920s, the increasing population and expanding settlement of the Petone Borough placed further demands on the Korokoro Stream water supply.³⁴ The water pressure was known to decrease to such a low level that key functions, like fire fighting, could not be fulfilled. Therefore, in the late 1920s the Council considered raising the height of the dam. However, this option was found to be too costly. Over the subsequent decades the Council explored a number of alternative options including the use of artesian wells and acquiring water rights for other catchments.³⁵ Eventually they decided to pump water from the artesian supply and retain the Korokoro waterworks.³⁶

In the early 1960s, the Ministry of Health raised concerns about the quality of the Korokoro Stream water, arguing that the “Korokoro source must require chlorination and protection of [the] catchment” or be abandoned.³⁷ In January 1962, the Korokoro reservoir was closed with the *Evening Post* attributing this to “adverse reports on the water”.³⁸ However Martin Harold Ferner (b.1926) from Spencer, Hollings and Ferner, the consulting engineers to the Petone Borough Council, championed the retention of the Korokoro Dam and reservoir. He argued “[s]uch a reservoir would be of great value to the Borough to provide storage for peak demand, and summer demand for water, and to provide an emergency alternative water supply in the event of a disaster”.³⁹ Ferner’s proposed upgrade of the Korokoro Stream supply included improvements to the pipeline, the installation of a pump to increase flow, and the necessary equipment to improve the quality and sterilisation of the water. The estimated cost of these developments was between £68,800 and £80,500.⁴⁰ This proved too expensive for the Petone Borough Council and from 1963 the Council

³² Nicholson, *Petone’s First Hundred Years*, 70.

³³ Walzl, ‘Belmont Regional Park History’, 36.

³⁴ Nicholson, *Petone’s First Hundred Years*, 70.

³⁵ District Engineer to Permanent Head Public Works Department, 12 October 1928. Archives New Zealand (ANZ), ABKK 889 W4357/299 50/345 pt1 [R17300386].

³⁶ Nicholson, *Petone’s First Hundred Years*, 70; Walzl, ‘Belmont Regional Park History’, 36.

³⁷ R.H. Thomas, Petone Water Supply Proposals: Record of Visit 13.9.1961; Interview with Mr Stewart: Petone Borough Engineer, 21 August 1961. ANZ, ABKK 889 W4357 299/50/345, pt 1 [R17300386].

³⁸ ‘Restoration of Water Urged,’ *Dominion*, 14 March 1962. Hutt City Archives (HCA), City Engineers Department Files, Korokoro Catchment Area, ARCH52046 53-7-7 vol. 1, SRS-126.

³⁹ Martin Harold Ferner, Water Supply Catchment Area, 18 September 1963. HCA, ARCH52046 53-7-7 vol. 1, SRS-126.

⁴⁰ Spencer Hollings and Ferner Engineers Ltd., ‘Report on the Korokoro Water Supply and Related Matters for the Petone Council’ (4 September 1964), 3-4. HCA, ARCH52046 53-7-7 vol. 1, SRS-126.

replaced the Korokoro Stream water supply with new wells and a pumping station in Buick Street.⁴¹

Susan Butterworth wrote a history of Petone in 1988 and described the Korokoro Dam and reservoir site as “a charming picnic spot for those willing to make the effort to walk over a somewhat rough and overgrown track and much splashing through the stream to get to it”.⁴² By this time the mill had closed and its buildings demolished.⁴³ In 1989, the Belmont Regional Park was established by the Wellington Regional Council and the Korokoro Dam was highlighted as one of its historic features, with the former mill dam also included. The Korokoro Dam is a prominent feature of the Korokoro Dam and Belmont Trig Walk. Both dams are accessible to park users along a track through mature and regenerating bush following the Korokoro Stream from its lower reaches.

⁴¹ P. Cooke, ‘Our Water History On Tap: Water supply in the Wellington Region, 1867-2006,’ Greater Wellington Regional Council, URL: <http://www.gw.govt.nz/assets/Our-Environment/Water-Supply/PDFs/Our-water-history-on-tap-complete-document.pdf> (accessed 13 January 2014).

⁴² Butterworth, *Petone: A History*, 223.

⁴³ Walzl, ‘Belmont Regional Park History,’ 29-30.

Social narrative

The provision of piped water to growing urban populations and for industry was an objective of many New Zealand town boards and borough councils from the 1860s onwards, although springs and artesian wells were still thought sufficient for small populations. Before long suitable streams and rivers were exploited and dams were required to store and supply water for fire fighting, household and commercial needs.⁴⁴ By the beginning of the 20th century technical knowledge and availability of materials led to the majority of public water supply dams built in the first decade of the 20th century being concrete gravity dams, starting with the Korokoro Stream Dams, which quickly developed into larger structures.



Figure 3: Officials at the laying of the Foundation Stone for the Petone Waterworks, 25 April 1903. Godber, Albert Percy, 1875-1949: Collection of albums, prints and negatives. Ref: APG-0071-1/2-G. Alexander Turnbull Library, Wellington, New Zealand. <http://natlib.govt.nz/records/22735327>. Permission of the Alexander Turnbull Library, Wellington, New Zealand, must be obtained before any re-use of this image. Jickell is standing behind the men on the left of this image.

On 25 April 1903 dignitaries were involved in a foundation stone ceremony at the Korokoro Dam site (Figure 3). The celebrations were presided over by Petone's Mayor, Richard Mothes, in front of approximately a hundred Petone residents who made the effort to trek out to the site.⁴⁵ This interest is indicative of the anticipated significant social benefit of Petone's waterworks scheme, as were the years of

⁴⁴ Offer, *Walls for Water*, 22, 25.

⁴⁵ *Evening Post*, 27 April 1903, 2.

consistent local media coverage following the Council's attempts to get the scheme started and then tracking its progress in the early 20th century.

Decommissioned in the 1960s, the Korokoro Dam, along with the Wellington Woollen Manufacturing Company's former dam, eventually became historic features of Belmont Regional Park. Even before the park was officially opened on 2 April 1989 informal public recreational use of the land was permitted. Limited walking tracks crossed the land and these encouraged locals to use the park for camping, hunting, walking and picnicking. For example, the Korokoro Dam Walkway was one of the first tracks built in 1978.⁴⁶ With their original purposes of supplying water and facilitating industry having ceased, the Korokoro Stream Dams are recognised by Greater Wellington Regional Council as key sites of historic heritage within the park.⁴⁷

⁴⁶ Cited in Tony Walzl, 'Belmont Regional Park History,' Greater Wellington Regional Council, 48. URL: http://www.gw.govt.nz/assets/council-publications/Belmont_Regional_Park_History.PDF (accessed 14 January 2014)

⁴⁷ 'Greater Wellington Parks Network Plan,' Greater Wellington Regional Council, 50. URL: <http://www.gw.govt.nz/assets/Parks-and-Recreation/Parks-Network-Strategy/5-Belmont-Regional-Park.pdf> (accessed 27 January 2014).

Physical narrative

In New Zealand water supply dam building began early in the colonial period, using British earth and masonry dam technology. Two early examples of municipal structures were puddled clay core dams built at Ross Creek in Dunedin (1867) and Karori in Wellington (1878). Likewise, the introduction of mass concrete gravity structures in New Zealand was contemporary with British developments, but on a smaller scale.⁴⁸ Although the Korokoro Dam was the first mass concrete dam in New Zealand, concrete had been used in earlier examples. For instance, a concrete facing had been used for wave protection on the Karori dam, some partially concreted weirs and dams were constructed elsewhere in the country in the 1880s and 1890s and in 1902 a “solid concrete” weir was constructed for Whangarei’s public water supply.⁴⁹

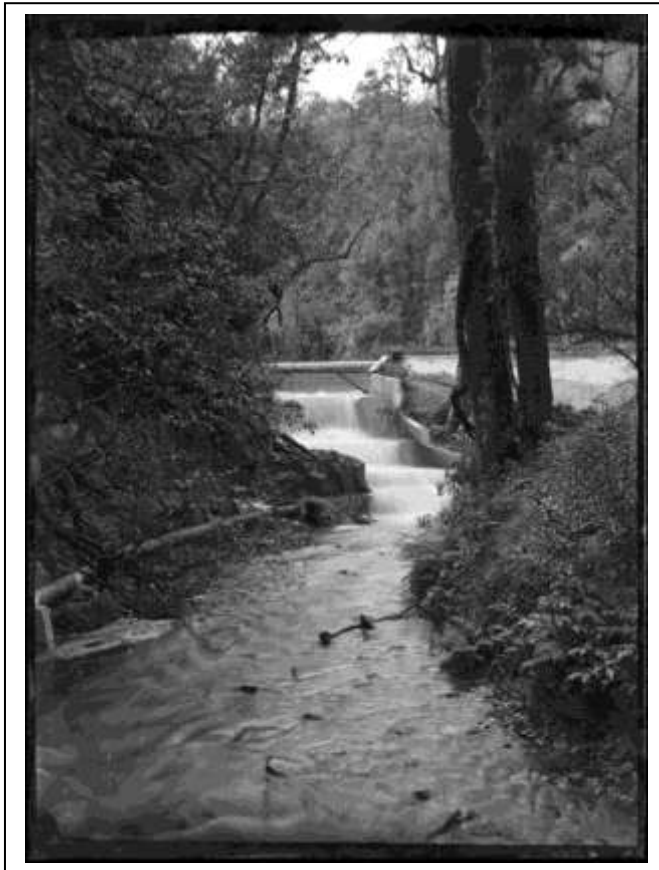


Figure 4: Korokoro Reservoir [1906]. Godber, Albert Percy, 1875-1949: Collection of albums, prints and negatives. Ref: APG-0133-1/2-G. Alexander Turnbull Library, Wellington, New Zealand. <http://natlib.govt.nz/records/22815962>. Permission of the Alexander Turnbull Library, Wellington, New Zealand, must be obtained before any re-use of this image.

⁴⁸ Offer, *Walls for Water*, 21.

⁴⁹ Walzl, 'Belmont Regional Park History,' 48; Offer, *Walls for Water*, 40; 'Korokoro Dam,' IPENZ, URL: www.ipenz.org.nz/heritage/itemdetail.cfm?itemid=105. Quote from *Northern Advocate*, 2 March 1906, 2. Pers. Comm. Jac Jenkins to Karen Astwood, 18 February 2014.

By the turn of the 20th century, use of concrete as a construction material in New Zealand was well established in buildings and structures such as graving docks and bridge piers and towers. However, it was only in the early 20th century that concrete began being widely used, especially in engineering structures. For example, Dunedin's George Street Bridge (1902–1903) was the first reinforced concrete bridge in New Zealand.⁵⁰ Contemporary with this, the Korokoro Stream Dams mark an important transition away from timber, earth and masonry dams to the use of mass concrete in dam construction. Indeed, the former Wellington Woollen Manufacturing Company Dam replaced an earlier totara structure.⁵¹ At eight m high with a crest length of 37 m, Offer refers to the Korokoro Dam as “a small beginning” in the development of New Zealand's concrete dams.⁵² Smaller still is the mill's former dam, approximately 2.5 kilometres downstream from the Korokoro Dam. This is also a mass concrete gravity dam, six m high with a crest length of 15.5 m, and was completed in June 1904.⁵³

The Korokoro Stream Dams were followed closely by the construction of two other concrete gravity dams. The Brook Stream Dam (*circa* July 1904) in Nelson is significantly larger than its counterparts, at 12 m high and 94 m long. However, it was decommissioned in 2000 and no longer has water storage capability because its spillway has been lowered significantly.⁵⁴ Another example is Richard Mestayer's (1844-1921) structure at the Okehu Stream for Whanganui, completed in late 1904.⁵⁵ Also known as the Waitahinga Dam, this structure was decommissioned in the late 1990s. Originally it was 17 m high and 10 m wide, but in 1926 a further 16 m were added to its height and it still has an associated reservoir.⁵⁶ After leaving Petone Borough Council Jickell designed the Turitea Dam (1907, enlarged 1913) for

⁵⁰ Geoffrey Thornton, *Cast in Concrete: Concrete construction in New Zealand, 1850-1939* (Auckland: Reed, 1996) 98-100.

⁵¹ Damwatch 'Safety Review of Birchville, Korokoro and Woollen Mills Dams,' Wellington Greater Regional Council (June 2006), 9. URL: <http://www.gw.govt.nz/assets/council-publications/Safetyreview%20dams%20issue%201.pdf> (accessed 19 November 2013).

⁵² Damwatch 'Safety Review of Birchville, Korokoro and Woollen Mills Dams,' 3; Quote from Offer, *Walls for Water*, 44.

⁵³ Damwatch 'Safety Review of Birchville, Korokoro and Woollen Mills Dams,' 3, 9; 'Petone Borough Council,' *Evening Post*, 11 June 1904, 2.

⁵⁴ A search of online newspapers has not provided a definitive date for the completion of the Brook Dam. However, it seems like it may have been finished in July 1904 because this is when the Nelson City Council dispensed with the services of the inspector of works. 'Nelson City Council,' *Nelson Evening Mail*, 16 July 1904, 1. 'A History of the Environs of the Brook Waimarama Wildlife Sanctuary,' Brook Waimarama Sanctuary, URL: <http://www.brooksanctuary.org.nz/about/history> (accessed 19 November 2013); Offer, *Walls for Water*, 51.

⁵⁵ Offer, *Walls for Water*, 25; 'The Okehu Water Works,' *Wanganui Chronicle*, 30 November 1904, 5.

⁵⁶ 'Waitahinga Trail Opens,' *Wanganui District Council Community Link*, 621 (May 2013). URL: <http://www.wanganui.govt.nz/news/commmlink/issue621.asp> (accessed 19 November 2013); Offer, *Walls for Water*, 56.

Palmerston North's water supply. Like the Korokoro Dam this had a stepped spillway. Partly due to financial restrictions, the Turitea Dam was smaller than the other municipal dams in this group, at seven m high. That dam is now unrecognisable having been incorporated into a concrete faced rock-filled structure in the late 1990s.⁵⁷

After this initial group of structures, New Zealand's public water supply concrete dams quickly became larger with examples such as Wellington's Upper Karori Dam (1908), Auckland's Waitakere Dam (1910) and the Morton Buttress Dam (1911) in Wainuiomata. The Korokoro Stream Dams provided a starting point for concrete dams in New Zealand, which became the predominant type for water supply and hydro-electric dams until the mid-20th century.⁵⁸



Figure 5: Korokoro Dam crest, 28 August 2013. K. Astwood, IPENZ. The foundation stone can be seen at the centre top of the image.

Korokoro Dam

The wall of the Korokoro Dam rises almost vertically from its foundations before curving in towards the top. The crest features a concreted brick coping (Figure 5). A striking feature of the Korokoro Dam's is its uncontrolled, chute type, curving

⁵⁷ This dam is also known as the Tiritea Dam. 'Turitea Water Supply,' Palmerston North City Council (April 2004), pp.3, 20-21. URL: <http://www.pncc.govt.nz/media/30185/turiteawatersupplybook.pdf> (accessed 19 November 2013); Offer, *Walls for Water*, 62.

⁵⁸ Offer, *Walls for Water*, 21-22.

stepped spillway.⁵⁹ The foundation stone is embedded at the top of the spillway's north wall. The inscription reads:

This stone was laid by his Worship the Mayor, Richard Mothes, Esq.,
Councillors A. Fraser, J. G. A. Castie, F. C. Priest, W. D. Perry, T. Price, J.
McEwan, and H. Alexander, Engineer S. Jickell, Town Clerk J. Wheeler, 25th
April, 1903.⁶⁰

It appears that the Korokoro Dam underwent few changes, but an associated underground settling tank was built in 1907.⁶¹ Over the years, councillors and engineers proposed increasing the height of the dam, improving supply pipelines and installing pumps, but none of these were advanced. Since the Korokoro Dam was decommissioned in January 1962 the reservoir has been steadily infilling with silt. The dam has now become a feature of the Belmont Regional Park and visitors can walk along the safety-railed south half of the dam's crest to the offtake tower, which is also fenced, with timber seating provided. Remnants of the mains pipes are visible in the stream bed and also alongside the walking track.



Figure 6: Former Wellington Woollen Manufacturing Company Dam, 17 January 2014. K. Astwood, IPENZ.

Former Wellington Woollen Manufacturing Company Dam

The smaller lower Korokoro Stream concrete gravity dam, constructed for the Wellington Woollen Manufacturing Company, has similar characteristics to the

⁵⁹ 'Korokoro Dam,' IPENZ.

⁶⁰ *Evening Post*, 27 April 1903, 2.

⁶¹ Nicholson, *Petone's First Hundred Years*, 70.

upper dam. These include a similar wall shape, brick crest coping and an uncontrolled chute type spillway on its true righthand side, although the dam's spillway is not stepped (Figure 6 and 7).

By the early 1970s the mill had closed and its buildings were demolished.⁶² It is unclear whether the dam continued to be used for water supply up until that time. Since the late 20th century it seems the east bank of the reservoir has been extended through accumulated silt, and vegetation surrounds the timber and steel remnants of the dam's valve tower. Despite having survived several severe floods in the 20th century unscathed, around 2004 a rock slip caused by flooding damaged part of the right abutment wall and a sizable lower west portion of the spillway.⁶³



Figure 7: Former Wellington Woollen Manufacturing Company Dam from east Korokoro Stream bank, 17 January 2014. K. Astwood, IPENZ.

Remnants of pipes used for the power supply scheme can be seen beside the stream and along the walking track between the Cornish Street entrance to Belmont

⁶² Walzl, 'Belmont Regional Park History,' 29-30.

⁶³ Damwatch, 'Safety Review of Birchville, Korokoro and Woollen Mills Dams,' 11. An example of a previous flood which topped the Korokoro Stream Dams but resulted in no recorded damage was the December 1976 event. 'NZ Historic Weather Events Catalog – December 1976 Wellington Flooding,' NIWA, URL:http://hwe.niwa.co.nz/event/December_1976_Wellington_Flooding (accessed 10 March 2014). During the 1976 storm, flood waters in the Korokoro and Petone industrial areas were recorded as being over 1 metre high. According to local waterworks engineer Jeff Jones, both Korokoro Stream Dams came through the event undamaged. Pers. Comm. Jeff Jones, 25 February 2014. Flooding in December 1939 was comparable to the 1976 event.

Regional Park and the dam. Another likely remnant of the mill's activities is the concrete used to reinforce the curve in the stream bank several metres south of the dam and also further downstream.

Key physical dates

<i>circa</i> April 1903	Korokoro Dam and Wellington Woollen Manufacturing Company Dam construction begun
25 April 1903	Korokoro Dam foundation stone embedded in side wall of spillway
December 1903	Korokoro Dam completed
June 1904	Wellington Woollen Manufacturing Company completed
1907	Korokoro Dam underground settling tank added
<i>circa</i> 2004	Former Wellington Woollen Manufacturing Company Dam's right abutment and spillway base damaged by rock slip.

Assessment of significance

The Korokoro Stream Dams, completed in 1903 and 1904, have outstanding engineering heritage importance as the earliest mass concrete gravity dams built in New Zealand by a municipality. Constructed by the Petone Borough Council, the mass concrete form of the Korokoro Dam and the former Wellington Woollen Manufacturing Company Dam was pivotal in the development of dam construction. These modestly sized structures were the forerunners of New Zealand's large early to mid-20th century water supply and hydro-electricity dams.

The Korokoro Stream Dams are also noteworthy for their association with the important New Zealand engineer, Samuel Jickell. He pioneered the use of mass concrete dams in New Zealand, starting with the Korokoro Stream Dams and being involved with two other structures completed by 1907. The Korokoro Stream Dams have the highest level of original integrity of this initial group of early 20th century dams.

Therefore, the Korokoro Stream Dams are of sufficient engineering heritage significance to merit inclusion in the IPENZ Engineering Heritage Register.

C. Supporting information

List of supporting information

Link to: 'Korokoro Dam,' The Institute of Professional Engineers of New Zealand,
URL: <http://www.ipenz.org.nz/heritage/itemdetail.cfm?itemid=105> (accessed 26 August 2013).

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