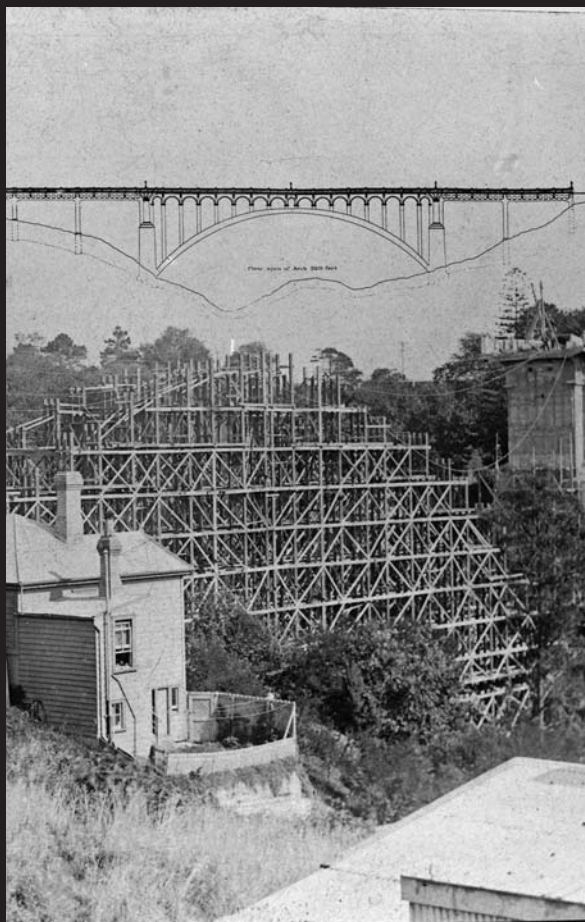


Heritage Walks — The Engineering Heritage of Auckland





Acknowledgements

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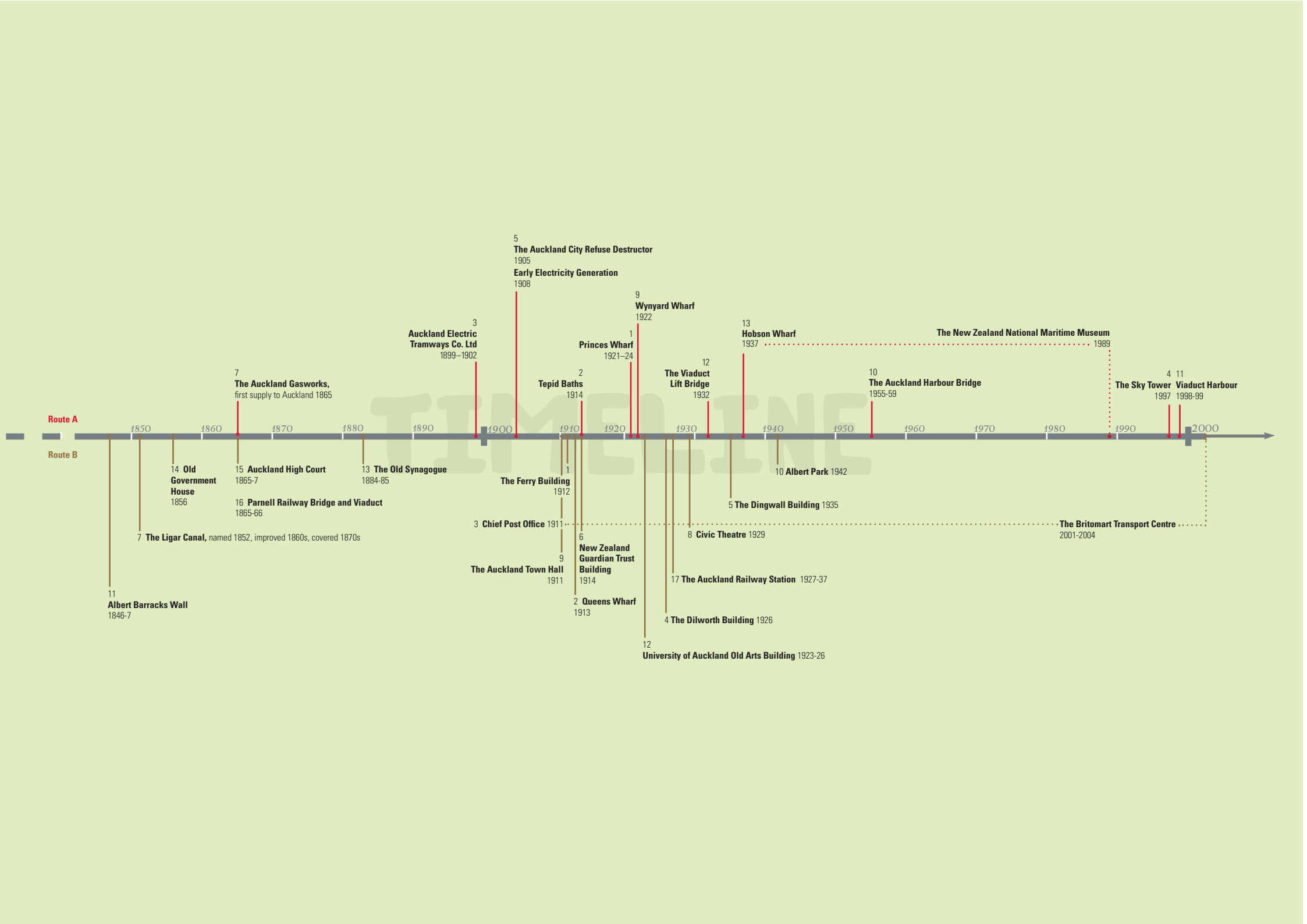
Introduction

The interconnections between city life and engineering are often concealed or go unheeded. These heritage walks reveal some of Auckland's engineering achievements and illustrate the powerful impact of the engineer on architecture, settlement patterns, health, convenience and trade.

In 1840, Apihai Te Kawau of the iwi (tribe) Ngāti Whatua invited Captain William Hobson, the Lieutenant Governor of New Zealand, to found the capital of the new Crown Colony on the Waitemata Harbour in the area known as Tamaki Makaurau (loosely translated, 'the bride sought by many lovers'). Hobson was attracted by the region's central position, sheltered deep harbour, fresh water supply and the agricultural and commercial potential of the region. Until the capital was shifted to Wellington in 1865, the fledgling city was the centre of government and headquarters of the military, churches, industry and business.

Engineers formed the landscape, built the physical infrastructure and developed roles for government, local authorities, special purpose boards and private firms. The very early engineers of Auckland came from abroad, but from the last quarter of the 19th century many were trained in New Zealand.

While some of Auckland's engineering achievements are internationally remarkable, many were conventional technical responses to local circumstances. Whether innovative or derivative, each initiative made a significant contribution to the building of this city and its region. This brochure contains two suggested trails around the city unveiling some of Auckland's engineering heritage. These trails are designed as loops, beginning and ending at Hobson Wharf. All of the heritage sites included in this booklet are marked on the map should you wish to make a trail to suit your own interest.



Route A

Route B

5
The Auckland City Refuse Destructor
 1905
Early Electricity Generation
 1908

3
Auckland Electric Tramways Co. Ltd
 1899–1902

2
Tepid Baths
 1914

1
Princes Wharf
 1921–24

9
Wynyard Wharf
 1922

12
The Viaduct Lift Bridge
 1932

13
Hobson Wharf
 1937

10
The Auckland Harbour Bridge
 1955–59

The New Zealand National Maritime Museum
 1989

4 11
The Sky Tower 1997
Viaduct Harbour 1998–99

11
Albert Barracks Wall
 1846–7

14
Old Government House
 1856

7
The Auckland Gasworks,
 first supply to Auckland 1865

15
Auckland High Court
 1865–7

16
Parnell Railway Bridge and Viaduct
 1865–66

7
The Ligar Canal, named 1852, improved 1860s, covered 1870s

13
The Old Synagogue
 1884–85

1
The Ferry Building
 1912

3
Chief Post Office
 1911

9
The Auckland Town Hall
 1911

6
New Zealand Guardian Trust Building
 1914

2
Queens Wharf
 1913

12
University of Auckland Old Arts Building
 1923–26

4
The Dilworth Building
 1926

17
The Auckland Railway Station
 1927–37

8
Civic Theatre
 1929

5
The Dingwall Building
 1935

10
Albert Park
 1942

The Britomart Transport Centre
 2001–2004



- Route A, approx 2.5 hours
- Route B, approx 2.5 hours
- Other features

START HERE

NORTH

to spaghetti junction

to Grafton Bridge

to War Memorial Museum

Walk along Princes Wharf, located at the northernmost end of Quay Street, toward the Hilton Hotel.

[1] Princes Wharf

Access from Quay Street

Princes Wharf was constructed between 1921 and 1924 following the closure and filling of Auckland's first dry dock, built in 1878. A remnant of the dry dock wall can still be seen by the kiosk on the west side of the ferry tee. It is the short diagonal wall with a heavy capstone indicating the line of the dock that still exists under the road and buildings opposite. The wharf had six double storey cargo sheds of flat slab construction designed by Auckland Harbour Board Designing Engineer, Neville L Vickerman.

The former Auckland Harbour Board office building (1986) dominates the approach to Princes Wharf. The board was set up by an act of parliament in 1871 to facilitate port development and was endowed with 2,023.4ha of seabed. The commercially oriented Ports of Auckland Ltd replaced it in 1988 and all non-port related lands passed into the ownership of the Auckland Regional Council, the Auckland City Council and subsequently, Auckland Regional Holdings Ltd (owned by the Auckland Regional Council).

The Princes Wharf sheds were re-developed in the late 1990s into multi-storey apartments, restaurants, bars and the Hilton Hotel. It remains the primary wharf used by large cruise ships that visit Auckland throughout the year.

Turn and walk up Hobson Street. Stop at the Trepid Baths on your right hand side.

Princes Wharf under construction, 1923.
Special Collections, Auckland City Libraries (NZ), 1-W434



The women's pool of the Trepid Baths, circa 1920.
Special Collections, Auckland City Libraries (NZ), 7-A565

[2] Trepid Baths - The 'Teps'

100 Customs Street

Opened in 1914, the 'Teps' are among New Zealand's oldest heated swimming pools. They were built by the Auckland City Council on reclaimed land leased from the Auckland Harbour Board. They were originally salt water baths with separate pools for men and women. The condensers of the Auckland Electric Tramway Company's powerhouse on Lower Hobson Street (next stop) initially heated water which was then gravity-fed down the hill to reach the pools. The pools' popularity declined when the power station closed in 1924 and the waters went cold, but heat was thankfully restored in 1925.

It took until 1986, when the baths were refurbished, for them to be de-segregated. The council bought the freehold in 1998 for the use of all Aucklanders and recent restoration has included the re-activation of the opening roof panels.

Cross over at the traffic lights behind you and walk under the Hobson Street overpass. Once on the other side of the road, follow the ramp up to Fanshawe Street. Cross at the lights over to the corner of Wolfe and Fanshawe Streets. Look up to view the old entrance to the AET building.



The Trepid Baths exterior view, 1921.
Special Collections, Auckland City Libraries (NZ), 7-A5154

[3] Auckland Electric Tramway Co Ltd

Corner of Wolfe and Fanshawe Streets



The privately owned Auckland Electric Tramway Company (AET) was formed in 1899 when the British Electric Traction Company (BET) purchased the Auckland City and Suburban Horse Tramways. The electrified network, built between 1899 and 1902, was the largest municipal

engineering project in the country at the time, with much of the expertise supplied by the BET. Under the Tramways Act 1894, the Auckland City Council had powers to impose condition of construction, operation and services and the company was obliged to supply electricity for lighting Queen Street in 1903. Tension between the two bodies was frequent and in 1919 the council purchased the company.

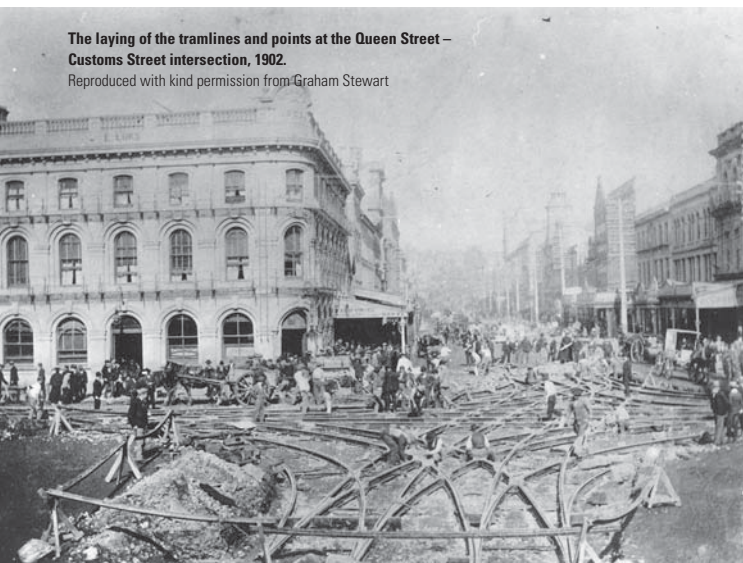
Trams were essential to early life in Auckland and their extensive patronage promoted the expansion of 'tramway suburbs', such as Mt Eden and Mt Albert, all over the Auckland isthmus. They were replaced in 1949 by the electric trolley bus system which operated until 1980.

Although nothing remains of the tramways system itself (except at the Museum of Transport and Technology in Western Springs), the office building (1902) can still be seen here. Look up to see the letters AET in relief over what was once the main entrance to the building.

Continue up Hobson Street. At the intersection of Victoria and Hobson Streets, to your left you will see the base of the Sky Tower.

The laying of the tramlines and points at the Queen Street – Customs Street intersection, 1902.

Reproduced with kind permission from Graham Stewart



[4] Sky Tower

Corner of Victoria and Federal Streets

In the relatively short period of time since it was constructed, the Sky Tower has become an Auckland icon. It opened in 1997 and its total freestanding height is 333.6m above its foundations, and approximately 328m above street level.

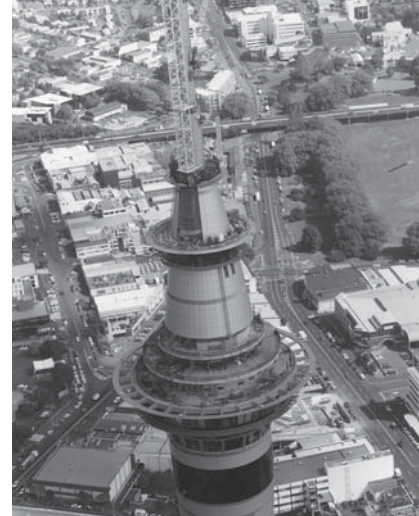
It functions as an observation, telecommunications and broadcasting tower. It contains five public levels, ten communication floors and three steel fire-refuge floors. The public levels, or pod, are reached by three glass-fronted elevators capable of transporting 225 people up or down every 15 minutes, in addition to a service lift. The shaft of the Sky Tower contains 124 flights of stairs with 1,307 steps to the base of the mast on top.

The main structure is a 12m diameter reinforced concrete shaft with a wall thickness varying between 350mm and 500mm. Slipform shuttering was used for continuous casting of the shaft. Eight reinforced concrete buttress legs stiffen it and a multi-sectional steel mast, equipped with tuned water dampers (to limit its vibration in the wind) tops the shaft.

The structure has been designed to provide a high level of performance against the elements, including gusts of wind of up to 200km an hour. It would remain essentially undamaged if subjected to the maximum credible earthquake, estimated to be Richter magnitude 7.0 at 40km from the site.

Construction began in 1994 and it was completed in 1997 at a cost of \$74 million. It was designed by Craig Moller Architects in conjunction with BECA engineers.

Walk up to the intersection of Hobson and Victoria Streets. Cross at the lights and head west down Victoria Street. Continue toward the brick chimney you see at the bottom of the hill in front of you, the site of the old Auckland City Refuse Destructor.



Aerial photograph of the Sky Tower under construction
Courtesy of Geosmart Ltd, Auckland

[5] Auckland City Refuse Destructor and Early Electricity Generation

1 Drake Street

The site of today's Victoria Park Markets was once the central refuse collection area for Auckland City. Disposal of refuse was a pungent city issue throughout the latter part of the 19th century. In the 1870s collection was contracted out and dumping occurred 'out of the sight and smell of citizens'. In the 1890s however, citizens were required to dispose of their own rubbish and vacant allotments became convenient, informal tips. Fear of the bubonic plague in 1900 prompted the council to consider a municipal refuse destruction plant and in 1904 a tender of £16,840 was accepted from J Barre Johnston Ltd of Sydney for the construction of a Meldrum destructor, completed in 1905.

The complex of polychromatic brick construction included the council's Works' Depot, blacksmith's and carpenter's shops, stables and a 38m high chimney. Alfred Wrigg (City Engineer from 1899 to 1906) probably supervised construction. He was also responsible for supervising the Auckland Electric Trams and for paving Queen Street with asphalt.

The capacity of the destructor was increased during the 1920s and 1930s, but by 1960, as controlled dumping grew in popularity, it was disposing of a mere 10% of the city's rubbish. The plant was closed in 1972 and it was subsequently converted into the Victoria Park Markets.

As Auckland grew, so did its requirement for electricity. The council was vested with the public supply of electricity by the Auckland City Electric Lighting Act 1900 and an

Australian engineer, W T G Goodman, was employed to report on the feasibility of using the destructor to generate electricity in 1906. His proposals were accepted, although he criticised the council for failing to incorporate a generating plant in the original design, despite a series of earlier reports endorsing the potential of electricity.

The electrical contract was won by Turnbull & Jones for £11,808. The cost subsequently escalated with revisions in potential demand and the provision of additional boilers and new feeders. In 1908, electricity was provided to the first 12 customers. Within four months demand exceeded supply and coal was used to supplement the burning of rubbish. It was replaced in 1913 by the Kings Wharf coal fired power station, again built by the council.

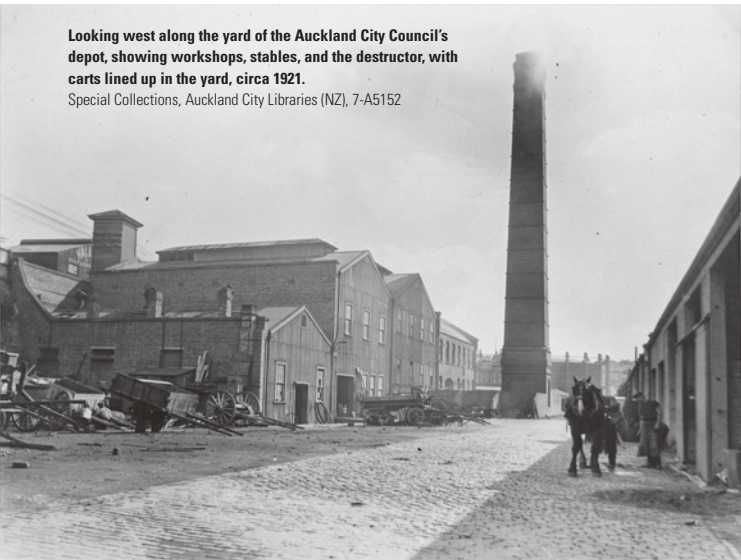
Continue along Victoria Street West past Victoria Park and turn right at the intersection with Beaumont Street.



View across Freemans Bay, towards Ponsonby, showing the Gas Company Works, Victoria Park, and the Auckland City Council Destructor, September 1921.
Special Collections, Auckland City Libraries (NZ), 4-4806

Looking west along the yard of the Auckland City Council's depot, showing workshops, stables, and the destructor, with carts lined up in the yard, circa 1921.

Special Collections, Auckland City Libraries (NZ), 7-A5152



[6] Freemans Bay

Access from Fanshawe Street or Ponsonby Road

Reclaimed from the sea, the natural bay after which this area is named no longer exists although Point Fisher, south Beaumont Street, Drake Street and south Halsey Street approximate the original shoreline. Māori beached waka (canoes) along the waterfront until the area was gifted to the British Crown in 1840 by local iwi (tribe), Ngāti Whātua. London speculators soon carved up the area and workers' cottages were quickly built on tiny plots on the lowest slopes, with modest attention paid to sanitation or building standards. Merchants built larger and more elaborate villas on the ridges, taking advantage of the sun and maritime vistas.

By the 1850s, the sawdust road that ran along the foreshore was densely developed with small industries: a sawmill, brick

kiln, iron foundry, glass furnace, shipbuilders and joineries. The first New Zealand steamboat was built here in 1851. Harbour reclamation and the construction of major public works followed, such as the gasworks and city refuse destructor. Resale values dropped and there was little incentive to maintain or replace dwellings. Since then, however, there has been a change in the fortunes of Freemans Bay. Along with neighbouring St Mary's Bay it is now a trendy suburb, with accompanying real estate prices.

Continue down Beaumont Street to the old Auckland Gasworks at number 90 Beaumont Street.

[7] Auckland Gasworks

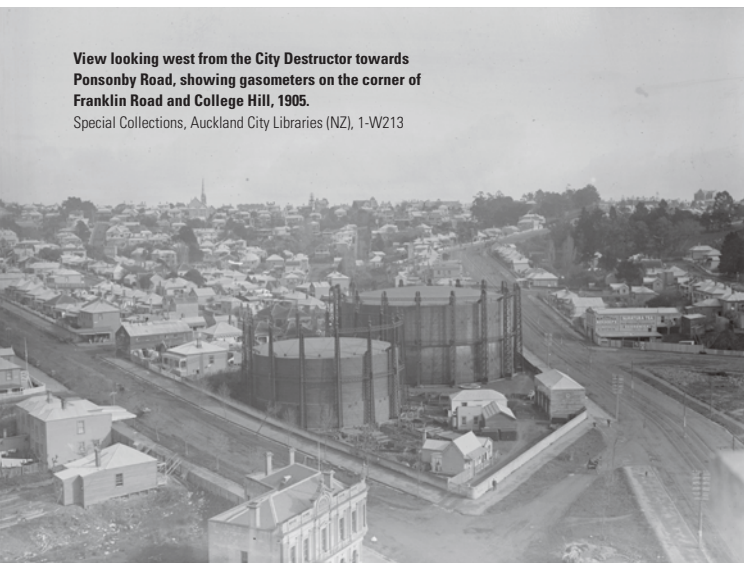
90 Beaumont Street

The Victorian Italianate administration building at 90 Beaumont Street is all that remains of the once large complex that made up the Auckland Gasworks Company's 'new' gasworks development of 1902-1904. The company was first established in 1862 but construction of the gasworks was delayed by the New Zealand Land Wars of the 1860s. Consequently, it was not until April 1865 that gas was supplied to the city's first 43 street lamps.

The first works were located less than one kilometre away at the corner of Nelson and Wyndham Streets and produced gas through the process of continuous destructive distillation of coal heated to 1,000°C. In 1871, the company was authorised by an act of parliament to lay gas mains within a 19.3km radius of the Chief Post Office, located at the bottom of Queen Street. The Auckland Gasworks Company was also

View looking west from the City Destructor towards Ponsonby Road, showing gasometers on the corner of Franklin Road and College Hill, 1905.

Special Collections, Auckland City Libraries (NZ), 1-W213



granted monopoly supply rights. In 1884, a 14,726m³ capacity telescopic gasholder with two 9m lifts was built at Freemans Bay and another with a capacity of 2,945m³ subsequently followed. These large tanks stored the gas which was then fed into the system during periods of peak demand.

Construction of the new 5.2ha works at Beaumont Street involved excavation of vast amounts of fill which was then used by the Auckland Harbour Board in the Western Reclamation Project. The complex of buildings once included the retort house (where the gas was manufactured), the administration offices, laboratories and stores.

The 'golden years' for the Auckland Gasworks Company were 1908-1910. Competition from electricity reduced demand and wartime coal shortages affected supply. Many of the buildings were demolished in the 1960s and early 1970s when natural gas came on stream from Taranaki. The administration building was restored and converted into modern offices in the late 1970s. The retort house was built up the cliff face and the only remaining building, thought to have been the retort manager's office, is now a gymnasium.

Continue along Beaumont Street, cross under the motorway viaduct and along Wynyard Wharf.

View looking west across the Western Reclamation, showing Victoria Park (upper left) with Auckland Gasworks behind, 1912.

Special Collections, Auckland City Libraries (NZ), 1-W961



[8] Western Reclamation

Access via Halsey Street and Jellicoe Street to Brigham Street

The Western Reclamation was an ambitious project that was part of the wider Freemans Bay reclamation programme carried out by the Auckland Harbour Board from the 1880s. Point Acharon was cut back and the earth from this was used to form the 9.4ha inner bay reclamation that created Victoria Park (1886-1901). This was enlarged by a further 38ha over the next 30 years by suction dredging and spoils from other city earthworks.

[9] Wynyard Wharf

Access via Brigham Street or Hamer Street

The reinforced concrete Wynyard Wharf (originally named Western Wharf) that begins at the end of Beaumont Street was built in 1922. Later that year, the outer end of the wharf collapsed into the harbour through slip circle failure due to unstable local clays. Following an official inquiry, subsequent dredged wharf structures were provided with more stable, sand-based foundations to ensure no subsidence occurred. The wharf was rebuilt to provide

berthage for oil tankers; the first discharge was made in 1926 and piped to newly built storage tanks on the western reclamation. It continues today to be an entry point for petroleum products, which are stored in the adjacent 'Tank Farm' on the northern side of the wharf. The bulk of these products however are now pumped directly from the Marsden Point Oil Refinery in Northland to the Wiri Oil Terminal in south Auckland.

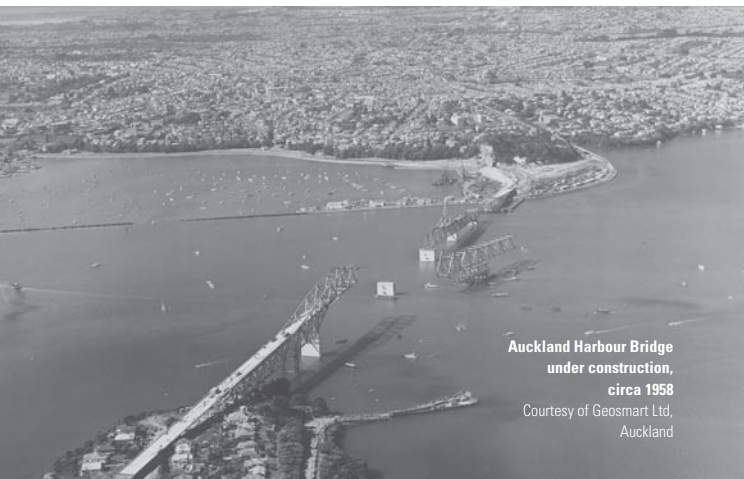


Auckland Harbour aerial view looking east showing Wynyard Wharf (bottom), 1940. Auckland Harbour Board collection, NZ National Maritime Museum

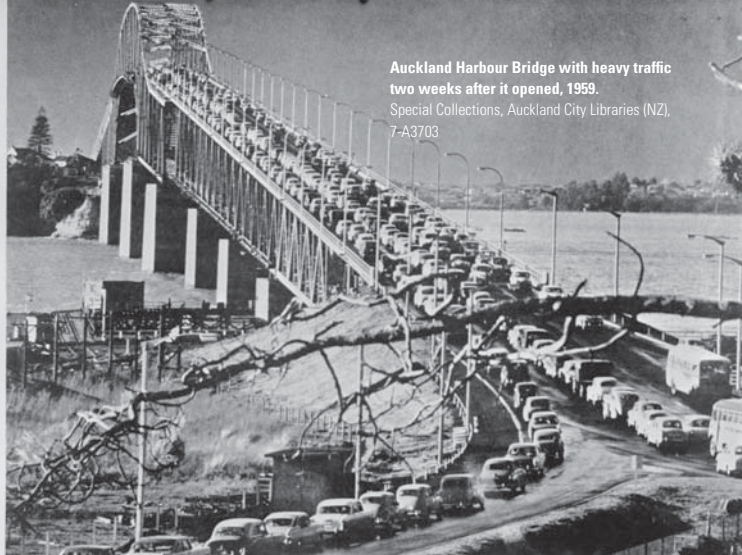
[10] Auckland Harbour Bridge

View from the end of Hamer Street

The end of Hamer Street provides a view of one of Auckland's best known landmarks, the Auckland Harbour Bridge. In 1950, after several failed earlier attempts to bridge



Auckland Harbour Bridge under construction, circa 1958
Courtesy of Geosmart Ltd, Auckland



Auckland Harbour Bridge with heavy traffic two weeks after it opened, 1959.
Special Collections, Auckland City Libraries (NZ), 7-A3703

the Waitemata Harbour, the Auckland Harbour Bridge Authority was formed with the purpose of constructing and managing a harbour crossing for vehicles. The steel lattice girder structure that you see here was designed by UK engineers, Freeman Fox & Partners, and built by the Cleveland Bridge Company and Dorman Long between 1955 and 1959. The bridge cost £7.5 million, partly recuperated by a bridge toll that was in place until 1984. This early bridge was four lanes wide.

The bridge remains the largest in New Zealand, with seven cantilever and suspended span sections set on six concrete and steel piers held together by seven high-tensile steel pin joints. The total length is 1,097m with a main span of 243m set 42m above mean sea level. A gap, or expansion joint, above pier three allows for temperature variation movements of up to 45.75cm.

A problem was experienced when sinking pier five. When the caisson was lowered, the cutting edge hit a layer of harbour bed of uneven strength and it heeled over. Anxious workers excavated for ten days before the caisson sank on to a layer of hard sandstone and righted itself.

The initial spans of the bridge were erected on false work and the proceeding spans cantilevered out. Because of the expansion joint it was impossible to use the same



Auckland Harbour Bridge attachment of bridge extension, 1967.
Courtesy of Geosmart Ltd, Auckland

method for the large span (146m) between piers three and four. In 'Operation Pickaback', the solution was to float the span into place on the back of another mounted on four pontoons at high tide. At the time this was regarded as a highly innovative feat and was widely admired.

Within a decade traffic exceeded the bridge's capacity. Between 1966 and 1969 the bridge was ingeniously expanded from four to eight lanes. Prefabricated hollow steel box girder extensions, designed by Freeman Fox & Partners and manufactured in Japan, were positioned by huge floating cranes and 'clipped' on to the existing piers using steel brackets cantilevered out and fixed by massive 'thru bolts'. The additional four lanes were somewhat affectionately known as the 'Nippon Clip-ons'. The bridge extensions cost £13.25 million, nearly twice that of the original bridge construction 10 years previously.

Following the discovery of some buckling, the box girders were strengthened in the early 1970s and in the 1980s, 2,000 splice joints were replaced using new techniques, after the discovery of some fatigue cracks by the Ministry of Works.

In 1990 a moveable concrete median barrier designed in Australia was installed to manage traffic flows. It is moved four times a day by purpose built vehicles and was a world first.

The Auckland Harbour Bridge has received an IPENZ heritage plaque.

Continue to the end of Hamer Street, turn the corner and walk down Brigham Street in the direction of Victoria Park. Turn left at Jellicoe Street, right into Halsey Street and past the America's Cup boat sheds. Turn left into Viaduct Harbour Avenue and continue walking through the Viaduct Harbour.

[11] Viaduct Basin

Access from Quay Street or Fanshawe Street

The Viaduct Basin has seen industries come and go. It was the early site of the city morgue, timber milling, boat building and repairs and, more recently, fish processing and the city produce markets.

Kauri logs were once rafted into the Kauri Timber Company or brought by sailing scows along the east coast from Northland, Great Barrier Island and further afield. Kauri timber was the main construction material of the day and its legacy lies in the many kauri villas and bungalows of Auckland.

The Basin, home to the fishing fleet since 1932, now provides a mixed leisure, residential and maritime environment. It was originally developed through the

View of Viaduct Basin area, 1904, with Freemans Bay in the distance (upper right).
Special Collections, Auckland City Libraries (NZ), 1-W1102



intermittent reclamation of Freemans Bay to provide an all-tide berthage for ships and boats, beginning with the western reclamation. The southern boundary was reclaimed in stages over many years.

In the 1950s, the harbour board decided to promote the use of lighters for unloading ships anchored in the channel, thus reducing the demand for new wharves. A fleet of lighters was built and an unloading facility developed in what became known as the Lighter Basin. However, the shipping companies refused to use the lighters and the project soon collapsed. The Lighter Basin is now known as the Viaduct Basin.

In 1993, dredging, reclamation and the reconstruction of the Fisherman's Wharf area was undertaken to accommodate the Whitbread Round the World race yacht fleet.

At a cost of \$80 million the Viaduct Basin was converted into Viaduct Harbour (1998-1999) to provide for the America's Cup regatta of 2000. New reclamation techniques included the use of cement to consolidate the mud-dredging fill forming the embankment. The basin was dredged, widened by 28m and new seawalls were constructed.

Continue to follow the water line around Viaduct Harbour. Once at Market Square, look across the water to view the Viaduct Lift Bridge.

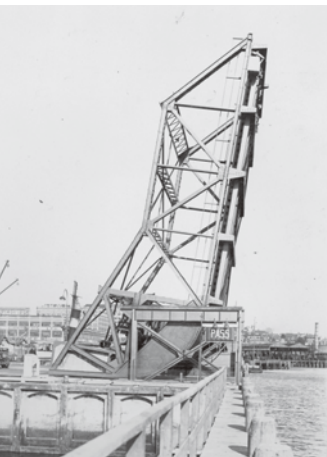
Rolling lift bridge viaduct to Freemans Bay with the bridge closed, 29 June 1932.
Auckland Harbour Board collection, NZ National Maritime Museum



[12] Viaduct Lift Bridge

Access from Viaduct Harbour

Installed in 1932, the Viaduct Lift Bridge is one of the few bridges of its type in the world and was fabricated by the Cleveland Bridge and Engineering Co Ltd, Darlington, England. It is a steel bascule rolling truss bridge. The Auckland Harbour Board installed it to span the 13.7m between the Eastern and Western Viaducts. It originally carried a railway connected to oil loading facilities on Wynyard Wharf and was raised and lowered at the arrival and departure of the fishing fleet. It was manually operated and raised by rolling back 90° on its cam ends under counterweight. A pinion moved along a horizontal rack at the height of the centre of the cam-end circle. Later driven by electricity, it was in use until the development of the Maritime Museum on Hobson Wharf in 1992. Now a 'bridge to nowhere', it has been preserved for its engineering heritage value.



Rolling lift bridge viaduct to Freemans Bay with the bridge open, 29 June 1932.

Auckland Harbour Board collection,
NZ National Maritime Museum

Continue around the harbour to reach the hull of the 'KZ 1' yacht and the entrance to the New Zealand National Maritime Museum.

[13] New Zealand National Maritime Museum and Hobson Wharf

West Quay Street

Lower Hobson Street and part of the original Hobson Wharf base were reclaimed between 1902 and 1908 through tipping spoil from city works into the sea. The existing wharf was built in 1937 for coastal shipping. In 1989, the Auckland Maritime Trust Board transformed it into an interactive museum depicting the maritime heritage of New Zealand and the Pacific, with active workshops preserving marine skills and a marina with a working fleet of period boats.

While the museum buildings themselves are not of heritage status, many of the artefacts within them are of considerable engineering heritage value. For example, 'Rapaki', a floating steam crane formerly used in Lyttelton (lifting capacity 80T at 50ft radius, gross tonnage 745, launched in 1926), and 'Puke', a small steam launch built in 1872, previously used for pushing rafts of logs and other cargoes, are both intact and in working order. Other steam engines and a collection of old outboard motors are also on display. The old harbour board archives include engineers' photographs of wharf and other constructions.

Walk across the entrance to Hobson Wharf, back to the Visitor Information Centre.

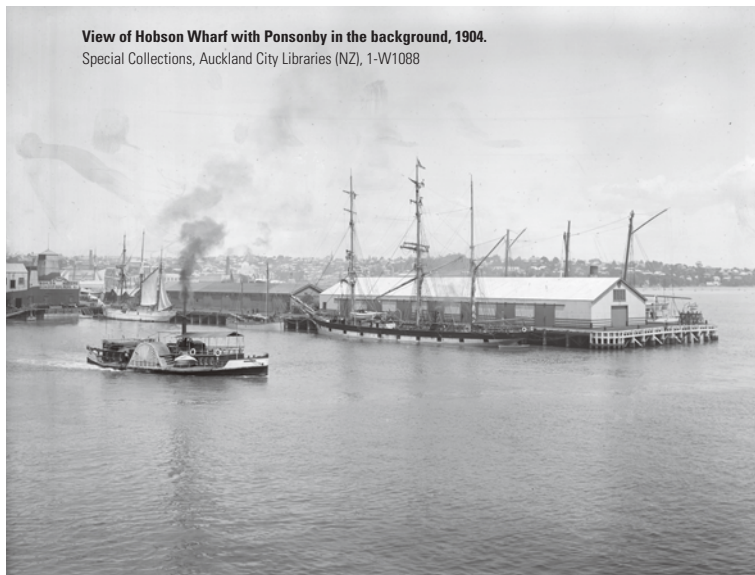


View of Princes Wharf with Hobson Wharf and Viaduct Basin in the background, 2004.

Courtesy of Geosmart Ltd, Auckland

View of Hobson Wharf with Ponsonby in the background, 1904.

Special Collections, Auckland City Libraries (NZ), 1-W1088





Starting from the Visitor Information Centre, turn left and walk along Quay Street in the direction of the Ferry Building.

[1] Ferry Building

Quay Street

The redevelopment of the Queen Street Wharf prompted Mr W H Hamer (the harbour board engineer from 1905-1923) to propose a new terminal for the ferry companies, whose craft connected the marine suburbs of the North Shore and the Eastern Bays to the city. His 1904 plan provided for new ferry tees at the base of the building. Alexander Wiseman was appointed architect in 1907 and tenders were let in 1909, after Auckland City Council objections to the building's height and site were resolved. It cost £68,000 and was completed in 1912, and is a good example of Edwardian Baroque revival architecture. Phlox & Sons built it in brick and Sydney sandstone on a base of Coromandel granite. Unreinforced, load-bearing masonry on reinforced concrete foundations was the construction method used and was typical of the time.

Ferry trade declined with the opening of the Auckland Harbour Bridge in the early 1960s and the building was almost torn down in the 1980s following engineering reports on the costs of earthquake reinforcement. In 1986, the Auckland Harbour Board leased the building to Challenge Properties Ltd to renovate. The building was gutted, strengthened with reinforced concrete and steel, and converted into shops and offices with the unobtrusive addition of an extra floor. The renovation cost around \$11 million.

Walk through the Ferry Building and you will see Queens Wharf, from where Devonport ferries depart.

[2] Queens Wharf

Quay Street

The early prosperity of Auckland depended on port facilities developed from the 1850s. The first wharf was the Wynyard Pier built in Official Bay in 1851 through private subscription. Construction of the Queen Street Wharf in Commercial Bay (where you now stand) commenced the following year, probably from plans prepared by the Royal Engineers. It was no more than a 'solid filling confined by timber and stone' when Daniel Simpson was appointed Engineer to the Auckland Harbour Commissioners in 1854. He improved the surfacing and by conventional pile construction extended its length to 244m. By 1871 it was 474m long and 12m wide, with tees providing additional berthage, principally for overseas vessels.

Surveyor-General Felton Mathew selected Commercial Bay as the trading heart of the new capital in 1841 and indicated extensive reclamation in his plan. Simpson's 1855 Harbour Development scheme reinforced this and the first reclamation project was undertaken from Fort Street (the original shore line) to Customs Street East in 1859 by the Auckland Provincial Government. By the end of the 1880s, Commercial Bay had disappeared through continuous reclamation.

Finding the Queen Street Wharf ramshackle and outdated, Hamer recommended in his 1904 report that it be replaced. The new, reinforced concrete Queens Wharf, on which you now stand, was completed in 1913.

Looking south from Queen Street Wharf (Queens Wharf) towards Quay Street East, showing ships at the various tees, horses and carts, cranes and produce being unloaded, 1905.
Special Collections, Auckland City Libraries (NZ), 4-655



Walk back through the Ferry Building, cross the road to the foot of Queen Street and walk toward the Britomart Transport Centre and old Central Post Office.

[3] Britomart Transport Centre and the Central Post Office

Lower Queen Street

The Central Post Office (CPO), built in 1911, is a building in the Edwardian Baroque manner faced with Oamaru stone over a Coromandel granite base. This handsome building served Auckland well until it was vacated by the New Zealand Post Office in 1989. The CPO originally backed on to



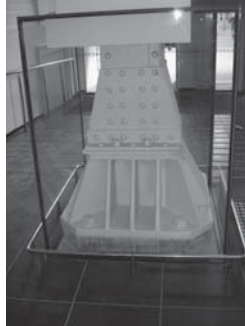
View of the Britomart Transportation Centre, 2005.
Courtesy of L. Rhys Thomas

the site of Auckland's first railway station which was later transferred to Beach Road (1930). The vacant land became the municipal bus station and was named Britomart Place.

Almost 70 years later, the Auckland City Council proposed a scheme recreating what had existed in the Britomart precinct in the first decade of the 20th century; a central city rail, bus and ferry interchange, with the refurbished CPO forming the grand entrance to the underground transport terminal. After nearly 10 years of political wrangling the decision was finally taken to proceed in 2001.

Costing \$170 million (CPO strengthening and ground floor refurbishment \$35 million, station \$135 million) and completed in 2004, the 30,626m² floor area project comprised an underground diesel train station designed to handle 10,500 passengers per peak hour, a 'glasshouse' linking the grand entry on the ground floor with the underground station entry, and leading out to the adjacent bus terminals and public spaces.

To meet the demanding seismic specifications, the close proximity to the sea and the need for major buildings within the station footprint to remain operational during construction, together with severe cost constraints, required much innovation in the engineering and architectural design. Examples included excavation by 'bottom up' construction in better ground and 'top down' in poorer ground, construction of the main beams at ground level prior to excavation and the use of shotcrete in upper shear walls of the CPO, which saved time and formwork costs. Lowering the ground floor exposed



Foundations in cases, 2005.
Courtesy of L. Rhys Thomas

the substantial steel connections between the concrete columns and the base walls supported on the raft foundation. The original CPO ground level was at the base of the concrete columns with a 'crawl-in' basement below, on the present floor level. These large connections are now displayed in glass boxes.

The architects were JASMAX Ltd/ Mario Madayag, engineers were Opus International, project managers BECA, and the main contractor Downer.

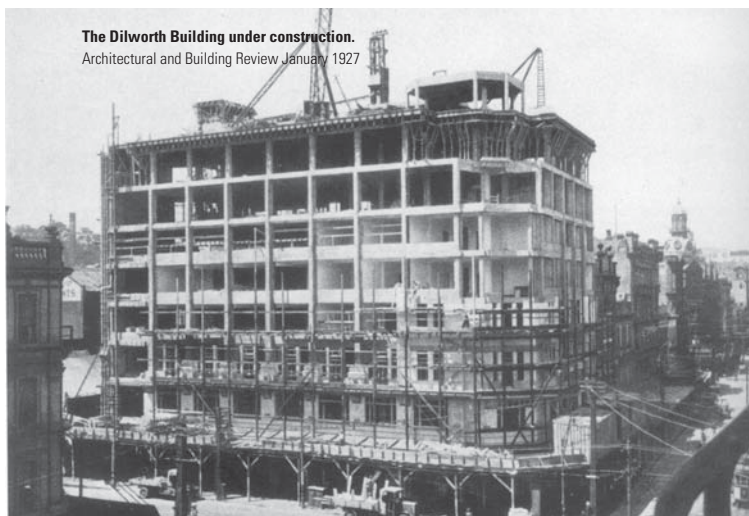
Continue up Queen Street. On the left hand side of the street you will see the Dilworth Building at 22-32 Queen Street.

[4] Dilworth Building

22-32 Queen Street

Built in 1926 by the Dilworth Trust Board to fund philanthropic work, the Dilworth Building was designed by Gummer & Ford and built by one of New Zealand's most important construction firms, the Fletcher Construction Company. Titled *Urbis et Porta*, it was originally intended to have a mirror image of itself on the site opposite, together forming a gateway to the city. Designed in the stripped-classical style, it is thought to have been influenced by the leading English architect Sir Edwin Lutyens, for whom WH Gummer worked in his early career.

The use of electric rather than hydraulic cranes enabled the building to be rapidly constructed. It has a reinforced concrete frame and floors and is faced with Portland stone.



The Dilworth Building under construction.
Architectural and Building Review January 1927



Continue up Queen Street until you reach the Dingwall Building on the right hand side of the street, at 87-93 Queen Street.

[5] Dingwall Building

87-93 Queen Street

Built in 1935 of reinforced concrete, it was the first Auckland structure to be erected after new regulations were passed following the 1931 Napier earthquake. It is built in the art-deco style with the front façade cantilevered out to allow for an uninterrupted line of glass across each of its eight storeys. Gummer & Ford were the architects and John J Booth was responsible for the structural engineering.

The Dingwall Building as photographed for Home and Building/Building Today, Oct-Dec 1936.

Continue along to The New Zealand Guardian Trust Building at 105 Queen Street.

[6] New Zealand Guardian Trust Building

105 Queen Street

New Zealand Insurance Company Ltd Building design sketches.
New Zealand Insurance Co Ltd Auckland, elevation 1914.
Hoggard, Prouse and WH Gummer. University of Auckland, Architecture Library.

This building was designed by Gummer following his return to New Zealand from Lutyen's London office and Daniel Burnham's office in Chicago. The building was commenced in 1914 and was finished after WWI. It employed the most modern Chicago skyscraper construction technologies of the time. At eight storeys high (the maximum allowed at the time) it was one of Auckland's tallest buildings until the 1960s. The steel frame construction, with concrete floors and steel framed windows, was intended to contain fires. The Queen Street façade is Sandy Bay Nelson marble.



Continue walking up Queen Street toward the Civic Theatre, tracing the line of the old Ligar Canal as you walk up Queen Street.

[7] Ligar Canal

Under Queen Street

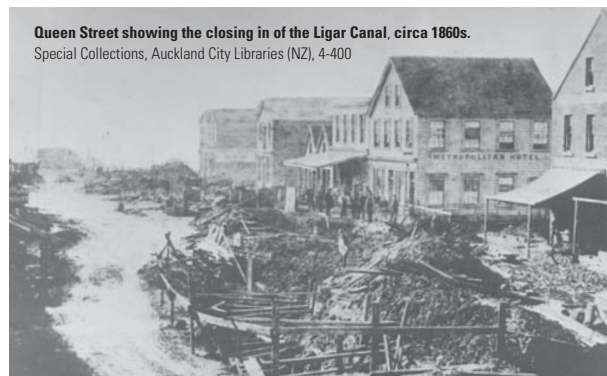
Before European settlement, the Waihorotiu Stream ran from a marsh (now Aotea Square near the town hall), to meet the sea, where the Guardian Trust Building now sits. From time to time the stream encroached on the course of Queen Street, as defined in Felton Mathew's 1841 town plan, but in the end it probably determined the real line of Auckland's main street.

Grog shops and hotels developed along the west bank of the stream and, in the absence of any long-term collective responsibility for sewage works, liquid and solid wastes were discharged directly into it. By 1852, the stream was known as the Ligar Canal (named after the second Surveyor-General) and had become an object of considerable public olfactory abhorrence. Timber walls lined the sides, the swampy sections were filled in, and some attempts had been made to encase it. Collapsed banks were not uncommon and in 1865, Sibbun's Theatre (later the site of His Majesty's Theatre) slid into the canal during construction. Queen Street at this time was a track running down the eastern side of the stream.

Piecemeal improvements occurred in the 1860s with the development of some local administrative responsibility for engineering and public health. It appears to have been covered in the 1870s to become the Queen Street sewer. Proper wastewater treatment did not begin until 1914.

It now lays unseen beneath the street as a brick-lined sewer of oval cross-section, intersecting modern concrete pipes.

Continue up Queen Street to the Wellesley Street intersection where the Civic Theatre stands.



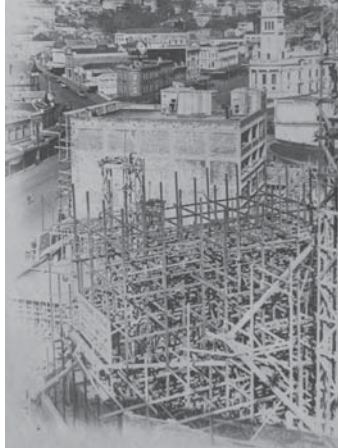
Queen Street showing the closing in of the Ligar Canal, circa 1860s.
Special Collections, Auckland City Libraries (NZ), 4-400

[8] Civic Theatre

Corner of Queen and Wellesley Streets

The 'Mighty Civic' has enchanted Auckland's citizens since it opened in 1929. One of the last of the great atmospheric picture palaces to be built, it is the largest in Australasia and one of a small number surviving in the world. It was built in a remarkably short eight months by the Fletcher Construction Co and the Super Construction Co (Sydney), for New Zealand impresario Thomas O'Brien. The structure has reinforced concrete column and beams, with brick infill and a steel-trussed roof. The ten major trusses, of up to 42.75m in length, were imported from England. One hundred plasterers moulded the Indian fantasy temple garden in the foyer and the romantic minarets of a Persian Palace in the 2,750 seat auditorium. A sunset machine and cloud projector transformed the sky blue ceiling which darkened into a night lit by 800 stars (24 watt blue bulb 'stars' imported from Germany). Other features included a Wurlitzer Organ, a rise and fall gondola orchestra pit, and the Wintergardens cabaret on the lowest level.

In 1994, when the lease reverted to the Auckland City Council, it was decided to restore and strengthen the building to convert it into a lyric theatre while retaining the 'Palace of Illusions' effect. The task was particularly complicated and was described as being like the 'reconstruction of a wedding



The Civic Theatre under construction. Building Report, F B Cavell. University of Auckland, Architecture Library

cake while keeping the icing intact'.

New concrete shear walls were constructed alongside the original brick walls on new foundation footings. A new and much larger stage, fly-tower facility, modern amenities and technologies were installed. In order to keep the ornate 5.8 tonne proscenium arch intact, it was braced and lifted in one piece to float above the auditorium while the wall behind it was demolished and rebuilt. The project cost \$41.8 million. Holmes Consulting Group were the engineers, JASMAX Ltd the architects and Downer the contractors.

Continue past the Civic up to the Auckland Town Hall on the edge of Aotea Square.

[9] Auckland Town Hall

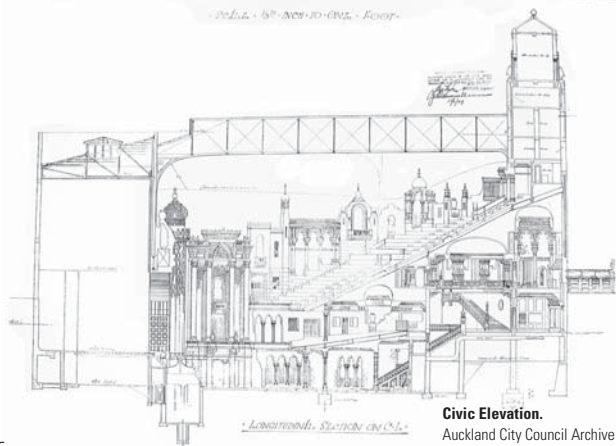
301-303 Queen Street

The Auckland Town Hall nearing completion, 1911. Special Collections, Auckland City Libraries (NZ),7-A3941



PROPOSED - CIVIC - THEATRE
CORNER QUEEN, WELLESLEY & ALBION STS. AUCKLAND - N.Z.
DESIGNED BY THOMAS A. O'BRIEN, ESQ.

SECTION - 50' ACROSS - CIVIC - FLOOR



LEVELS AND SECTIONS ON CIVIC

Civic Elevation. Auckland City Council Archive

Auckland became a borough in 1851 with an act of parliament, but the first council lasted just one year and a second election could not be held due to lack of interest. Auckland became a municipality for the second time in 1871, following the passage of the Municipal Corporations Act of 1867. Council affairs were administered from different offices until the town hall opened in 1911. The architect, J Clark & Sons of Melbourne, won a competition to design the Baroque revival structure, reminiscent of the Lambeth Borough Council Hall in London. Clad with Oamaru stone on a base of Melbourne bluestone, it was built by Ferguson & Malcolm of Auckland. Apart from civic offices, the building contained the great hall (modelled on Leipzig's Gewandhaus Concert Hall) and concert chamber, seating 300 and 880 people respectively. Plans for a monumental civic centre on the old market lands adjacent to the town hall were abandoned in the 1920s. The Civic Administration Building (1966) was later erected to ease office pressure and the Aotea Centre (1990) to provide a modern performing arts and conference venue.

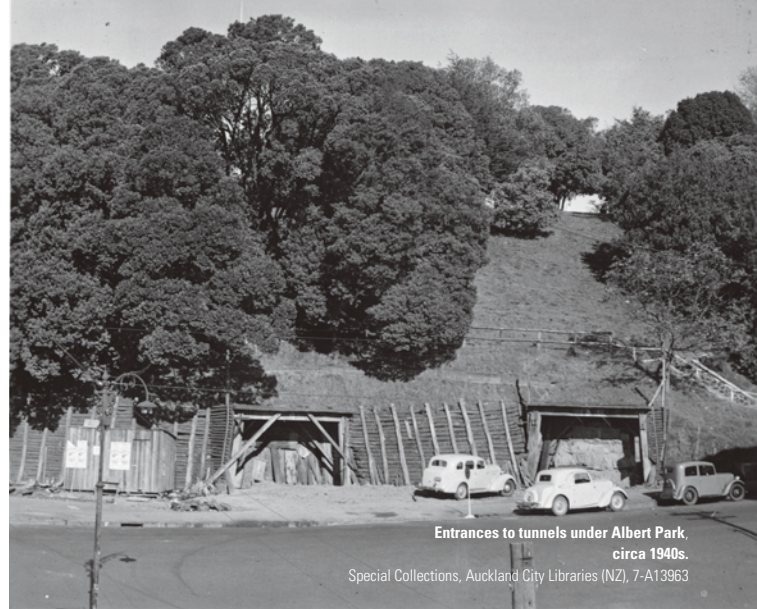
Valued for its heritage and contribution to Auckland's artistic and civic life, the town hall was refurbished in the mid-1990s. Because it was constructed of unreinforced masonry, it did not meet current seismic protection standards, particularly as a place of assembly. The structural engineering firm Kingston Morrison Ltd (now Sinclair Knight Merz Ltd) was appointed to strengthen the building so that it would not suffer earthquake damage. Many innovative techniques were introduced, including a diaphragm over the great hall and the use of carbon fibre to strengthen floor slabs. Within the great hall, a giant truss was threaded, member by member, into the original circle structure in order to brace the tall, slender walls. Many of the walls have been anchored down to the foundation rock, six metres below the ground, to resist earthquake loading.

Turn around and walk back to the Civic Theatre, head up Wellesley Street past the Art Gallery and enter Albert Park.

[10] Albert Park

Princes Street

This central city park was once a colonial defence post built in the late 1840s to withstand a feared Maori attack. Although never under siege, it was a military base for 20 years until finally disbanded in 1880. Auckland City then started developing the area as a 7.5ha park with formal Victorian-style gardens.



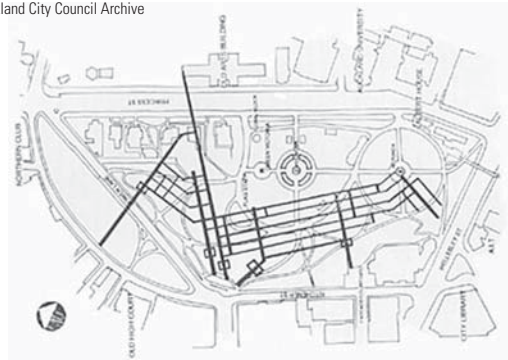
Entrances to tunnels under Albert Park, circa 1940s.

Special Collections, Auckland City Libraries (NZ), 7-A13963

During WWII, when a Japanese bomb attack was feared, the city council engineering department designed and built an extensive air-raid shelter network under the park with capacity for 20,400 people. Some mechanical equipment was used at the entrances, but the main excavation was carried out by hand by up to 100 council staff. It cost £120,000, three quarters of which was paid by the government. The construction involved some 1,200m³ of volcanic and sandstone rock and had 140,000m² of timber lining its tunnels and galleries which were arranged in a grid totalling 3,400m. To assist forced air ventilation there were no dead ends. First aid posts and diesel powered standby electric lighting were installed as well as a loud speaker system. Of the original seven entries, one visible remnant is the sealed-up entrance depicted by a decorative oval wall at the top of Victoria Street East. Another is the Parnell steel door at the bottom of Constitution Hill.

Plan of the Albert Park air raid shelters and tunnels.

Auckland City Council Archive



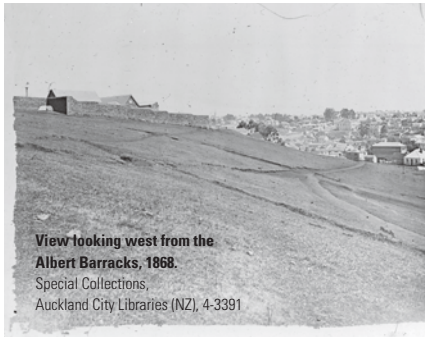
Continue through the park to the Princes Street exit, cross the road, walk 30m and turn right into Alfred Street. On the left hand side, in the gap between the library and the old Choral Hall, you will see the remnant of the old Albert Barracks Wall.

[11] Albert Barracks Wall

University of Auckland grounds

This stone wall was built between 1846 and 1847, using Māori labour supervised by the Royal Engineers to protect the Albert military barracks. It was part of a plan by Governor George Grey for the long-term defence of Auckland.

Bluestone was quarried from Mt Eden to build a typical mid-19th century fortification with bastions protecting the gates and a firing step along its length for troops to fire through loopholes. It protected an array of services and buildings, mainly simple timber structures but with some built in stone. They were designed to accommodate 1,000 soldiers, although only about 400 were ever quartered there.



View looking west from the Albert Barracks, 1868.
Special Collections,
Auckland City Libraries (NZ), 4-3391

This one section is all that remains of the barracks wall. The remainder of the stone was used to build the Kitchener Street retaining wall and railway culverts at Mechanics Bay.

Follow the wall to the left, look up to see the clock tower and Old Arts Building. Follow the path to the left back up to Princes Street and the entrance to the Old Arts Building.

Group of soldiers inside the Albert Barracks with the military store (left), circa 1850s.
Special Collections, Auckland City Libraries (NZ), 4-453



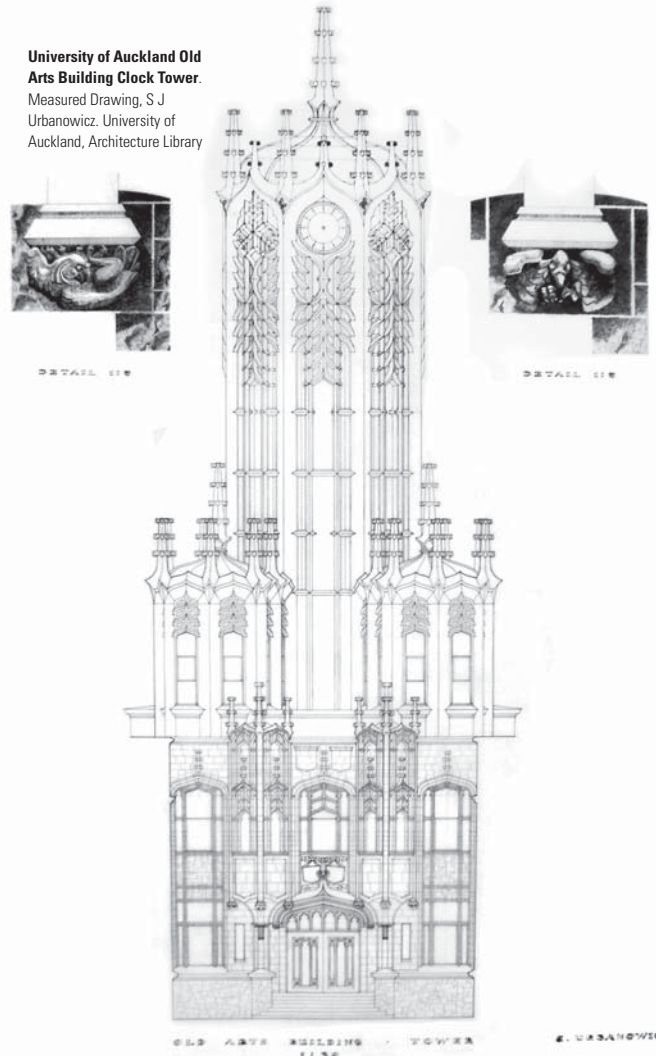
[12] University of Auckland Old Arts Building

22 Princes Street

The impressive University of Auckland Old Arts Building was built between 1923 and 1926 following a competition won by American architect R A Lippincott. Gothic in style, it is constructed of reinforced concrete faced with Mt Somers stone. The tower is 53.34m high and is based on Christopher Wren's Tom Tower at Christchurch College, Oxford.

The building was constructed by the Fletcher Construction Co, a company founded in Dunedin in 1909 by Scottish-born carpenter James Fletcher. At its zenith after WWII, Fletchers was active throughout Australasia, the Pacific and the west coast of North America. It is now a subsidiary of Fletcher Building Ltd.

University of Auckland Old Arts Building Clock Tower.
Measured Drawing, S J Urbanowicz. University of Auckland, Architecture Library



The building was refurbished and strengthened in 1985, whereby the tower was braced with steel and much of the concrete filigree replaced with fibreglass to reduce weight. Steel shear walls and diaphragms were installed in other parts of the building. The mosaic tile floor in the foyer under the tower is a special feature. The consultants for the refurbishment were Sinclair Knight Merz Ltd.

Continue along Princes Street to the Old Synagogue on the Bowen Street corner.

[13] Old Synagogue

19A Princes Street

The old Gothic and Romanesque styled Jewish synagogue was designed and built by Edward Bartley in 1884-1885. He used a novel approach by using scoria concrete as a construction material, thought at the time to be similar in strength to bricks and mortar. Today it would be considered lightweight concrete. Because it was more elastic than conventional concrete, it was likely to have been more robust in an earthquake than the brick construction typical of that time. Bartley (1830-1919) arrived in New Zealand from the Channel Islands, aged 14, and worked as an apprentice cabinet maker, eventually becoming a builder and later, an architect. The synagogue served the needs of the Jewish merchants, many of whom lived in mansions along Princes Street and Waterloo Quadrant.

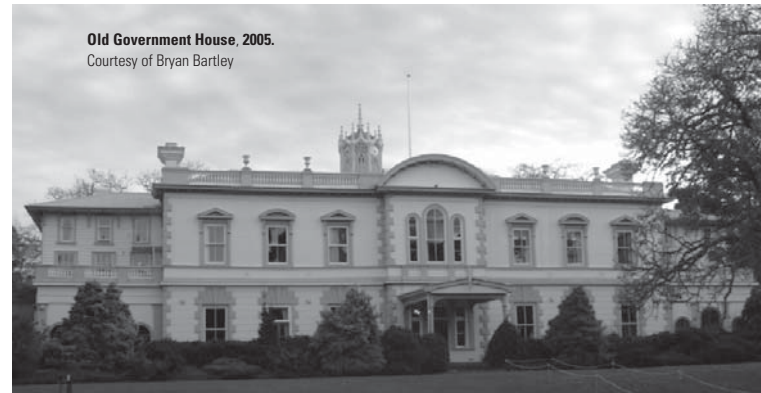
The building was earthquake-strengthened by the Auckland City Council. This included drilling holes vertically down the walls and grouting in reinforcing steel. Many of the

synagogue's handsome features remain; including an elliptical staircase, barrel vaulted stencilled ceilings, fine glass and richly ornamented plasterwork in the old Ark. The building is currently occupied by the University of Auckland.

At the Waterloo Quadrant corner, enter the grounds of Old Government House past its contemporary lodge and follow the drive towards the early governors' residence.

[14] Old Government House

Waterloo Quadrant



Old Government House, 2005.
Courtesy of Bryan Bartley

Old Government House, located on the University of Auckland's campus, was designed by William Mason, first Superintendent of Public Works, as the official residence of the Governor General. It was completed in 1856 and the timber construction of the building was perhaps its most significant feature. With a gross floor area of 2,073m², it is thought to be the second largest non-industrial wooden building in the country. It is certainly the grandest, reflecting the stature of its occupants who, as the Queen's representatives, were the most powerful officials in the early colony.

Timber was a commonly used building material in New Zealand and was the obvious choice in Auckland in its early days, although it was not considered the material of which great buildings were made. Thus, the timber construction makes a pretence of being stonework by overlaying the corners with chamfered board to represent quoins, by making lintels in the shape of wooden arches complete with 'keystones', and by using great slabs of close-butted kauri timber (450mm x 40mm) on the central block. It is certainly difficult to think of these heavy kauri boards merely as weatherboards.

Most of the original two-storeyed house perimeter is built on massive (600mm thick) bluestone walls, well founded on the



Synagogue on Princes Street, 1903.
Special Collections, Auckland City Libraries (NZ), 1-W1025

original weathered volcanic subsoil. The frame of the building is generally 150mm x 50mm studs at 300mm centres with massive plates, the top plate being 300mm x 150mm. The first floor structure comprises principal beams of the same size, with joists running lengthwise. Timber trusses support the roof over the central block while tied rafters span the 260m² ballroom.

Unlike the old masonry buildings in Auckland, Old Government House has required no subsequent seismic strengthening.

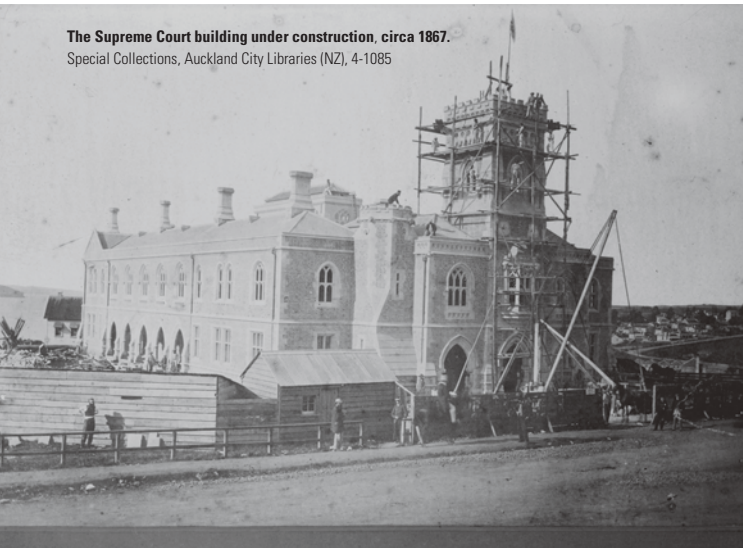
Continue to follow the path. Turn left when the path forks and exit at the intersection of Anzac Avenue and Symonds Street. Straight in front of you, on the corner of Waterloo Quadrant and Anzac Avenue, you will see the Auckland High Court.

[15] Auckland High Court

Waterloo Quadrant

The red brick and stone courthouse (formerly known as the Supreme Court) was designed by Edward Rumsey, a student of Sir Gilbert Scott, restorer of English Gothic churches. The Gothic influence can be seen in its castellated towers and in the portrait heads and gargoyles carved by Prussian immigrant Anton Teutenberg. He was a ship's carpenter and it was arranged that he would stay ashore for one round trip and carve the portrait heads in wood to be later cast in concrete. Some of these original wood carvings are displayed in the foyer. Construction began in 1865 and was finished in 1867. Edward Bartley completed the construction when the first builder went bankrupt.

The Supreme Court building under construction, circa 1867.
Special Collections, Auckland City Libraries (NZ), 4-1085



The old colonial building has been incorporated in a new law court complex developed by the Department of Justice. The task of strengthening the building to bring it up to modern earthquake standards was particularly complex. There were only limited locations for new strengthening walls which placed great demand on the floor diaphragms to transfer earthquake loads to the new walls. Consequently, steel sheet diaphragms were constructed and sandwiched between the original floor and the new floor overlay.

The central tower was an engineering challenge for Sinclair Knight Merz Ltd, as earlier modifications left it with very little gravity support over three of its sides. A giant frame was erected within the tower, extending down to foundation steel where it was anchored to the base rock.

Two pohutukawa trees behind the high court mark the entrance to the former New Zealand Parliament House (1854-1865), used during Auckland's brief reign as capital of the colony.

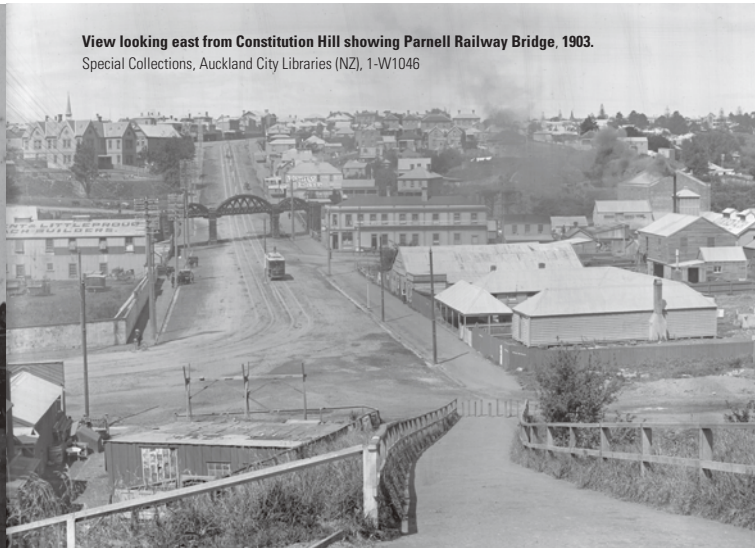
Cross the road and head down Anzac Avenue. At the top of Constitution Hill, look down to view the Parnell Railway Bridge.

[16] Parnell Railway Bridge

Parnell Rise

The Parnell Railway Bridge, originally constructed between 1865 and 1866, is believed to be the oldest railway bridge remaining and still in use in the North Island. It was to be part of the ill-fated Auckland to Drury Railway Project. The project proposed giving access to the Drury and Waikato coalfields south of Auckland, and providing a supply line to

View looking east from Constitution Hill showing Parnell Railway Bridge, 1903.
Special Collections, Auckland City Libraries (NZ), 1-W1046



the military forces engaged in the Waikato Land Wars in 1863-1864. The bridge was to be the first part of that project involving a link between Mechanics Bay and the Newmarket settlement. Unfortunately, time and cost over-runs resulted in abandonment of the project in 1866 and it became locally known as the 'bridge to nowhere'.

The construction involved a bowstring truss bridge with a viaduct over Parnell Rise, all supported on large basalt piers. They were built in a monumental style for the period with mortar bonded ashlar masonry concealing rubble backing. It was unusual for early railway bridges to feature basalt as a construction material. It is still in good condition except for some mortar cracking due to vibration at the top of a southwestern pier. It has technological value for retaining elements of major engineering achievement from our early colonial history and reveals information about construction, quarrying and other techniques of construction.

It remained a costly 'white elephant' until Prime Minister Sir Julius Vogel's public works policies came into operation in the 1870s. During this time it was reclaimed and became the first part of Vogel's railways to be operational and run by the government. Modifications were made in the 1890s and some masonry piers were raised in height. Between 1908 and 1909, substantial modifications were made and the entire superstructure was replaced with a 39m span double-intersection Warren truss with overhead ties. Two piers were removed to widen the roadway and the remaining piers widened for double track rail. The construction was of identical style to the original. It was completed in 1909 when the main trunk railway between Auckland and Wellington was opened.

It is interesting to note that the original 1860s rail gauge was 1435mm wide for a single track, but this was later replaced with the present, narrower 1067mm gauge.

The Parnell Railway Bridge remained part of the main trunk link until the Orakei to Westfield deviation eventuated in 1930, but has remained in daily use for suburban trains with only some rail replacement. In 1974 overhead ties were added to the truss. The aesthetic value of the monumental appearance is largely concealed today by advertising hoardings.

Continue down Anzac Avenue until you reach the zig-zag path. Follow this path down to Beach Road and the Auckland Railway Station.

[17] Auckland Railway Station

26-48 Te Taou Crescent

The 'new' railway station that you see here was the result of a controversial decision to move the trains from their inner city site in the 1920s. Gummer & Ford, one of New Zealand's most distinguished architectural firms in the early 20th century, designed the building and was awarded the New Zealand Institute of Architects gold medal. It was built between 1927 and 1937 and at the time was the largest contract ever undertaken in New Zealand, costing £320,000.

Between 1901 and 1915 the Auckland Harbour Board had reclaimed the land on which the railway station sits, on behalf of the Railways Department. Because of reclamation instability, the foundations were piles tied together at ground level with reinforced concrete beams. The building frame was reinforced concrete with brick facings and a plaster parapet. Great care was taken to allow for seismic movement and train vibration. The station was never fully utilised, as the planned underground connection to the northern line at Morningside was never built.

In 1999, the Covington Corporation converted the station into conference facilities and 227 student apartments. It is now the University of Auckland's Railway Campus. Public entry is now restricted to the Grand Foyer where the lavishly decorated tile floor and walls can still be seen.

Continue along Beach Road and turn right at Britomart Place.



Railway Station Perspective 1927 Permission of Hoadley Budge, Auckland

[18] Point Britomart

Britomart Place

Britomart Place marks the end of the headland known as Point Britomart which was demolished during the 1880s for the reclamation of Official Bay. It was the spot where the city of Auckland was founded in September 1840 by Lieutenant William Hobson, marked by the raising of the Union Jack of the British colonists. It was named Point Britomart after the HMS Britomart, the brig that brought Felton Mathew, the first Surveyor-General, to Auckland.

Auckland's first colonial fort was built on this point under the supervision of George Graham of the Royal Engineers. The Royal Engineers, or 'sappers of the Empire', had become a separate part of the British Army in 1683 and were largely responsible for the development of modern defence techniques. Fort Britomart was a half-moon shaped redoubt protected by cliffs on two sides and a ditch on the landward side. Soldiers built the barracks in 1841. They were dismantled in 1883 to make way for Auckland Harbour Board 'improvements'.

Continue along Quay Street back to the Visitor Information Centre.



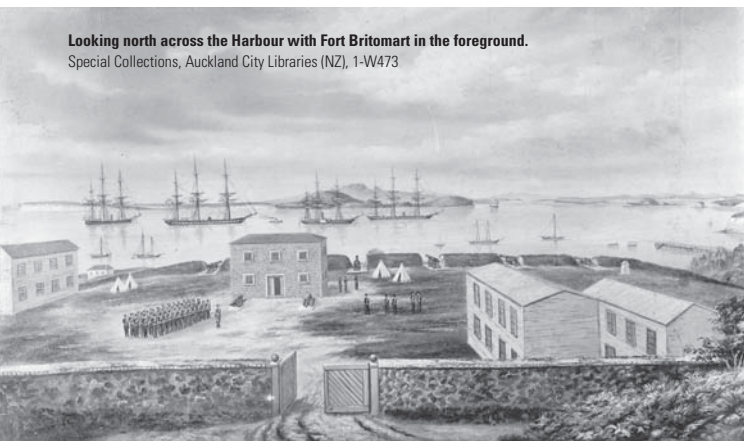
View from Customs Street looking toward Point Britomart which is in the process of being dismantled to fill Commercial Bay, 1865.

Auckland Harbour Board collection, NZ National Maritime Museum

Other features worth the walk

Looking north across the Harbour with Fort Britomart in the foreground.

Special Collections, Auckland City Libraries (NZ), 1-W473



[a] Grafton Bridge

Linking Symonds Street and Grafton Road

When it was opened in 1910, Grafton Bridge had the longest reinforced concrete arch span in the world, a distance of 96.7m. It replaced a low level timber foot bridge. Although it was considered extravagant at the time, it provided a critical link between Auckland Hospital and the urban centre.

The Ferro-Concrete Company of Australasia built the bridge from the design of chief engineer R F Moore. It was the more expensive of two tenders received by the Auckland City Council, but the concrete structure was preferred against the steel alternative on the grounds of lower maintenance. The contract was let for £31,918, but the



View from the temporary footbridge showing the 'new' Grafton Bridge on the Grafton side of the gully, 1909.

Special Collections,
Auckland City Libraries (NZ),
7-A353

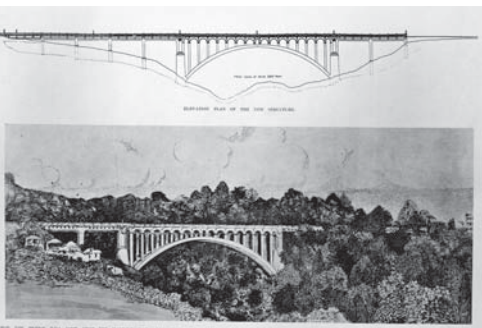
contractor got into difficulties and was soon bankrupt.

Council staff completed the project.

Grafton Bridge was one of the first large reinforced concrete structures to be built in New Zealand and a work

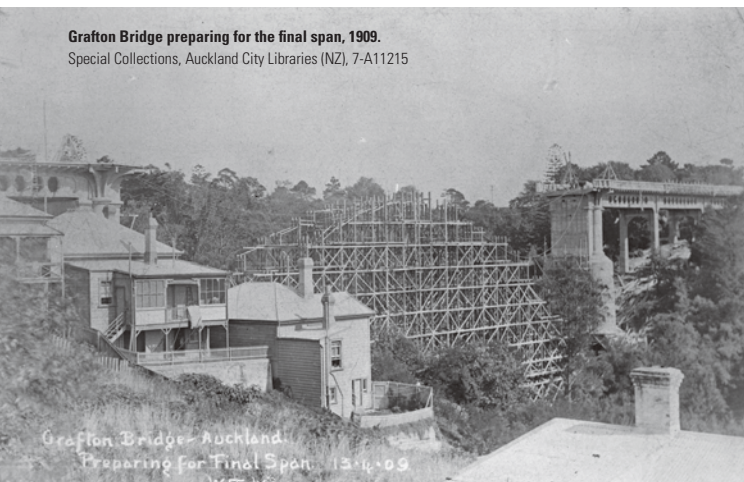
Elevation plan and sketch of the completed Grafton Bridge structure as seen from the harbour, 1907.

Special Collections, Auckland City Libraries (NZ), 7-A282



Grafton Bridge preparing for the final span, 1909.

Special Collections, Auckland City Libraries (NZ), 7-A11215



*Grafton Bridge - Auckland
Preparing for Final Span. 12.14.09*

of considerable engineering enterprise and aesthetic merit. False piers were used to suggest strength and inspire public confidence but the load was carried on slender reinforced concrete supports. The twin, three pinned arches rose 25.6m above the abutments, to a height of 43.3m above the valley floor. Load tests were carried out before the bridge was opened using 292 tonnes of road metal on one half of the arch span and two steam rollers, together weighing 32 tonnes.

Built at a time when cars were rare and trucks were small, the bridge now accommodates heavy traffic flows with some truck load restriction.

In 2003, glass anti-suicide barriers were installed above the footpaths on both sides of the bridge with great care being taken as far as possible to protect the structure's aesthetics.

The Grafton Bridge has received an IPENZ heritage plaque.

From the centre of the bridge, look out to view some of the Auckland motorway network.

[b] Auckland Motorway Network

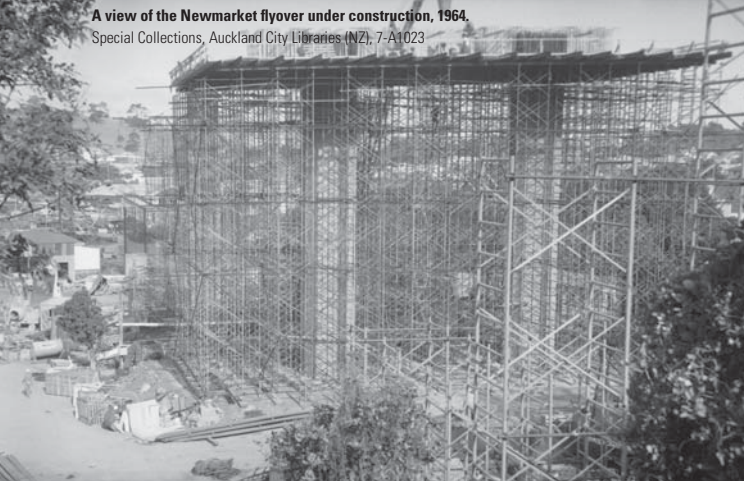
Viewing from Grafton Bridge

Traffic congestion prompted engineers from the 1940s onward to consider alternative transportation systems for the city. In 1949, the London engineering firm Halcrow, Thomas & Partners recommended the rail network be extended across the city, but a motorway system (based on American and British models) was eventually favoured over mass transit. The approach was advocated in the 1955 Master Transportation Plan by an expert committee chaired by the City Engineer Alan Dickson and in the 25-year plan prepared by the American engineering consultancy De Leuw, Cather & Co from 1963 to 1965 (approved by the Auckland Regional Authority in 1966). This report concluded that there was a need for the parallel construction of a rapid transit system. It was not built, as the authorities involved could not resolve who

Aerial view of 'spaghetti junction', 2004.

Courtesy of Geosmart Ltd,
Auckland





should meet the capital cost of \$42 million.

Following recommendations from a study carried out by the Ministry of Works and Development, New Zealand Rail and the Auckland Regional Authority, central government offered to finance the capital cost of an electric rail system in 1973, provided local government met the operating costs. The offer was rejected.

A more cautious approach to motorway construction was taken in the late 1970s, following the Auckland Regional Authority's comprehensive transportation study of 1976 which noted growing environmental and capital cost concerns.

Work began on the Southern Motorway in 1950 and in five development stages reached and completed the Bombay section in the mid-1990s. Construction of the Northwestern Motorway also began in 1950, with a two-lane road between Point Chevalier and Lincoln Road. This was transformed into a dual lane carriageway from the late 1970s. The Hobsonville to Western Springs section was finished in 1970 and the Western Springs to Motion Road section in 1983.

Coinciding with the completion of the Auckland Harbour Bridge, the first four-lane section of the Northern Motorway was finished as far as Northcote Road in 1959. It was widened to six lanes and stretched to Sunset Road in the 1970s. An extension north to Albany commenced in the 1980s and to Puhoi in the 1990s.

The Central City Motorways were built during the 1970s and the Onehunga and Mangere Bridge sections of the Southwestern Motorway were completed in 1983. This motorway has since been extended to the airport and south to Manukau City.

There are a number of motorway projects of particular engineering interest. The Newmarket Viaduct (1965), designed and built by the Ministry of Works, was New Zealand's first continuous, concrete, box girder bridge and the first using cantilever construction rather than falsework.

Subsequent problems with the opening of construction joints led to the first code of practice for temperature gradients in the world.

The Symonds Street Bridge (1968), which runs perpendicular to Grafton Bridge, was built before underlying motorway excavations commenced, with the foundations and piers sunk from the existing street level. The bridgework was completed in two stages so that traffic could continue to flow along Symonds Street.

The Newton Gully Interchange (1969-1970), which links the southern, western and northern motorways, was an engineering work of immense difficulty requiring massive earthworks and many multilevel bridges.

The Ministry of Works and Development was responsible for the design and construction of the motorways and most of the bridges. The Ministry was corporatised from the mid-1980s, following government restructuring. The motorway system was recognised as one of New Zealand's greatest engineering achievements by the Institution of Engineers in 1990, and received an IPENZ heritage plaque.

Continue across Grafton Bridge, past the Auckland Hospital. Just past the Hospital, enter the Auckland Domain, walk past the duckpond toward the Auckland War Memorial Museum at the top of the hill.

[c] Auckland War Memorial Museum

Access from Stanley Street, Park Road, Carlton Gore Road, George Street or Domain Drive



An aerial view of the museum, looking south east, 1966.
Special Collections, Auckland City Libraries (NZ), 7-A3769

The Auckland War Memorial Museum sits on Pukekawa, 'hill of bitter tears', which is part of the tuff ring of the ancient Domain volcano. The museum was built in two stages as a memorial to those who enlisted from the Auckland province and were killed in the two world wars. The first half was opened in 1929, and the second, rear half in 1960. In the Hall of Memories on the third floor of the museum, 7,297 names are inscribed for WWI and 4,702 for WWII. More broadly the building stands as a living memorial to all those who have served in conflicts throughout our nation's history.

The extension was provided for in the original plans of Grierson, Aimer & Draffin, the firm that won a competition to design the new building in 1922. All three architects were veterans of WWI.

The first stage was built by contractors Hansford & Mills at a cost of £192,454, which was raised by public donation and government contribution. The second stage cost £337,000, the funds again sourced from the public and government. The architects were Draffin & Sons, the engineers Beca and the contractors McLeod Construction.

A solemn but grand building with massive Doric columns and portico, the museum draws on classical Greek style. The first stage was constructed of reinforced concrete clad with imported Portland stone on a Coromandel granite base. Because of cost constraints, cement was used to mimic the Portland stone on the stucco exterior of the second stage, providing an interesting opportunity for comparison of the two exteriors. The difference is still barely discernable.

From 1996 to 1999 the building was unobtrusively modified to meet new seismic and other codes, and the amenities modernised. All the galleries were refurbished and displays extended and renewed.

A recent (completion date December 2006) major construction has been within the inner courtyard. Extending over seven levels, it includes two basements excavated beneath the original building housing exhibition storage space and workshops. A four storey structure (the bowl) containing the learning centre, auditorium and events centre is suspended dramatically above the grand atrium and special exhibition spaces. The whole development is capped by a copper clad dome with glass perimeter. The engineer was Holmes Consulting, the architect Noel Lane Architects, and the contractor Hawkins Construction.



View showing the north and west faces of the Auckland War Memorial Museum under construction, 1927.

Special Collections, Auckland City Libraries (NZ), 1-W/862

Glossary

Ashtar A square block of hewn stone for use in building.

Bascule bridge The most common type of movable bridge in existence. A drawbridge with a counterweight that continuously balances the span throughout the entire upward swing in providing clearance for boat traffic.

Bluestone Basalt.

Caisson A watertight chamber open at the bottom and containing air under pressure, used to carry out construction work under water.

Cam A rotating cylinder attached to a revolving shaft to give a reciprocating motion to a part in contact with it.

Cantilever A beam, girder or structural framework that is fixed at one end only.

Chamfer A narrow, flat surface at the corner of a beam.

Coromandel granite Not actually granite but diorite, an igneous rock, sourced from the Coromandel peninsula, north-east of Auckland.

Destructive distillation Driving off (and collecting) gas from some matter by heating it in the absence of air.

False work The temporary framework, usually timber, used to support a structure while it is being built.

Ferry tees A wharf or jetty in the form of the letter T.

Formwork Timber boxing used as a mould for concrete.

Lighter A flat-bottomed barge used for transporting cargo, especially in loading or unloading a ship.

Lintels Horizontal beams, as over a door or window.

Meldrum destructor A type of incinerator made by the Meldrum Brothers of England.

Mt Somers Stone A hard, high-density stone from Canterbury that can be cut with clear, sharp edges.

Oamaru stone A soft stone sourced from Oamaru on the east coast of the South Island.

Pinion A cogwheel that engages with a larger wheel or rack.

Portland stone A limestone quarried from the Isle of Portland, Dorset, England.

Proscenium The arch or opening separating the stage from the auditorium.

Quoins Stones forming the external corner of a wall.

Retort A vessel used for heating coal to produce gas.

Shotcrete Concrete which is sprayed on to a surface.

Slipform shuttering A process where concrete is poured into formwork that is then progressively moved upwards as the building is constructed.

Truss Structural framework of wood or metal used to support a roof, bridge, etc.

Water dampers Tanks of water that are used to counter balance a structure to reduce it swaying with the wind.

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