

Waihorotiu Stream



Waihorotiu Historic Alignment

KEY

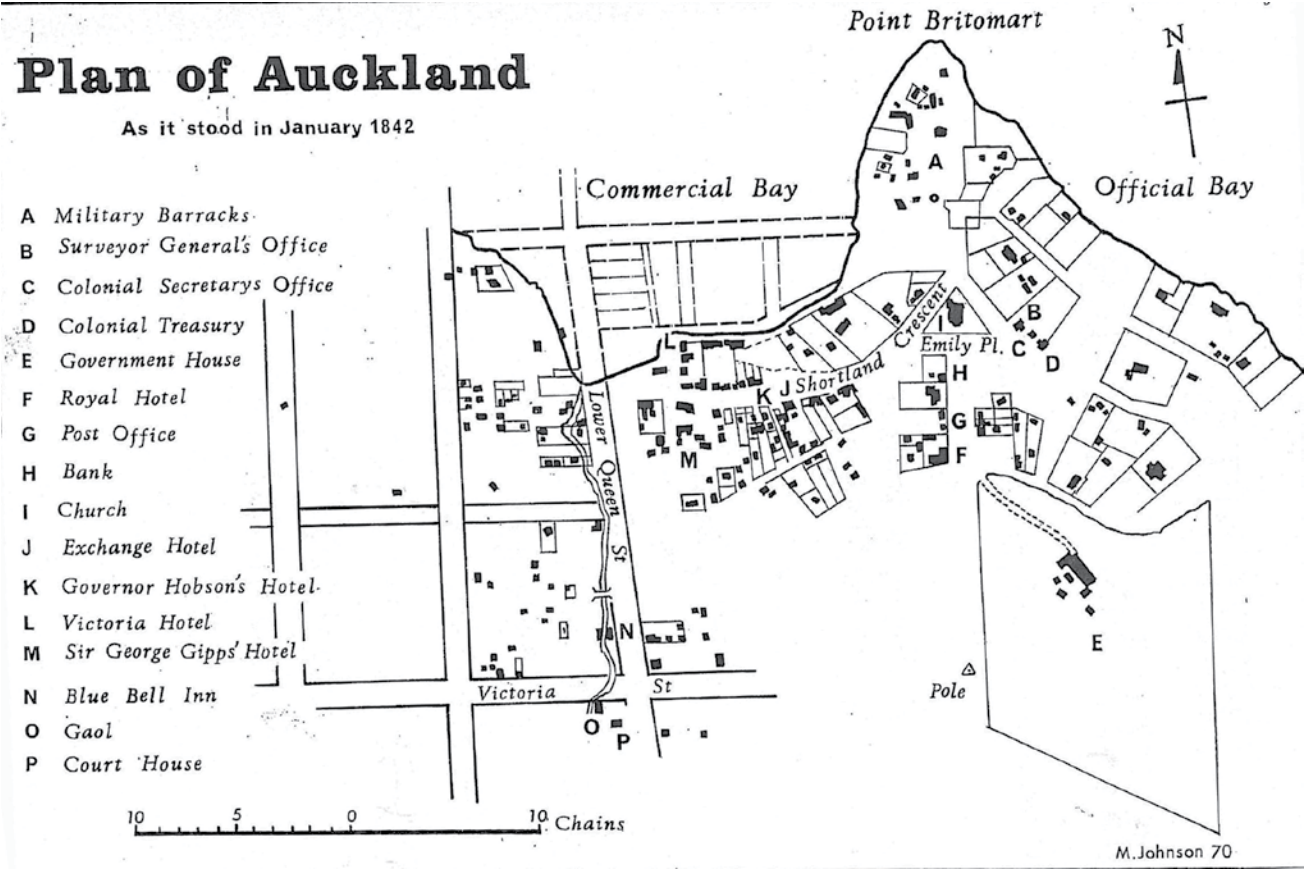
-  Early Auckland, undated map
Special Collections, Auckland City Libraries (NZ)
-  Map of Auckland 1882
NZ Map 2664, Special Collections, Auckland City Libraries (NZ)
-  Felton Mathews Plan of Auckland 1841
NZ Map 2664, Special Collections, Auckland City Libraries (NZ)
-  Waihorotiu Gully drainage
ACC Drainage 015 2565-1
-  Plan of Auckland 1841
Bush's ACC Centennial
-  Auckland in its natural state. *ibid*
-  Ligar Canal drainage
ACC Drainage 015 3038-1
-  Map of Auckland 1882
NZ Map 91, Special Collections, Auckland City Libraries (NZ)



The stream alignments as indicated on the plan above were traced from historical maps sourced from ACC and ARC records, Auckland City Libraries and Land Information New Zealand. Maps were scanned rotated and scaled according to tags on individual plans, or were placed according to coincidence with existing road networks and the known historic coastline. Distortion was inevitable since historic maps were often stylised, never orthorectified, and often poorly surveyed.

Other reference material included historic photographs, historic aerial photography, allotment maps from the 19th century, focus site plans and early city planning documents. GIS information also provided topography and historical flood-plains which when mapped together provided for logical historic drainage patterns.

Derived stream alignments did not overlap with precision but there was regularity in terms of stream forms in relation to specific gullies as they occurred in the mid-19th century. These reoccurring systems appear as a blue wash on the plan above, sitting atop the coincident stream alignments.



Plan of Lower Queen St and Britomart Point in 1842
Bush, G.W.A 1971. Decently and in order: the government of the city of Auckland 1840-1971, the centennial history of the Auckland City Council



Waihorotiu Gully Drainage between Greys Avenue and Upper Queen St
Auckland City Council Archives NZ, City Engineers Plans, ACC 015/2565-1



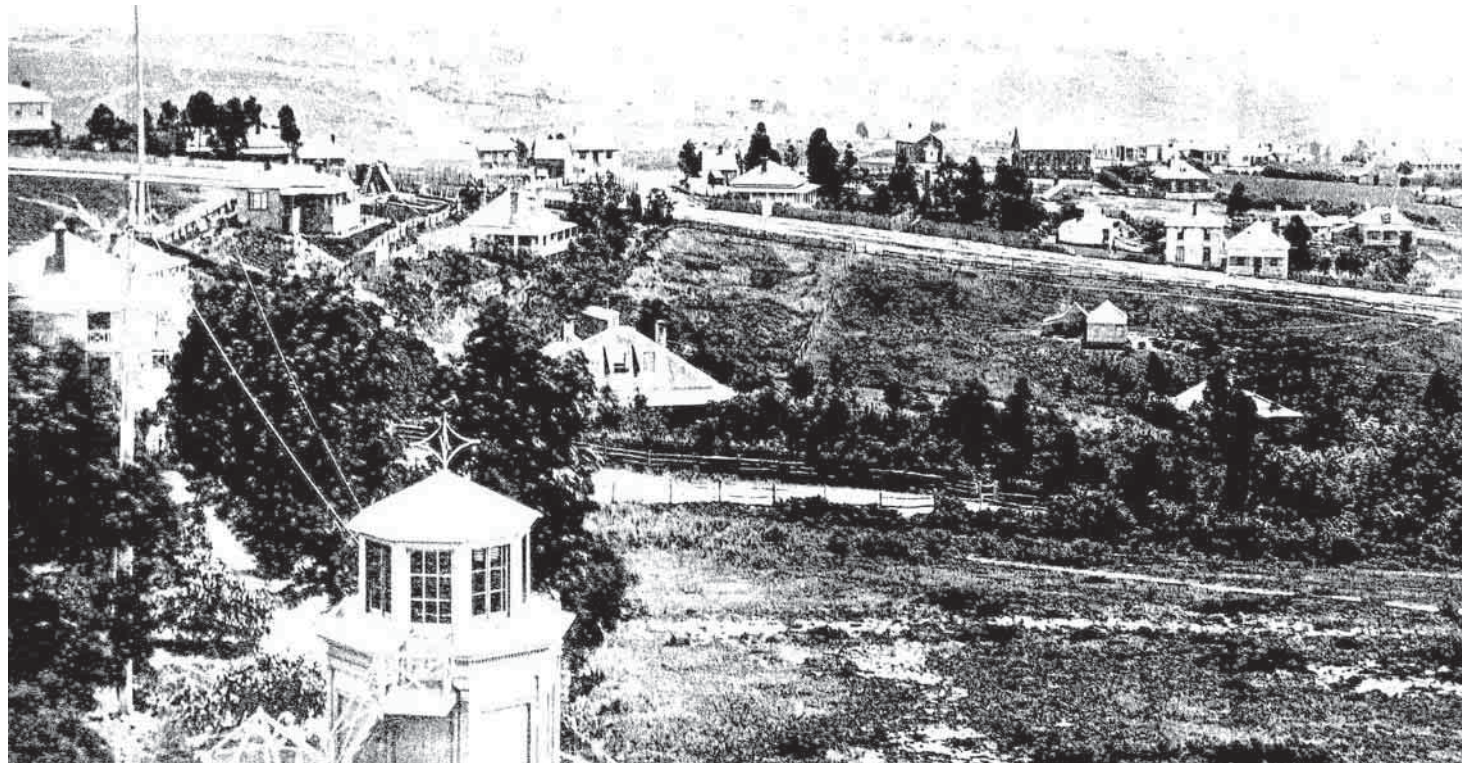
Plan of the Town of Auckland, New Ulster 1841
NZ Map 4611, Special Collections, Auckland City Libraries (NZ)

Waihorotiu History

Te Waihorotiu's original catchment was bounded by Symonds Street, Karangahape Road and Albert Street, with perennial flows emanating from Grey Street (Myers Park) and Vincent Street gullies, and a watercourse from the current location of Wellesley Street East. Approximately 60,000 years ago, volcanic activity near the site of the present day Victoria Street Car Park sent lava flowing down what is now Victoria Street, crossing the Queen Street gully to dam Te Waihorotiu. This created the Aotea swamp in the area of the Town Hall today (NZ Map # 2664, Special Collections APL). It has also been suggested that a landslip (horo) came down the line of Wellesley Street, spreading and temporarily impeding the stream's flow (Best 1992). This may also be the reason for the curving westward line of the stream between Wellesley and Victoria Streets, seen on Felton Matthew's 1841 plan of Auckland (NZ Map # 2664, Special Collection, APL) and a 1910 Auckland City Council Queen Street drainage plan (Ligar Canal Drainage, PAn 3038-1, ACC 015, City Archives).

During the course of an archaeological examination of the first courthouse and gaol at the corner of Queen and Victoria Street, an analysis of organic material showed that 25,000 to 18,000 years ago the stream flowed through a deforested landscape dominated by grasses, herbs and shrubs, the vegetation of a cooler climate. At this point, during the glacial maximum, Te Waihorotiu would have been a tributary to a larger watercourse where the Waitemata Harbour is today. Around 700 years ago, in the warmer climate of that period, Te Waihorotiu flowed through a typical coastal broadleaf podocarp forest (Best 1992).

Indications of human activity in archaeological surveys show fire-induced scrub species and possibly regenerating forest over the last centuries. Rat-gnawed hinau berry kernels were also found, showing the presence of the Polynesian rat. Given the results of this analysis, along with those from radiocarbon dating, archaeologist Simon Best came to the conclusion that land in forest clearings of the Waihorotiu catchment was used for agriculture by Maori approximately 700 years ago. Between 1400 and the arrival of Europeans to the area, Auckland's environment changed again; once again the streams flowed from treeless slopes, but with dominance of fern. A village known as Nga Wharau a Tako (Tako's Reed Huts) was sited on the Hobson Street ridge, "well famed for its hospitality", with a track leading down from the village via present day Swanson Street to Te Waihorotiu in the gully below (Nepia 1931).



1860 looking down to the Waihorotiu where Myers Park is today with Greys Avenue running left to right at centre. 1-W1846, Special Collections, Auckland City Libraries (NZ)



1857 James Richardson. Looking northwest along Queen Street

4-387, Special Collections, Auckland City Libraries (NZ)

Other place names associated with the stream and the activities around it are:

Te Rou Kai (the food gathering), a former pipi bank between the mouth of Te Waihorotiu and Point Britomart on the eastern side of the bay (ACC 2004d); Te Whatu (the rock), said to have been a rocky ledge jutting into the tidal creek, and therefore a convenient landing place for canoes located somewhere near the foot of Shortland Street (Nepia 1931); Te Tara Karaihi (a tern), a rock opposite Te Whatu on the western side of Queen Street, where it is said terns gathered waiting for food occasionally thrown out by incoming food gathering parties; Nga u Wera (the burnt breasts), near the mouth of Te Waihorotiu, where the stream once emptied into Horotiu Bay (Commercial Bay). According to one story, children from two settlements often went down to the foreshore to spear patiki (flounder). A disagreement arose, leading to a quarrel, and then a full-scale battle on the mud flats (Auckland Star 1931).

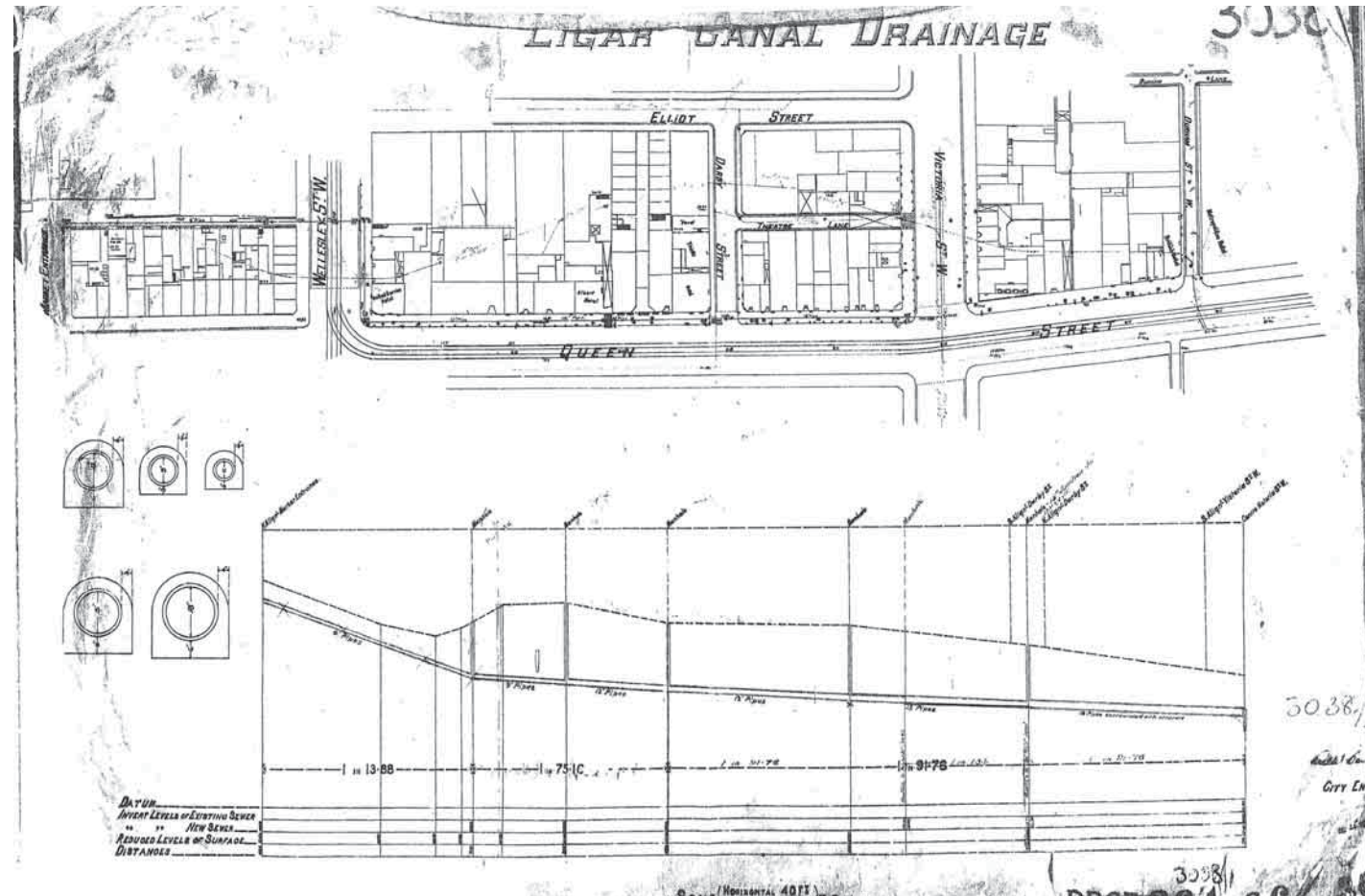
In 1925, an elderly gentleman recollected that Maori women camped in what is now Myers Park into the early 1860s (Auckland Star 1925). It was reported that Maori kits were known to be washed down to the bay via the drain of the Ligar Canal in the late 1850s, which would again seem to indicate a degree of Maori occupation along the banks of the stream (Southern Cross 1859).

European settlers described Te Waihorotiu in the 1840s as "a considerable tidal creek" running along the west of Queen Street where, "five or ten boats could be safely moored. A path through ferns wound its way along the creek, until it reached the junction of Queen- and Victoria Streets, where some soldiers were then trying their hands at brick-making; but to push further in that direction, through swamps, fern, and scrub, would have been a hopeless task" (Southern Cross 1862). Te Waihorotiu was a source of drinking water in the earliest period of Auckland's settlement and it was reported to be full of eels and small native trout above the tidal estuary that began close to Wyndham Street (Best 1992).

Waihorotiu History cont.

The pressures of settlement north of Victoria Street meant the natural watercourse soon became fouled by drains and sewers. An attempt at engineered drainage was made in 1842, when an open drain, at the edge of Queen Street, allowed access to sold allotments “impassable, without risking a fall into a muddy ditch in attempting to jump over it” (NZ Herald 1981).

The then Surveyor General, Charles Whybrow Ligar, adjusted Felton Matthew’s 1841 plan for Auckland, to move Lower Queen Street to the west and change Te Waihorotiu to a drain running on its eastern side. The Ligar Canal extended from the mouth of Te Waihorotiu, to the former tidal estuary at Wyndham Street. The Southern Cross at the time referred to Ligar as “the distinguished engineer of the works” (Southern Cross 1843). However, by the end of June 1843 heavy rains had caused the banks to give way, flooding Lower Queen Street and nearby houses and businesses.



Ligar Canal drainage plan and profile. Ligar Canal from city market to Durham St West, 10 November 1910, Auckland City Council Archives NZ, City Engineers Plans ACC 015 3038-1

At the beginning of August 1843, a day’s rain in Auckland saw the canal overflow its banks again in Lower Queen Street, creating “one vast sheet of water” sweeping away animals, goods, shingles and timber far out into the harbour (Southern Cross 2006). On 12 June 1860, the canal roofing collapsed, forming “an irregular ditch, resembling an earthquake crack” from the old mouth of the canal near the Metropolitan Hotel at Fort Street almost as far as the William Denny Hotel near Swanson Street. A photo from this period shows the aftermath of this collapse (Southern Cross 1860).

Between Wyndham and Shortland Streets, a footbridge spanned the canal, and was dubbed “Waterloo Bridge” or “Ligar’s Folly” (NZ Herald 1981). In May 1844, the canal was covered by planks and later that year Queen Street had been macadamised. By 1859, the Ligar Canal was the largest of 13 drains emptying into Commercial Bay, measuring six to ten feet across and three feet broad at the bottom.



Circa 1865. Queen Street looking north at the collapse of the Ligar Canal

4-400, Special Collections, Auckland City Libraries (NZ)

Upstream of the Aotea Swamp, in the area that is now the Auckland Town Hall, there was open pasture before subdivision in the 1860s. The Town Hall was completed in 1911 and development intensified upstream, including construction of shanty dwellings from 1880 onwards. Myers Park was cleared and opened as a public park in January 1915. The removal of the Aotea Swamp may have begun in 1843, when prisoners were seen scraping dry fill from part of Queen Street and “throwing all the earth they collect into the swamp in the middle” (Southern Cross 1843). Spoil from the grading of Upper Queen Street was apparently used to “choke up the swamp” in 1855 (NZ Herald 1981). The area wasn’t fully drained until 1872 when the first building of a market reserve was constructed. By 1859, and perhaps earlier, a sawmill was operating at the foot of Grey Street. There was still a “big pond of water, where geese and ducks disported themselves” close to Cook Street in the early 1860s (Auckland Star 1925).

The first Supreme Courthouse and gaol at the corner of Queen and Victoria Streets was on a site which straddled Te Waihorotiu from 1841 until 1864, serving as a public market (Best 1992). The stretch of the canal from Victoria to Wellesley Streets caused much public concern, described in 1869 as “the receptacle of abominable filth of every kind, night-soil, garbage, the putrescent carcasses of animals, and every conceivable kind of rubbish left to stagnate and fester, liable to generate plague and pestilence in the very heart of the city” (Southern Cross 1869).

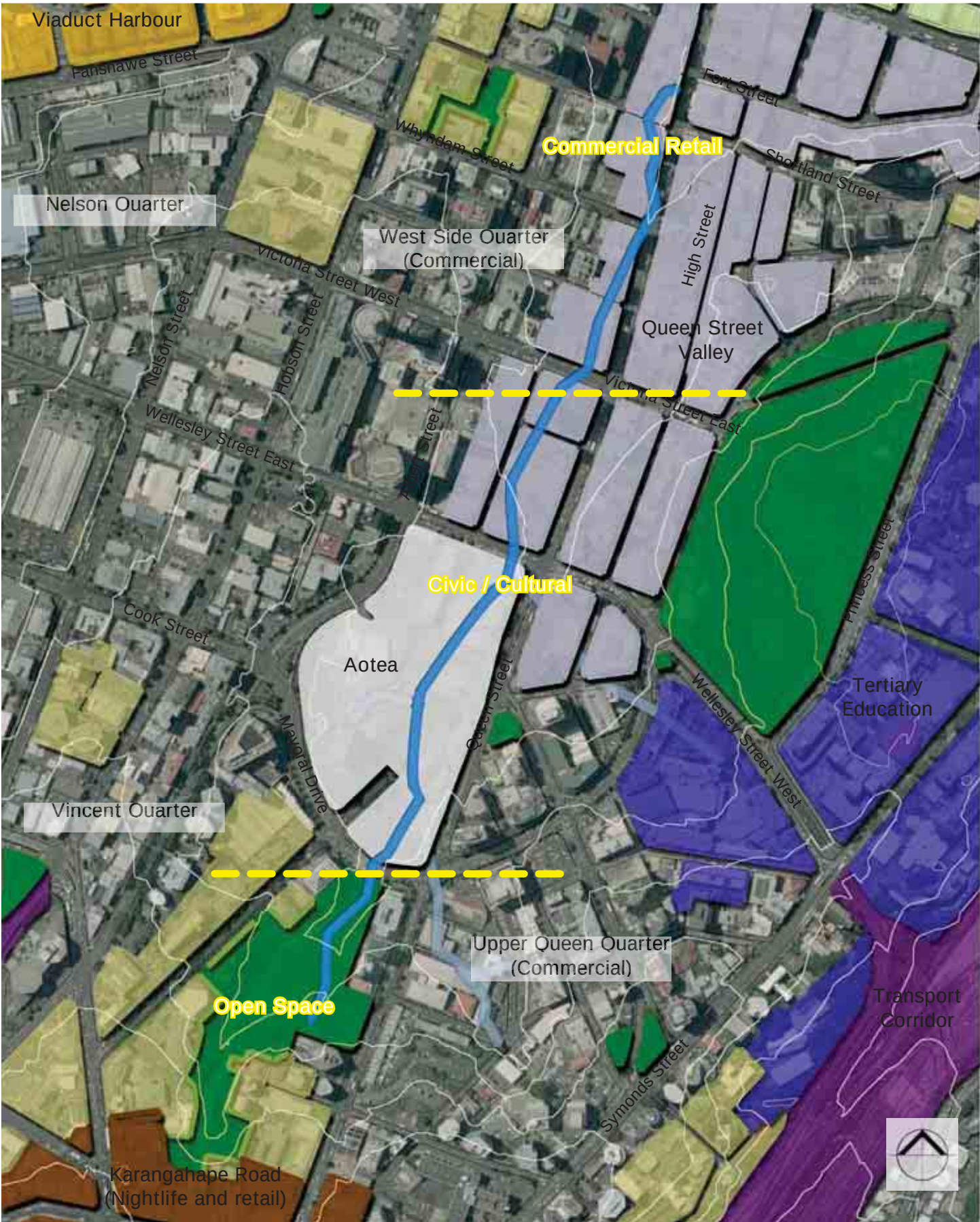
Therefore Te Waihorotiu was still an open drain up to the 1870s. In 1873 the newly-created city council advertised for tenders for work on “drainage of old Supreme Court-House Site, corner Queen- and Victoria-streets”. This was part of a period of replacement of the old canal by a fully-enclosed brick barrel drain, followed later by concrete drains (Southern Cross 1873).

By 1987, the old brick sewers were only used for “a bit of seepage”, made redundant by modern drainage systems installed during the course of last century. The Ligar Canal by this stage was said to be “only about 25 yards long before it terminated in a brick wall with the raw sewage flowing through a low gap” (Metro 1987).

Waihorotiu Land Use

KEY

-  Residential
-  Special designation
-  Open space
-  Business
-  Focus stream
-  Transport corridor
-  Tertiary education precinct
-  Queen Street Valley precinct
-  Viaduct Harbour precinct
-  Karangahape Road precinct
-  Aotea precinct



The Central Area section of the District Plan is evolving through parallel planning processes for urban design, transportation, and open space. Currently the overlying zones are based on “Precincts”, replacing the former overlay of “Quarters”.

The Waihorotiu historic alignment flows through the Queen Street Valley, combining the nightlife and fashion of the old town around high street, with retail and business on the west side of Queen Street. Generally Queen Street is the conduit for pedestrian activity during the course of the day and the connection between a wide diversity of land use types within the city.

Upper Queen Street has generally low to mid-rise buildings at the edges of Mayoral Drive. Downhill there are large scale institutional buildings such as the St James and Civic theatres, the Town Hall, and the Aotea Centre. Sidewalks are wide in this location with many converging side streets.

Between Wellesley and Customs Street the buildings are high-rise of minimal setback, with integration of both heritage and modern buildings. Street trees are both mature and juvenile exotic specimens with occasional nikau and cabbage tree planted in association with 2007 streetscape improvements.

At the terminus of Queen Street is a transportation hub, with fast moving cross streets of Quay and Customs Streets, Britomart Bus Terminal, and the ferry terminal. There is an area of civic space between the heritage buildings of Britomart and the Westfield Downtown Shopping Centre, containing public seating, sculpture and a ricket of juvenile kauri trees.

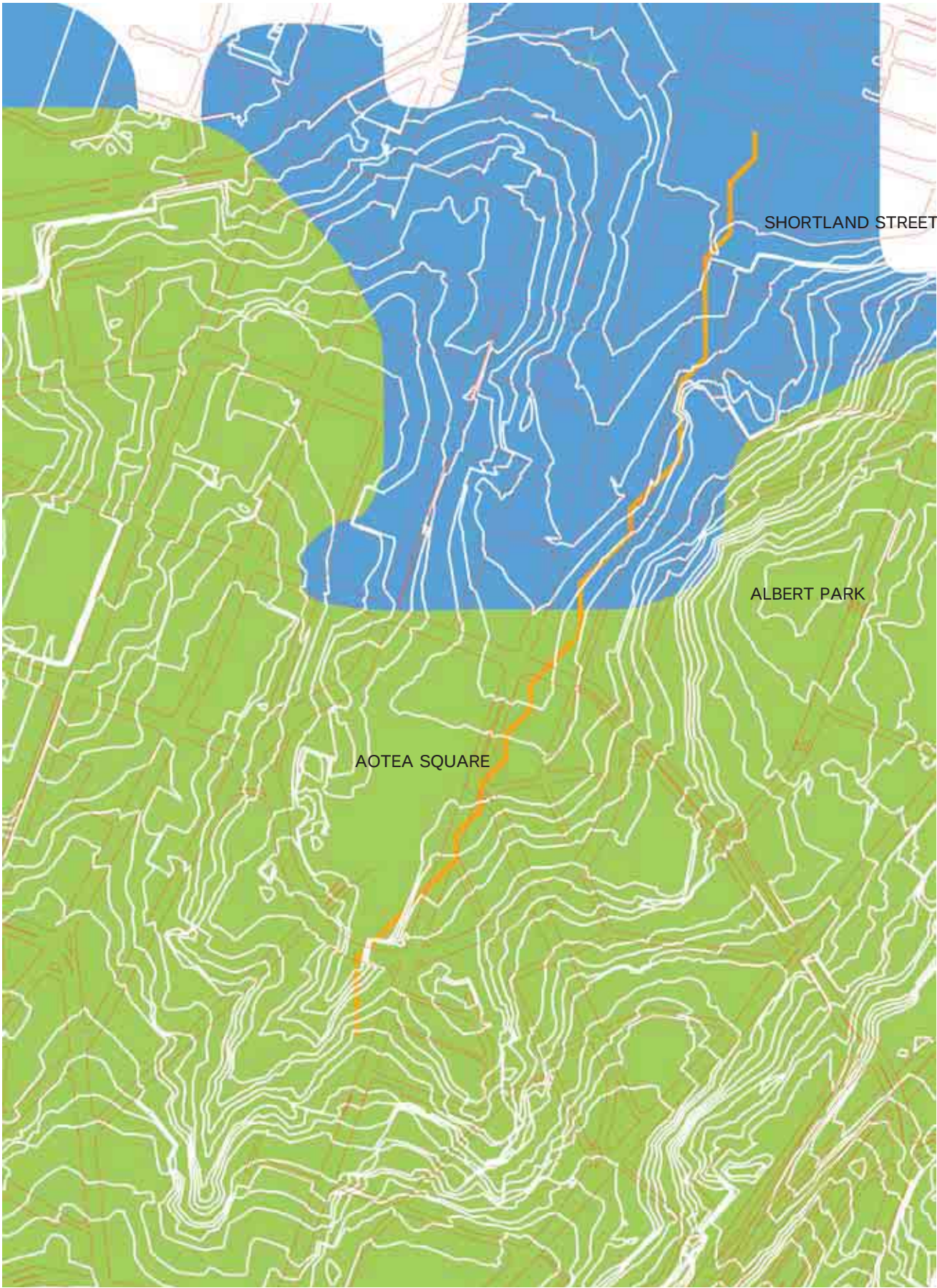
Heritage buildings and views to the harbour are important factors in the redevelopment of Queen Street. The intense public debate around paving stones, heritage kerbs and street trees, indicates there are many elements within the streetscapes that bear consideration in terms of perceived value. The combination of steep west-east slopes and the straight alignment of Queen Street provides for heavy shading and wind tunnel environments in many instances.

The straight alignment of Queen Street and the sequence of perpendicular cross-streets, provides the iconic images of Auckland diagonal crossings over wide streets and beneath high-rises. The straight alignment of Queen Street at the base of the Waihorotiu Gully also provides for a strong datum that defines the centre of the CBD and connects coast and ridge, and the Viaduct to Karangahape Road.

Waihorotiu Land Environments

KEY

-  Reclaimed land
-  5 metre contours
-  Level 2 - A6
Undulating hills of weathered greywacke and sandstone. Very low fertility and moderate drainage
-  NZREC low valley gradient



The information relating to environments in the Waihorotiu catchment has been derived from databases associated with Land Environments New Zealand (LENZ), New Zealand Geological Society, New Zealand River Environment Classification (NZREC) and Land Resource inventory (LRI) of the former Ministry of Works.

The geology is similar to other lowland environments in the CBD of the Waitemata group, with underlying weathered greywacke and sandstone with alluvial deposits. The eastern catchment has an underlying geology of basalt tuff from the volcanic cone associated with Albert Park. Geology along the historic stream alignment is generally moderate drainage with poor fertility.

The valley would be expected to support kauri, tanekaha and kanuka forest on the upper slopes and ridgelines, with mid slopes supporting a greater diversity of podocarps such as rimu and totara. Tributaries would support broadleaf stands of kohekohe, taraire and puriri with nikau and tree ferns prevalent. On lower slopes, in damp areas and in deeper soils kahikatea, matai and pukatea would have featured.

The coastal environment would also have favoured pohutukawa with a dense canopy of coastal shrub species. Before European arrival, fires would already have induced bracken and manuka on the slopes and produced gumland areas of sedges, rushes and tanglefern.

There is evidence of Maori cultivation in the area and frequent harvesting of resources in wetland areas at the site of the existing Town Hall and the mouth of the Waihorotiu. The mouth of the valley into Commercial Bay would have consisted of estuarine deposits of alluvial soils and sand flats.

The catchment is generally undulating land that is strongly rolling in the upper catchment. The main stem of the Waihorotiu stream has a low valley gradient with steeper valleys to the east and west of the stream that would have supported tributaries and ephemeral watercourses. The reclamations of the bay extending beyond the historic mouth of the Waihorotiu is comprised primarily of land borrowed from excavations of Britomart Point.

Waihorotiu Landscape Connections

KEY

- City "Netwalks"
- Ecological linkages
- Strategic bus routes
- Strategic rail routes
- Proposed art bridges
- Major arterial roads
- Secondary arterial
- Major pedestrian cross connections
- Neighbourhood connections
- Nodes of activity
- Point of interest
- East - west art link
- Historical stream alignment
- Greenway distributor

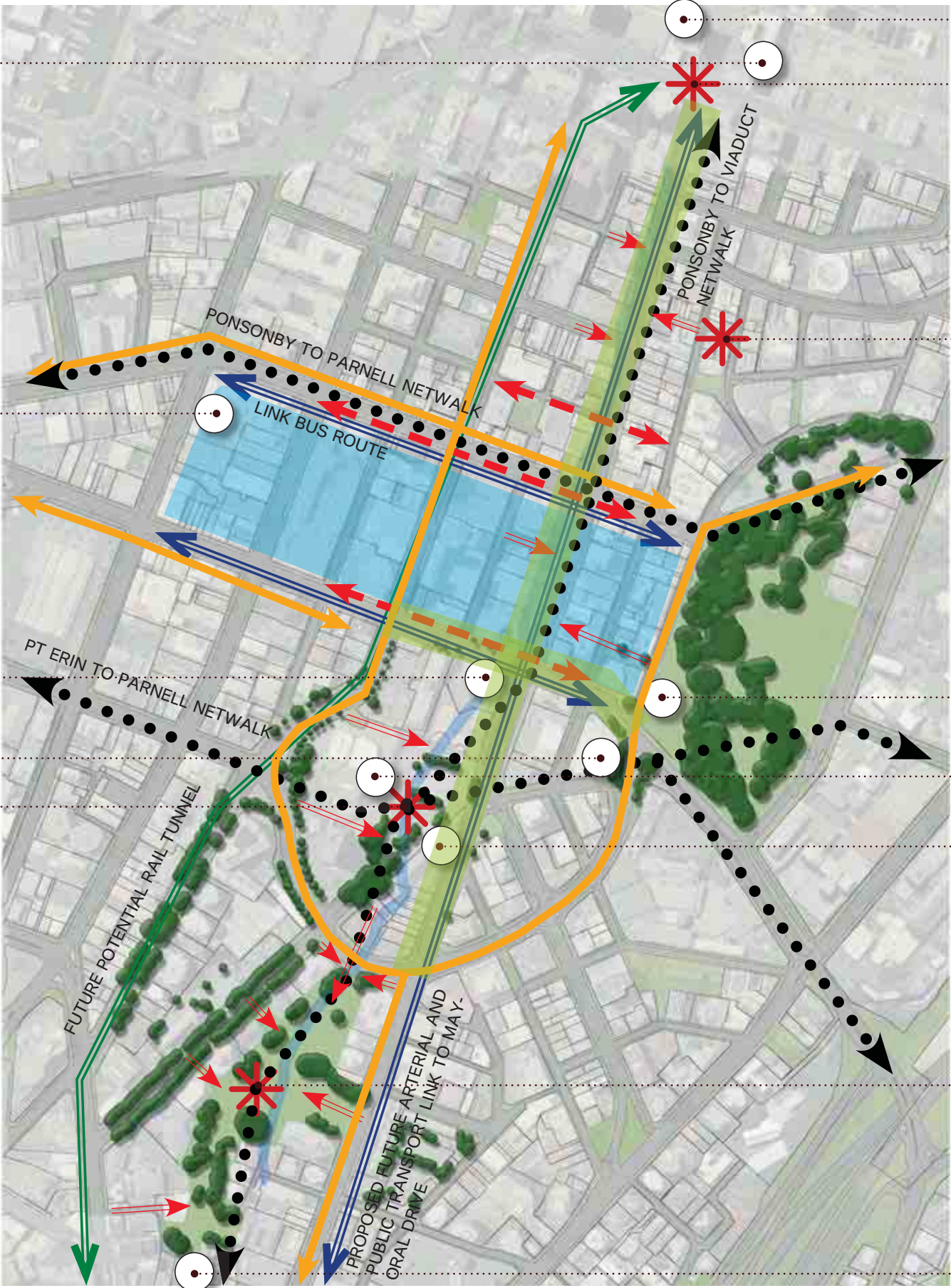
Former central post office and Britomart Rail Station.

Sky City Bus Terminal.

Civic Theatre and Sky City Auckland.

Auckland Public Library.

Aotea Square, public outdoor concerts and market days.



QEII Square, associated sculpture and plantings.
Westfield Downtown Shopping Centre and access to Britomart Bus Terminal.

Vulcan Lane and High Street retail area at the original coastal foreshore.

Auckland Art Gallery.
Aotea Centre.
Auckland Town Hall.

Myers Park.

St Kevin's Arcade entrance from Myers Park to Karagahape retail and nightlife precinct.



Plantings and art installations as part of the Queen Street streetscape works relating to the Waihorotiu Stream

Upper Waihorotiu

Myers Park sits at the head of the valley between the ridgelines of Karangahape Road, Symonds Street and Hobson Street. This was historically the location at which the spring that fed the Waihorotiu Stream came to the surface in the vicinity of the Baptist Tabernacle in Myers Park. A former mayor of Auckland, Sir Arthur Mielzinier Myers (1868-1926), donated £10,000 to construct Myers Park and the Free Kindergarten in 1914. The Free Kindergarten is a fine example of Arts and Crafts Architecture. There are many fine heritage features within Myers Park, including stone statues, rows of mature trees and classical elements of park design. Myers is a linear park with a central pathway connecting Karangahape Road's historic St Kevin's Arcade to the Aotea Centre. There is a large playground area and a toilet facility. The park is sometimes used for outdoor concerts organised by the Auckland City Council.

Stormwater and overland flow are localised to the park, since there is stormwater reticulation on Queen Street and Greys Avenue. 100-year flood areas occur at the bottom of the park in an above ground dry detention area below the Mayoral Drive overbridge. It is unknown whether there are still perennial flows from groundwater sources in the area since there has been considerable fill within Myers Park. The volcanic aquifer that historically fed the Waihorotiu Stream spring would have been largely capped with impermeable surfaces in upper catchments. However, in the event of a daylighted stream, there is a large stormwater catchment available that could be pre-treated at the Queen Street entrance to the eastern slopes and through bioretention facilities within Greys Avenue, entering the park at a number of entry points.

Stormwater flow to the stream could be formalised and celebrated in keeping with the character of the park. These open water elements could run alongside existing stairways, and be constructed of similar materials to other elements in the park. During periods of high-flow, water would cascade into the park and down its valley through a multitude of entrances, bringing a dynamic new element to the park. This water would play through the stream, fountains, canals and cascades according to the axes and character of original design elements within the park.

The detention area at the base of the park could be formed into a wetland to detain and control the release of flow to downstream reaches. From here the stream would enter a piped section under Mayoral Drive and through the adjoining parking lot, to then resurface at Aotea Park. This assumes there is sufficient hydraulic head to bring the stream to Aotea Square and above the underground parking area. The wetland could play a part in creating the necessary elevation change. This might also allow a stream to be constructed under Mayoral Drive to Aotea Square, but this would require considerable modification of the carpark at the rear of the Silo Theatre.

Low impact design proposals in Greys Avenue and stream daylighting within Myers Park would need to take account of existing protected trees and potential contaminants in fill areas. There may also be potential conflicts between users of the park; kindergarten children by day who would explore, and night time activities. Security and lighting would need to be provided. In many ways, the enhancement of this park and connectivity to Aotea Square would provide more "eyes on the street" and therefore better passive security.

There is a network of stormwater infrastructure that has been installed within the last decade in Myers Park. It would therefore be considered a sink cost and a loss to stormwater assets for these systems to become inoperative. In reality, the advent of surface waters in an urban environment often require a bypass system (eg for high stormwater flows) and the existing reticulated stormwater system would be utilised for this function.

Currently stormwater is reticulated from ridgeline to the Waitemata Harbour without primary treatment. Additional water quality benefits can be achieved through natural systems and processes.



One of the gullies entering Myers Park from the east



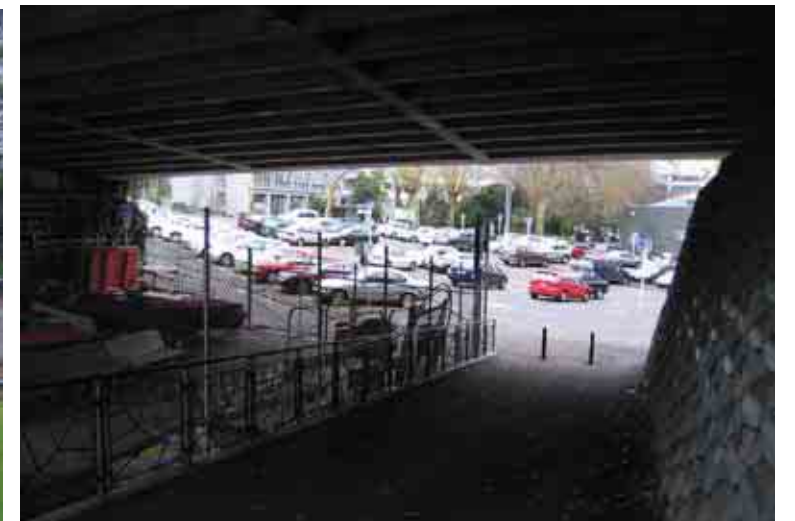
A pedestrian connection between Myers Park and Greys Avenue, and potential location for a water feature



The top of Myers Park with the stairway leading to St Kevin's Arcade and Karangahape Road, stormwater is reticulated underneath. Catchment flows would be minimal in this location, possibly requiring only a riffle structure along the path



Flood detention area at the base of Myers Park and potential treatment wetland location



Looking underneath Mayoral Drive to the ACC carpark

Upper Waihorotiu Stream Daylighting Constraints

KEY

- Historic stream
- Gravity stormwater pipe
- Gravity wastewater pipe
- Gravity combined storm and waste
- 100-year flood plain
- Manholes
- Catchpits
- Significant protected feature
- Significant trees
- Treatment device
- Inlet/Outlet
- Cadastral boundaries
- Public land



Upper Waihorotiu Stream Daylighting Opportunities



- Potential to realign the reticulated stormwater system under an existing parking area to retain the hydraulic head of the Waihorotiu into Aotea Square.
- Open flows/water feature under the Mayoral Drive (future proposed “Art Bridge”).
- Potential for a stormwater wetland in an existing dry detention area, receiving overland flow from Mayoral Drive, Greys Avenue and Upper Queen Street (via LID retrofit opportunities).
- Opportunities to create formal water features dropping from Greys Avenue into the daylighted Waihorotiu.
- Potential to retrofit Myers Park Kindergarten for LID.
- Potential to retrofit Greys Avenue for LID.
- Overland flow directed to the daylighted Waihorotiu.
- Viaduct to Karangahape “Netwalk”/Waihorotiu Riverway.

Mid Waihorotiu

Aotea Square has the potential to be the hub of cultural activity within Queen Street, having four cinema complexes, the Aotea Centre, the Auckland Library, the Town Hall, Auckland's central art galleries and two universities nearby. Aotea Square is the focal civic space, with centralised parking beneath. The square, is adjacent to the Town Hall, contains large outdoor sculpture, a park with mature trees, and is home to large outdoor concerts and regular market places.

Despite the range of public amenities there are relatively few obvious connections between Aotea, the open spaces of Myers Park, and the commercial district of Mid- and Lower Queen Street. The square occupies a different level to the street and although people gather in small groups for lunch on grassed areas, the area is not overly populated during the day. The adjacent park has suffered recent flooding issues, and construction works to repair flooding damage in the lower carparks has prompted discussion around redesigning the square, heralded as “thinking outside the square”.

There are opportunities through stream daylighting within the square to draw people into the civic space of Aotea. The use of flowing water in civic spaces is well documented as a drawcard to the public. It acts as a respite from street noise, heat and dust in both pocket parks and larger civic spaces. Water also acts as a focal point that defines space through inverting the open sky in its reflection. People would be especially encouraged to Aotea Square and Myers Park by a lineal water feature in the form of the Waihorotiu.

A stream with associated walk/cycle ways has the potential to draw people from Upper Queen and Karangahape Road, through the open spaces of Myers Park and Aotea to Queen Street. According to the Auckland Central Area Access Strategy, downslope of Aotea and Wellesley Street, Queen Street changes from an arterial road to a proposed “greenway distributor”. Aotea and Myers Park therefore could act as a gateway to the pedestrianised areas of Lower Queen Street. To strengthen this connection and to work within the hardscape areas of Aotea Square and the Civic Theatre footpath, it may be appropriate to daylight the Waihorotiu in an architectural, or hard-engineered fashion. This might take the form of rivulets or canals, level or subverted below the street, streamlined or riffled, that might come above the surface to act as celebratory water features in Aotea Square or beside the Civic where the historical confluence of Queen Street and the Waihorotiu occurred. A celebratory water feature in Aotea Square could reference the large wetland area that was once in this location, an area once well known for eel and native trout.

These potential future proposals coincide with Architectus' designs as part of the Queen Street upgrades. A lineal feature within the wider sidewalk from Aotea to Wellesley Street has been constructed as a collaboration with an artist to celebrate movement and reference the Waihorotiu Stream. Architectus have also proposed a water feature at Wakefield Street, close to the location of a former tributary.

Wellesley as a major cross connection for public transportation is a significant barrier to a the daylighted stream and the stream is likely in this location to flow beneath the street, at a height that would allow sufficient head to resurface on Queen Street north of Wellesley

The daylighting of the Waihorotiu in Queen Street has the potential to reawaken the consciousness of the public to water in the cityscape, and to the “sense of place” that natural heritage can evoke. The concept of a park environment in Queen Street is a radical paradigm shift from the forms of the last century. However, a century is not a long time for the Waihorotiu, which has flowed in this location for millennia. Daylighting possibilities were mooted for the ongoing Queen Street improvements but were considered too difficult in the short-term for reasons of existing infrastructure. Daylighting options for the Waihorotiu would require significant investment in infrastructure and a vision that is shared by politicians, the public and council departments. The concept may therefore represent a long-term opportunity.



Queen St footpath from Aotea to Wellesley St



Wellesley Street crossing, looking down Queen Street



From the top of Aotea Park to the civic space of the Aotea Centre and Aotea Square, a potential stream alignment



Queen Street entrance to Aotea Square

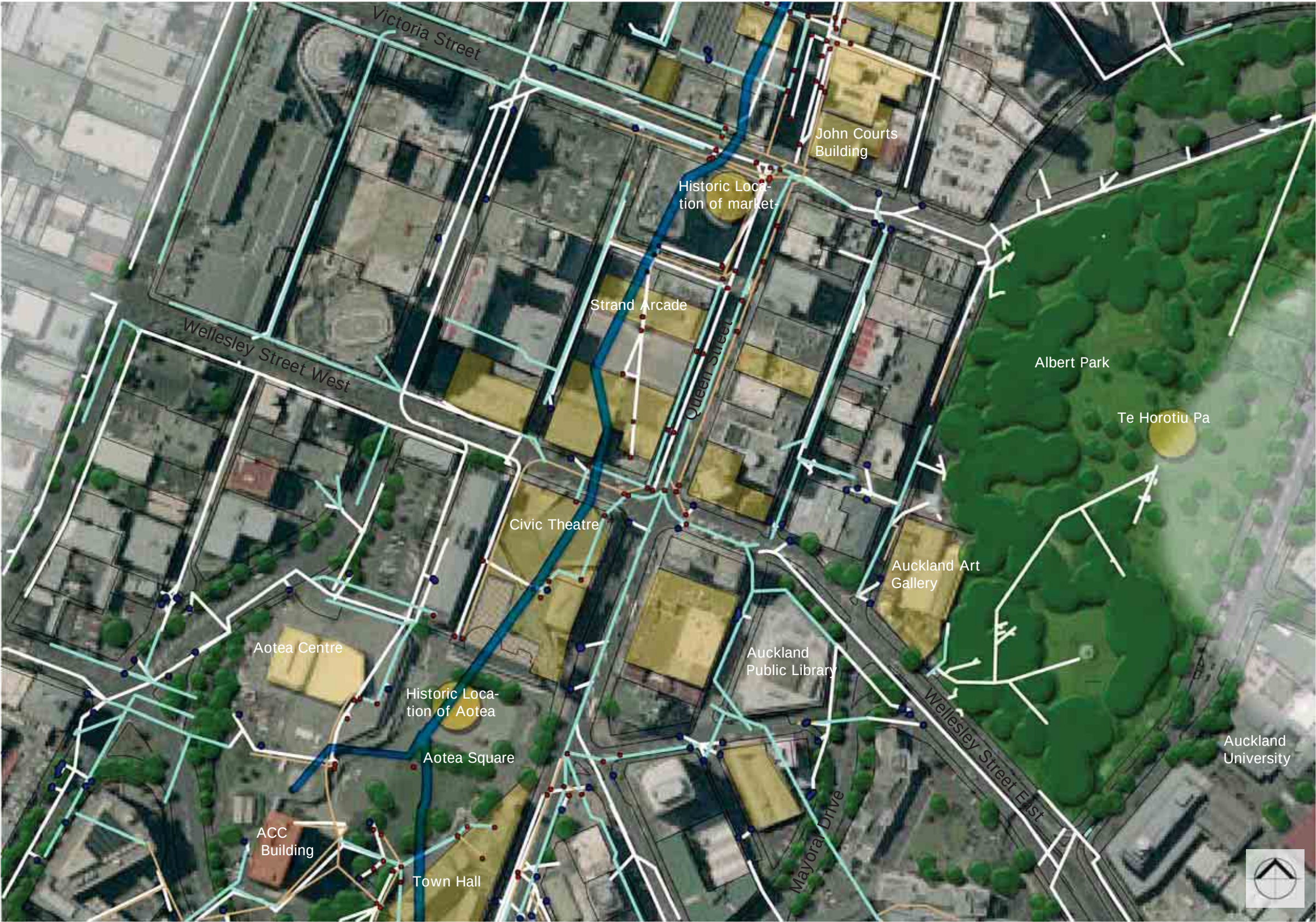


Existing water feature within Aotea Square

Mid Waihorotiu Stream Daylighting Constraints

KEY

- Historic stream
- Gravity stormwater pipe
- Gravity wastewater pipe
- Gravity combined storm and waste
- 100-year flood plain
- Manholes
- Catchpits
- Significant protected feature
- Significant trees
- Treatment device
- Inlet/Outlet
- Cadastral boundaries
- Public land



Mid Waihorotiu Stream Daylighting Opportunities

NOTE:

Daylighting of the Mid Waihorotiu Stream was investigated by Auckland City Council as part of their feasibility studies for Queen Street enhancements in 2007. Significant constraints made daylighting impractical in the short to medium-term.

The city celebrated the buried stream and the local geology through the selection of representative plant and rock materials within the streetscape as well as providing surface water features and interpretation.



- Potential for a daylighted Waihorotiu Stream in a semi-naturalised form. The morphology of the stream would respond to service access, public transport, pedestrian flow, and the formation of open spaces.
- Waihorotiu crossed by Victoria Street.
- Ponsonby to Parnell "Netwalk".
- Potential open space and overland flow from Darby Street.
- Potential to retrofit Lorne Street, for LID stormwater design.
- Waihorotiu crossed by Wellesley Street.
- Potential to retrofit Kitchener Street and Lorne Street for LID stormwater design.
- Potential to retrofit institutional area for LID and education/interpretation.
- Potential architectural or artscape stream channel connecting Waihorotiu from Wellesley to Aotea and Town.
- Potential celebratory water feature at Aotea Square. Interpretive information on Aotea Wetland.
- Potential to retrofit Aotea Centre for LID.
- Pt Erin to Ponsonby "Netwalk".
- Viaduct to Karangahape "Netwalk"/ Waihorotiu Riverway.

Lower Waihorotiu

The lower Waihorotiu historically flowed from the location of Victoria Street today to Customs Street before it entered the Waitemata. Below Shortland Street, any future potential daylighting of the Waihorotiu would extend beyond its historic flow path, into the reclaimed land of the Auckland waterfront.

Daylighting of the lower Waihorotiu would most likely occur within the main traffic route of Queen Street and therefore would entail the removal of some or all automobile traffic. This would necessitate the transfer of the streetscape into civic space and open space. The street would in effect cease to function as a traffic arterial, and instead become a civic park and pedestrian promenade. The Waihorotiu would become the water feature that defined the appropriated open space, leading from the waterfront and public transport hubs in QEII Square to the civic spaces and public facilities of Aotea. Such a concept has been mooted previously by the city council, and considered infeasible in the short to medium-term. As discussed below, such a proposition would entail a dramatic paradigm shift for the city and significant requirements for infrastructure, which are currently not in place.

Assuming a long-term proposition, opportunities abound for a lineal park associated with the daylighted Waihorotiu. This would incorporate buildings, structures, earth and planting to create intimate spaces within the shopping corridor, deflecting the wind, and creating shade and sun pockets as required. The promenade between buildings would open to the sky at discrete pocket parks at the street-ends of Wyndham, Shortland, Fort Street etc. Pedestrian flows would lead into the old quarter while the Nelson Street ridgeline would continue as a main arterial and public transportation route.

The introduction of stormwater is possible to increase permanent flows in the Waihorotiu. This must take into account the existing combined sewers, currently confined to individual buildings, but also the potential contaminants from road surface run-off and groundwater pumps within the building basements. Clearly catchment wide initiatives would be required to realise the Waihorotiu as ecological infrastructure. Other constraints, relate to heritage structures within the street, conflicts with infrastructure beneath the street and the tidal influence from the Waitemata. Recent construction on Queen Street, while separating pedestrians from road traffic at night, has also caused significant noise and traffic disruptions during the day. Compensation to businesses would be one of the possibilities for the realisation of a daylighting project.

Clearly the planning and design around such a proposition can only be alluded to in this study. The opportunities identified here would require a number of stages, of which the initial stages have been undertaken by the city. These include referencing of the Waihorotiu in planting, materials, water features and interpretation in order to educate the public to the presence of the Waihorotiu. The city's transportation planning provides for lower sections of Queen Street to become a "greenway distributor" in the near future modified from its current role as an arterial route. The city has even suggested that Queen Street be closed to traffic, and function as a pedestrian promenade during large events such as the Rugby World Cup.

Daylighting of the Waihorotiu through Queen Street would require comprehensive and co-ordinated planning involving the revision of transport and utility infrastructure. Most significantly this opportunity would require a collective vision by the public, business groups, politicians and council officers. Clearly a paradigm shift is required, something equivalent to stream daylighting in Seoul, the "Big Dig" in Boston, or the revival of the Presidio in San Francisco. All of these projects removed major arterial roads in order to prioritise public open space and provide their cities with connections to water. In all of these exercises a mix of public open space, civic building and commercial space has seen revitalisation of business centres.

Transition is often best achieved in stages, manageable through funding and/or public goodwill. In many daylighting projects, grass roots involvement has led to public education and smaller daylighting exercises; these have then lead to larger daylighting projects in the catchment and subsequently to buy-in by political and commercial interests. A primary objective of this report is to highlight opportunities within the Waihorotiu and neighbouring catchments to increase awareness and possibilities.



Sidewalk and elevated dining at Queens Arcade



Vulcan Lane, east of Queen Street



The Ferry Terminal in front of Britomart



From Customs Street looking up Queen Street



The outlet of the Waihorotiu



Entrance to the Ferry Terminal beside Queens Wharf

Lower Waihorotiu Stream Daylighting Constraints

KEY

- Historic stream
- Gravity stormwater pipe
- Gravity wastewater pipe
- Gravity combined storm and waste
- 100-year flood plain
- Manholes
- Catchpits
- Significant protected feature
- Significant trees
- Treatment device
- Inlet/Outlet
- Cadastral boundaries
- Public land

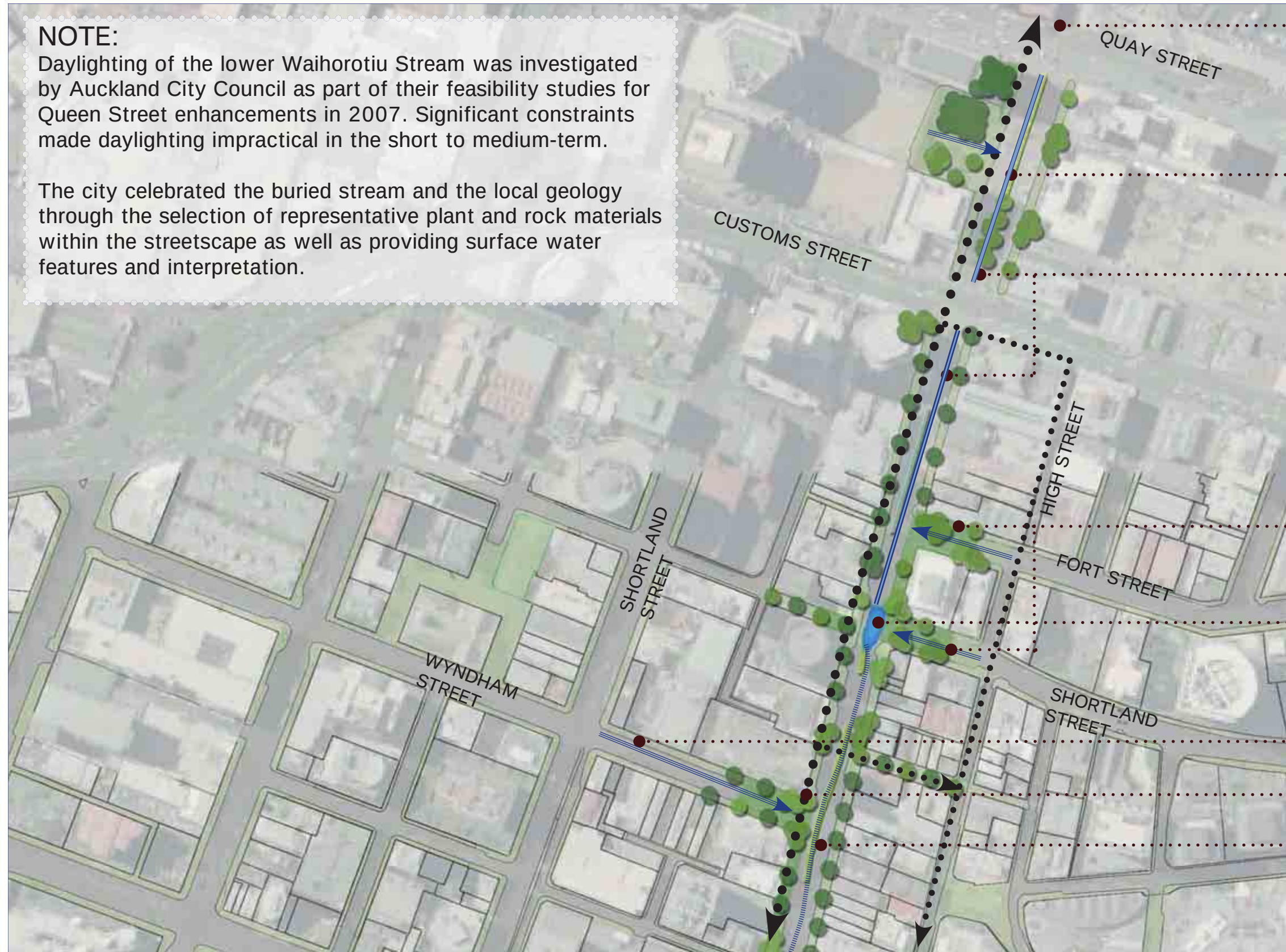


Lower Waihorotiu Stream Daylighting Opportunities

NOTE:

Daylighting of the lower Waihorotiu Stream was investigated by Auckland City Council as part of their feasibility studies for Queen Street enhancements in 2007. Significant constraints made daylighting impractical in the short to medium-term.

The city celebrated the buried stream and the local geology through the selection of representative plant and rock materials within the streetscape as well as providing surface water features and interpretation.



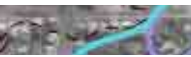
- Potential to direct the Waihorotiu under Quay Street with proposals to subvert Quay Street notwithstanding. A celebratory entry to the Waitemata would be adjacent to the ferry terminal and future proposed open space on Princes Wharf.
- Potential for block planting of representative coastal sedges and rushes adjacent and within the Waihorotiu to perform stormwater treatment functions.
- Potential to feature the Waihorotiu as an engineered channel in Britomart's civic space referencing the reclamation of Commercial Bay Opportunities to form a canal at the tidal datum or raise the channel with check dams to support planting and retain a permanent water body.
- Open spaces at the end of previous roadway connections, with provision of waterplay using treated stormwater.
- Transition from a naturalised stream form with meanders, riffle and pools to engineered channel/canal. A water feature celebrates the former mouth of the Waihorotiu and historic coastline.
- Potential to retrofit Wyndham street for LID stormwater design.
- Viaduct to Karangahape "Netwalk"/Waihorotiu Riverway.
- Waihorotiu stream with naturalised stream patterns and streamside planting. The alignment would respond to service access and public transportation. Potential to form open spaces, seating areas, amphitheatres etc within inside bends of the meandering stream.

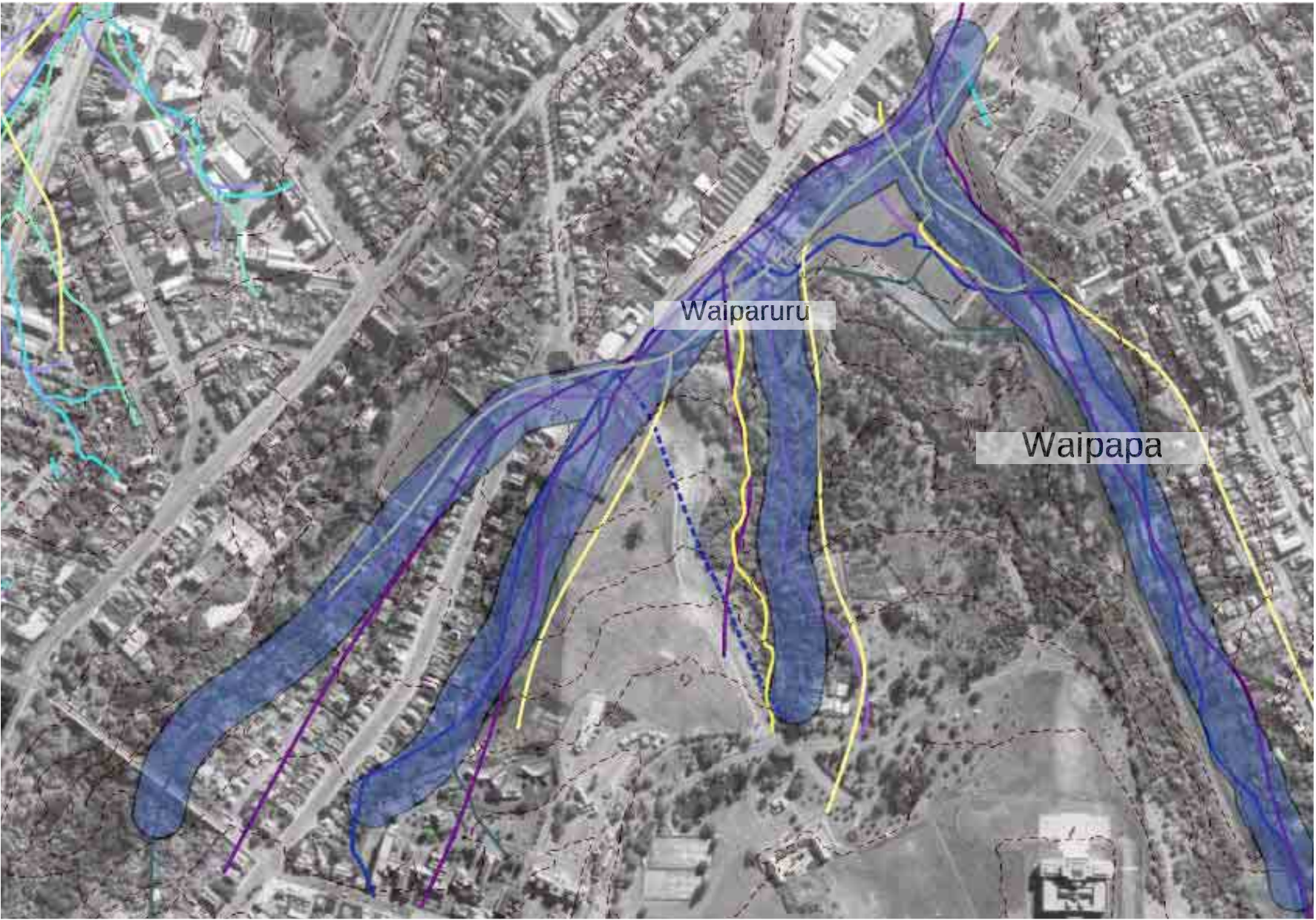
Waipapa Stream



Waipapa Historic Alignment

KEY

-  Survey Office Plan SO 13 of Auckland Park
Sourced from LINZ,
Crown Copyright reserved
-  Auckland Domain 1856
John Kinder [rs]
-  Felton Mathews 1841
NZ Map 2664, Special Collections,
Auckland City Libraries (NZ)
-  Survey of Office Plan SO 3933 of the Auckland Domain
Sourced from LINZ,
Crown Copyright reserved
-  Auckland in its natural state
M. Johnson from Bush's ACC
Centennial History
-  City & Suburbs of Auckland prepared by C. Palmer
Sourced from LINZ,
Crown Copyright reserved



The stream alignments as indicated on the plan above were traced from historical maps sourced from ACC and ARC archives, Auckland City Libraries and Land Information New Zealand. Maps were scanned rotated and scaled according to tags on individual plans, or were placed according to coincidence with existing road networks and the known historic coastline. Distortion was inevitable since historic maps were often stylised, never ortho-corrected, and often poorly surveyed.

Other reference material included historic photographs, historic aerial photography, allotment maps from the 19th century, focus site plans and early city planning documents. GIS information also provided topography and historical floodplains which when mapped together provided for logical historic drainage patterns.

Derived stream alignments did not overlap with precision but there was regularity in terms of stream forms in relation to specific gullies as they occurred in the mid-19th century. These reoccurring systems appear as a blue wash on the plan above, sitting atop the coincident stream alignments.



City & Suburbs of Auckland, prepared by C. Palmer. Sourced from Land Informations New Zealand, Crown Copyright reserved



Survey of Office Plan SO 3933 of the Auckland Domain. Sourced from Land Information New Zealand, Crown Copyright reserved

Waipapa History

For many centuries the Waipapa Stream served as a natural moat protecting the Pa at Pukekawa (Museum Hill) on the northern and eastern flanks. This was the case during the Ngati Whatua invasion of the Ngati Paoa circa 1760, who were in turn attacked during the Ngapuhi raids circa 1793. The stream was a valuable resource for eeling and the lower wetland afforded many resources to the adjacent Pa. The mouth of the Waipapa as it flowed into Mechanics Bay (now adjacent to the Strand Hotel) and was the arrival place of the Tainui canoe, and was a main portage for Maori entering Tamaki Makau Rau (Auckland).

At this time the lower part of the stream was a large wetland area and estuary. The stream mouth was the entry point for the first settler ships into Auckland in 1842, the “Jane Gifford” and “Duchess of Argyle”. Immigrants rapidly settled the lower stream for its safe harbour, fresh water and gradient for powering mills. The first tannery in Auckland was established in the early 1840s with a dock on the stream serviced by cutters. The first flour mill (Lowe and Motion) in Auckland was established on the Waipapa in 1843 followed closely by the first ropewalk opened by James Robertson in 1843 using the flow of the stream for the manufacture of cordage. The business eventually became Donaghey Industries.



Mamaku and rustic bridge, entrance to Auckland Domain (2). Auckland Art Gallery Toi o Tamaki, purchased 1983 (accession no. 1983/22/46)



Parnell Bridge, The Domain Mackelvie Trust Collection. Auckland Art Gallery Toi o Tamaki. Bequest of James Tannock Mackelvie (accession no. M1885/1/136)

The first entrance to the Domain was a footbridge over the Waipapa stream near Birdwood Crescent, which was captured in paintings and photographs on a number of occasions before it was demolished in 1864. The second main entrance was Ngahere Terrace Steps, which also crossed the Waipapa with formal gardens in the area now supporting the rail sheds. A bridge was also provided over the first railway line, but was removed with the dual tracking in 1914.

The railway, constructed under the 1865 Public Domains Amendment Act, provided for the first public railway line in New Zealand, linking Britomart to Drury. The Waipapa River Valley was the gateway into Auckland for early rail passengers. The old Parnell Tunnel was created at the head of the Waipapa stream and completed in 1872 despite landslips from the stream. The dual track tunnel was built approximately 50 years later. Recent discussion has ensued around the true alignment of the railway (the first or second tunnel), which provides for the boundary of the Domain, and the coincidence of the Waipapa Stream with public land.



Domain to Mechanics Bay with the Waipapa gully in the foreground. Water colour by H.A. Scrivener, Reference no. D-032-001, Alexander Turnbull Library, Wellington NZ

Henry Niccol established his shipwright business at the mouth of the Waipapa and from 1843 to 1865, he used the natural depth of the stream to launch over 80 ships, including the Undine, Bishop Selwyn's ship that was used to evangelise Christianity throughout New Zealand and the Pacific Islands.

The Waipapa was valued for its purity of water, with Christian churches using the stream for Baptism and the acclimatisation society introducing trout in New Zealand to its waters. The water quality would inspire the founding of Auckland City's first brewery on the Waipapa in 1852. The brewery, owned by John Logan Campbell, would evolve into Lion Nathan Breweries.

Parnell was one of New Zealand's first planned suburban neighbourhoods. Early properties in the area of the Waipapa Stream had names such as “Claybrook” a house built in 1842 by Kempthorne that still exists today.

The Waipapa and Waiparuru streams were the natural landmarks, which defined the boundaries of the Domain in 1840, in an agreement between Governor Hobson and the Ngati Whatua Chief Apihai Te Kawau. In 1843 Governor Robert FitzRoy arrived from his voyages on the Beagle sharing his cabin with Charles Darwin for over 5 years. One of his first actions was to cease the felling of trees in the Domain and commence replanting.

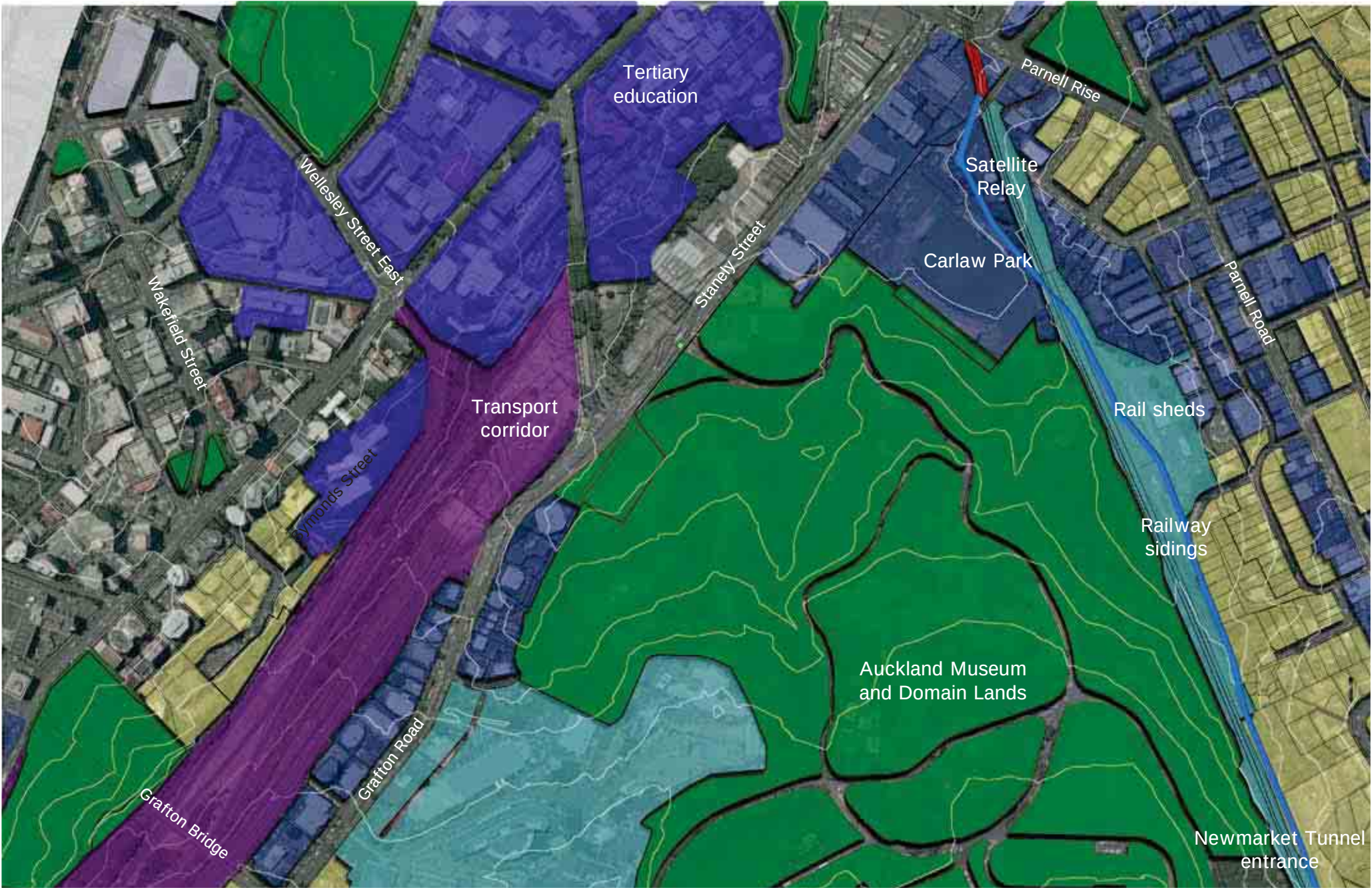


Claybrook House in Parnell. Courtesy of Richard Simpson (2006/7)

Waipapa Land Use

KEY

-  Residential
-  Special designation
-  Open space
-  Business
-  Focus stream
-  Transport corridor
-  Tertiary education



For the majority of its length, the Waipapa flows within the designation of the Auckland - Newmarket rail line and service sheds. The sheds are currently occupied by private workshops for artists, light industry etc. To the west of its alignment are Domain lands and Carlaw Park (former Domain land and currently zoned for business). Carlaw Park has recieved resource consent for mixed-use redevelopment including elderly housing and commercial land use. To the east of the stream are Parnell residences, including the recent construction of 30 town houses.

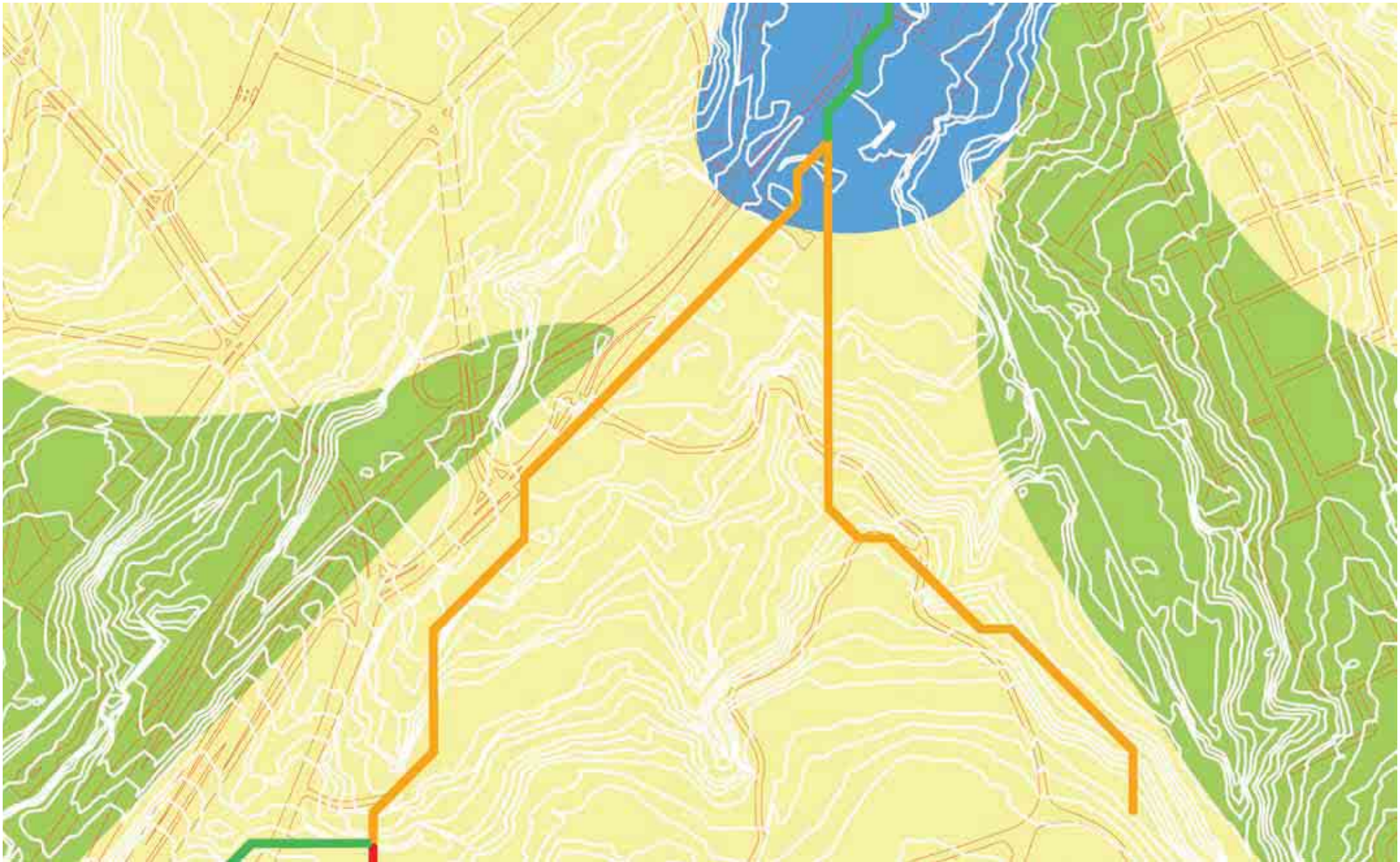
Townhouses have building platforms based on literal interpretation of boundaries often at the expense of the floodplain of the Waipapa Stream. In one location the stream is piped in order to extend building foundations. These modifications to the Waipapa have caused residents of the Hobson ward significant concern. In order to protect the stream corridor, the Parnell Historic Society has done extensive digital mapping in this area and the absolute boundary of the Domain lands is still a contentious issue for residents.

In its lower reaches the Waipapa flows into the commercial areas at the intersection of the Strand and Parnell Rise with a privately-owned commercial area to the south west of the rail bridge occupied by a satellite relay station. The use of the valley as a railway corridor has led to limited public access and industrial characteristics to the area. It is surprising therefore that the public often occupy the space, crossing from Parnell to the Domain in multiple locations and utilising the railway bridge to cross the Strand intersection. The railway sheds and trains on abandoned siding also attracts the curiosity of train buffs. The lower part of the Domain supports a diverse mix of mature broadleaf forest and stands of intentional exotic plantings from the last century. The lower slopes are permeated with formal tracks.

Waipapa Land Environments

KEY

-  Reclaimed land
-  5 metre contours
-  Level 2 - A2
Estuarine flats with moderate drainage and poor fertility
-  Level 2 - A6
Undulating hills of weathered greywacke and sandstone. Very low fertility and moderate drainage
-  NZREC low valley gradient
-  NZREC moderate valley gradient



Information relating to the Waipapa catchment has been derived from the datasets of Land Environments New Zealand (LENZ), the New Zealand Geological Society, the New Zealand River Environment Classification (NZREC) and the Land Resource Inventory (LRI) of the former Ministry of Works. The Waipapa Stream is a low gradient valley, with steep slopes to its catchment that sits along a fault line extending from Parnell Rise to the foreshore. The low gradient of the stream makes it attractive as a railway bed to connect Auckland City to Newmarket and then to the rest of the country. The slope is easily manageable by diesel engines hauling freight and the incised nature of the gully places the transport infrastructure at the back of residences and away from public view.

The geology is similar to other lowland environments in the CBD of the Waitemata group, with underlying weathered greywacke and sandstone with alluvial deposits. The western banks are underpinned by the basalt tuff of the Pukekawa Volcanic Cone. The Domain acts as an aquifer with interflow appearing within the Waipapa and Waiparuru catchments. The surficial geology represents moderate fertility and drainage through to subsoils. In lowland environments alluvial deposits occur along with leached sands, generally having moderate drainage properties and poor fertility.

Prior to European arrival the slopes of the Domain and Parnell would have supported coastal shrubland species such as ngaio, mangeao, whau, houpara, parapara and tawapou, overtopped by pohutukawa, kanuka, manuka, kauri, and tanekaha. The gully areas would have seen a lush broadleaf taraire, kohekohe, and tree fern habitat supporting a diversity of podocarps such as rimu, kahikatea and matai. Before European arrival fires would already have induced bracken and manuka on the slopes, and produced gumland areas of sedges, rushes and tanglefern. Extensive wetlands noted around Mechanics Bay would have supported manuka flax and cabbage associations *Baumea* and *Schoenus* species, *Dracophyllum*, grading to salt tolerant *Leptocarpus*, *Juncus*, *Carex*, *Cyperus*, and *Austrostipa* species.

Waipapa Landscape Connections

KEY

City "Netwalks"

Ecological linkages

Strategic bus routes

Strategic rail routes

Proposed art bridges

Major arterial roads

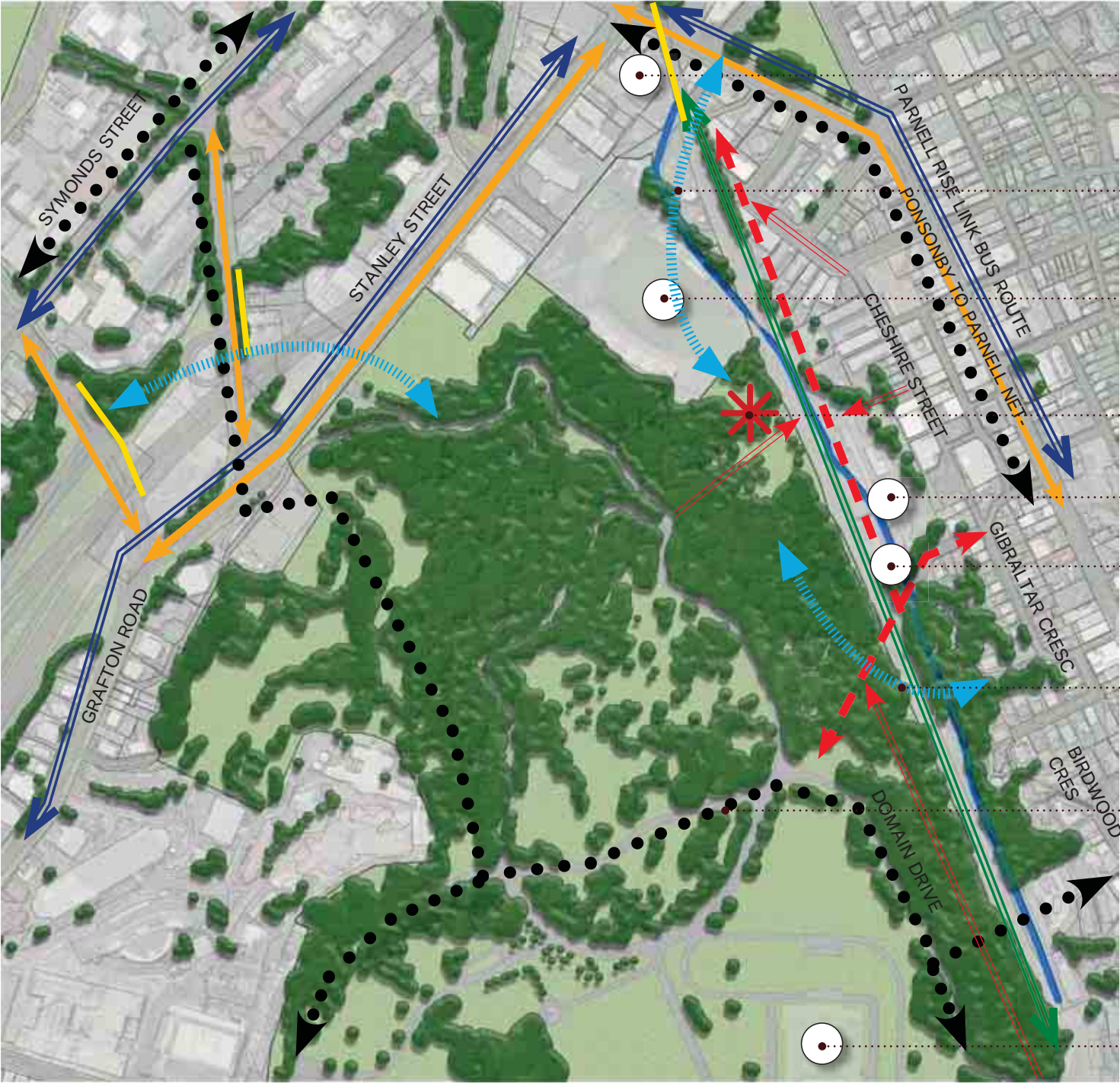
Pedestrian cross connections

Neighbourhood connections

Nodes of activity

Point of interest

Historical stream alignment



- o Historic Strand Hotel at the intersection of Parnell Rise, Beach Road, The Strand, and SH16 (Stanley Street). This intersection is the southern entrance to the CBD and was once the location of the Waipapa Stream mouth.
- o Potential future ecological connections between the daylighted Waipapa Stream, wetland, and coastal environments of Mechanics Bay.
- o Future mixed-use commercial and residential development. Floodplain issues in respect to stormwater are expected to be dealt with through underground detention.
- o An existing wetland receives flow from the Waipapa via a pipe, and a tributary from the Domain via overland flow.
- o Railway sheds, now utilised for light industrial workshops, inc. live-in artists. In this location there is road access to Parnell Rise.
- o A tunnel under the railway tracks connects the Domain to Birdwood Crescent in Parnell. The Waipapa Stream enters the stormwater system under this path.
- o Ecological connections between the Waipapa Stream and the Domain environments.
- o Pt Erin to Parnell and Te Araroa "Netwalks" with a potential elevated bridge to connect the Domain to Parnell over the Waipapa and railway.
- o Auckland War Memorial Museum.

Waipapa Riverway



Artist's impression of a wetland at Carlton Gore Road at the entrance to the Domain
Courtesy of Neil Coleman

Upper Waipapa

Upstream of the railway sheds, the Waipapa is an open stream channel with perennial flows derived from groundwater, and augmented by stormwater from the surrounding catchment. Banks can still be restored and replanted to return some function and natural character. However, there are significant invasive weed issues, and modifications resulting from recent development have compromised the riparian buffer, increased bank instability, and impinged upon the floodplain of the stream. Such activities represent an opportunity cost for complete restoration.

The alignment of the Waipapa in the upper catchment is between the access drive for the Newmarket branch rail corridor and the Parnell properties to the east. Vegetation is primarily dense exotic creepers with exotic canopy overhead. Litter however is minimal which can be problematic in urban streams. Effects of recent development are prominent in its first 100 metres where the stream has been filled in places to accommodate the footprint of an apartment block.

There are immediate opportunities to restore the stream, which have already been undertaken to an extent by volunteer groups, including clearing sediment and refuse from choke points in the stream, removing weed species, and restoration planting within the margins of the stream and riparian banks. Of greater difficulty is the rehabilitation of the stream's immediate catchment, requiring buy-in from the railroad operator, private residents, and developers in order to accomplish the following:

- Replacement of existing retaining structures within the stream banks with batter slopes of biotechnical construction.
- Removal of weed species from the lands adjacent to the stream and where practicable providing a 10 metre buffer of riparian vegetation to prevent further incursions of problem weeds.
- Provision of energy dissipation structures at the outlets of reticulated stormwater pipes and concentrated overland flow, or where possible providing for dispersed run-off or parallel wetlands.
- Removal of seed bearing weed trees and replacement with native canopy to shade the stream.
- Re-alignment and replanting of the stream around building footprints.

In this way the stream could be expected to provide an amenity for the properties alongside the railway, providing for a natural feature that links visually with the Domain, integrating homes into the Waipapa Gully and mitigating the visual impact of the railway embankment. The stream would enhance the entrance to the Domain, and complete the passage of rail through the Domain.

The Waipapa would define a pedestrian/cycleway connection from Stanley Street and Beach Road to the Domain and Parnell village. There are even possibilities conceptually, to connect trails through the historic rail tunnel to Newmarket Park and Newmarket shopping centre, providing a cycleway of less than two per cent grade between the city and the hills of Newmarket and Remuera.

In a manner the stream is the responsibility of the community of western Parnell. The Waipapa has advocates all over Auckland, but the co-operation of individuals that share private titles with this public waterway is the key to saving the Waipapa and preserving its place in Auckland's history. In this way consultation is unquestionably important to see a sustainable outcome for the Waipapa.



Auckland Domain entrance under the railway embankment



New development extends to the surveyed boundary



Flowing Waipapa Stream through sprayed weeds



Waipapa Stream flows beside the railway embankment



Waipapa aligned beside the railway



Waipapa between new development and the railway

Upper Waipapa Stream Daylighting Constraints

KEY

- Historic stream
- Gravity stormwater pipe
- Gravity wastewater pipe
- Gravity combined storm and waste
- 100-year flood plain
- Manholes
- Catchpits
- Significant protected feature
- Significant trees
- Treatment device
- Inlet/Outlet
- Cadastral boundaries
- Public land



Upper Waipapa Stream Daylighting Opportunities



- Replace retaining walls with planted batter slopes to stream.
- Rehabilitation of existing stream through weed controls in the channel and adjacent banks and replanting of appropriate species.
- Stormwater outlets to instream or parallel wetland systems.
- Realign the stream around the foundations of recently constructed dwellings. Streamside planting to mitigate the effects of building encroachment.
- Pedestrian connection between Parnell and the Domain as identified in the city's art development plan.
- Verify stormwater inputs from existing stormwater infrastructure, rectify combined systems and construct appropriate outlets to the stream.
- Potential connection of cycle/ walkways through historic tunnel to Newmarket Park and Newmarket's retail centre.

Lower Waipapa

The Waipapa Stream is open for the majority of its upper reach but enters the reticulated system at the Domain entrance from Gibraltar Crescent. The pipe is directed to an overflow wetland above Carlaw Park. An outlet to this wetland connects to stormwater reticulation on Stanley Street.

On the surface of the piped section there are large areas of abandoned sidings in association with the railway. This area is used by dog walkers and people in their lunch hour to relax and/or cross to the Domain over the tracks. The railway sheds, track sidings and even an abandoned train provide for a unique exploration of the area. There is sufficient space to incorporate a daylighted stream and walk/cycleways while retaining existing sheds and railway relics for interpretation. There is also sufficient room through the open spaces to avoid trees and buildings and to replace large tracts of weeds with riparian and wetland vegetation. Workshop buildings house light industrial activity and artist live-in spaces. These buildings provide passive surveillance to open spaces and walk/cycleway connections. There is good public access from Parnell Rise.

Stormwater wetlands could be placed parallel to the Waipapa and intercept stormwater before it enters the stream from reticulated systems. This would provide benefits to stormwater management in terms of reducing water quantity during peak rainfall events. Some combined wastewater and stormwater (sewer) reticulation exists within the catchment. Occasional combined sewer overflows from the network near the Blind Institute on Parnell Road occur. However, this localised problem can be rectified.

The daylighted Waipapa would need to cross the railway lines and their embankment at some point. Investigations of these areas will determine the extent to which contaminated fill around the rail sheds or in conjunction with the rail corridor will influence daylighting in these areas, although capping the stream and/or piping in sections may address these issues.

From the area of the rail corridor the Waipapa historically flowed into Carlaw Park. Expansive wetlands would once have occurred in Carlaw Park at the confluence of the Waiparuru Stream. The area is currently slated for a proposed commercial development. These lower areas of the catchment are prone to flooding due to the bottleneck at the Waiparuru Gully and the inadequate sizing of stormwater system in Mechanics Bay. Future development in Carlaw Park proposes extended underground detention to deal with existing stormwater issues. Storage and treatment for the site's stormwater could be incorporated into daylighting proposals in the adjacent Carlaw Park Avenue.

Between Carlaw Park and the railway line is a satellite relay station. This is a prominent headland above Carlaw Park and forms the entrance to the Domain for the rail corridor. Pedestrian/cycle connections to the Domain are officially through Lovers Lane to the University of Auckland or through Parnell. In reality the tracks are used informally by much of the community to gain access from the Domain and western Parnell to Beach Road. These pedestrians use an existing rail bridge to cross the busy intersection at the Strand. There are safety issues in relation to this connection, but also some recognisable opportunities, including forming a gateway for trains and cycle/pedestrians to the Domain.

The daylighted Waipapa could also occur at this location, crossing underneath the rail tracks, flowing through a carpark adjacent to the satellite relay station, before falling to Carlaw Park Avenue. In this location a wetland could detain stormwater from the Waipapa catchment as well as Carlaw Park. A cascading stream and wetland in this location would also be an amenity that would be visible to train, cycle, pedestrian and cars, and would powerfully demonstrate the presence of the Waipapa Stream, and provide many opportunities to interpret the natural and cultural heritage of the area. This stream and wetland feature (illustrated on page 47) would celebrate the entrance to the Domain and enhance the experience of train passengers as they leave the city and enter the Domain environments.



Looking west along the track and abandoned sidings to the railway sheds



Adjacent tributary in the Domain



Carlaw Park



View east along the rail branch toward the satellite station

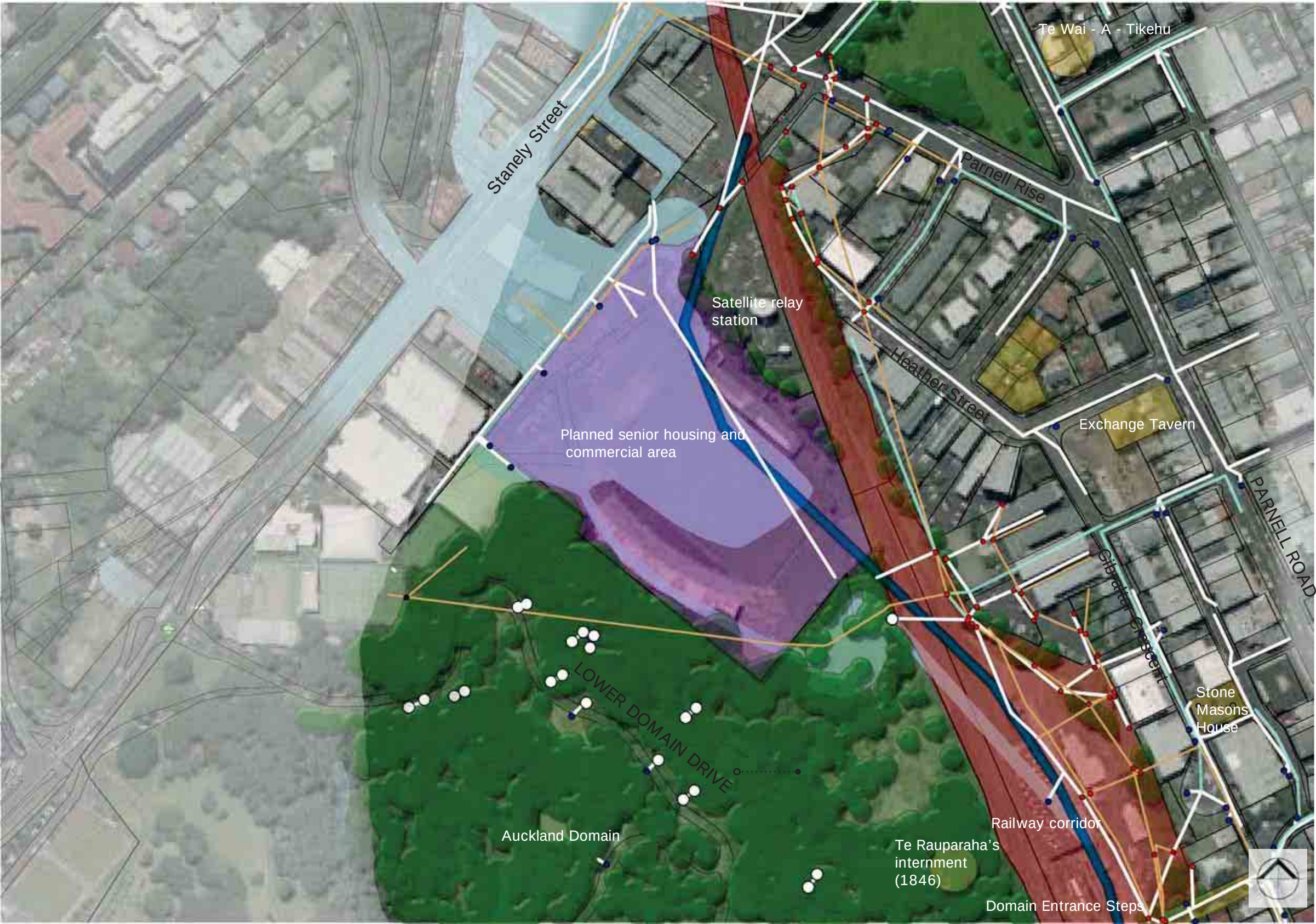


Wetland area and park above Carlaw Park

Lower Waipapa Constraints

KEY

- Historic stream
- Gravity stormwater pipe
- Gravity wastewater pipe
- Gravity combined storm and waste
- 100-year flood plain
- Manholes
- Catchpits
- Significant protected feature
- Significant trees
- Treatment device
- Inlet/Outlet
- Cadastral boundaries
- Public land



Lower Waipapa Stream Daylighting Opportunities



- Walkway connection from the Domain to Beach Road via Quay Park.
- Wetland relieving the Waipapa and stormwater from future proposed development. Overlooked by rail and pedestrian connections.
- Daylighted Waipapa cascades to proposed wetland.
- Stream daylighted at existing parking area.
- Daylighted stream in place of abandoned railway sidings.
- Stormwater is separated from combined flows and enters the Waipapa at a stormwater wetland.
- Potential for wetland to relieve the overflows from Waipapa.
- Stormwater wetland within the existing open space and at the intersection of pedestrian connections. Potential for interpretative materials.
- LID retrofit of commercial and industrial zoning in conjunction with separation of storm and sewer systems.
- Daylighted stream around existing workshops and within open spaces.

References

Auckland City Council. 2002. *Auckland Waterfront Vision 2040*. Auckland: Auckland City Council.

Auckland City Council. 2004a. *City of Auckland District Plan. Central Area Section*. Operative 2004. Auckland: Auckland City Council.

Auckland City Council. 2004b. *Auckland's CBD Together Creating Your Place: into the Future Strategy*. Auckland: Auckland City Council.

Auckland City Council. 2004c. *Central Area Access Strategy*. Auckland: Auckland City Council.

Auckland City Council. 2004d. *Britomart Precinct Urban Design Guidelines*. Auckland: Auckland City Council.

Auckland City Council. 2006. *CBD Public Artwork Development Plan*. Auckland: Auckland City Council.

Auckland Star. 1925. A Cook Street pig hunt. 15 January.

Auckland Star. 1926. Old Ponsonby: Memoirs of a pioneer: How the district was settled. 20 November.

Auckland Star. 1931, October 10. Queen Street Gully, Landmarks in Maori Days

Auckland Star. 1961 Queen St not always main street. 11 March.

Auckland Star. 1962. Gift of beacons for Kawau Is. 22 October.

Auckland Star. 1962. 16 October 1962.

Auckland Star. 1967. Queen St frontages. 25 January.

Best, Simon. 1992. *The Queen Street gaol: Auckland's first courthouse, common gaol and house of correction*. Auckland Conservancy Historic Resource Series No. 2. Auckland: Department of Conservation.

Best, Simon. 1996. *The thin end of the wedge: Archaeological excavations under the town hall, Auckland*. Report prepared for Auckland City Council. Auckland: Auckland City Council.

Conradin, F. 2002. The Zurich stream daylighting program. Abstract from *2002 Gray Water and Brownfields Conference* at the Harvard Graduate School of Design, Cambridge, Massachusetts.

Campbell (Dr), Nerida. 2005. *Auckland's original shoreline*. Auckland City Council.

Ferguson, B.K. 1999. Urban stream reclamation. *Journal of Soil and Water Conservation*, 46 (5): 324-328.

Hassall, Peter. 1987. The subterranean city. *Metro*, December, 223.

McKinnon, Malcolm. ed. 1997. *Bateman's New Zealand Historical Atlas*. Auckland: David Bateman Ltd.

Ministry for the Environment. 2003. *Land Environments of New Zealand, Nga Taiao o Aotearoa. Technical Guide*. Auckland: David Bateman Ltd.

Ndubisi, F., DeMeo, T., and N. Ditto. 1996. *Environmentally sensitive areas: a template for developing greenway corridors*. In *Greenways, the beginning of an international movement*. Eds. Julius Fabos and Jack Ahern. 159 -178. Amsterdam: Elsevier.

Nepia, E. 1992. Queen Street gully – landmarks in Maori days. *Auckland Star*, 10 October, 8(5).

New Zealand Herald. 1870. A market for Auckland. 1 February.

New Zealand Herald. 1953. The old days of carousal at Freemans Bay. 14 October.

New Zealand Herald. 1981. The clogged veins of Auckland. Grammaticus (Edward Musgrave Blaiklock), 10 March 1981.

Paul, M.J.; Meyer, J.L. 2001. Streams in the urban landscape. *Annual Review of Ecology and Systematics* 32: 333-365.

Pinkham, Richard. 2003. *Daylighting: New life for buried streams*. Colorado: Rocky Mountain Institute.

Riley, Ann L. 1998. *Restoring streams in ities: A guide for planners, policy makers and citizens*. Washington, DC: Island Press.

Simpson, Richard. 2003. *Waipapa: Parnell's forgotten stream*. Te Karere, 75(June), p.3.

Southern Cross. 1859. Testimony of J Watson Bain. 16 September.

Southern Cross. 1859. Testimony of Daniel Simpson, engineer 16 September.

Southern Cross. 1862. Auckland twenty years ago. 10 December.

Southern Cross. 1869. City Improvements – The Ligar Canal. 22 March.

Southern Cross. 1843. 29 April 1843.

Southern Cross. 1843. 20 May 1843.

Southern Cross. 1843. 1 July 1843.

Southern Cross. 1843. 29 July 1843.

Southern Cross. 2006. 5 August 2006, p. 3.

Southern Cross. 1860. 28 June 1860.

Southern Cross. 1860. 29 June 1860.

Southern Cross. 1860. 15 June 1860, p. 3(1).

Southern Cross. 1865. June 5 1865.

Maori - English translations from Blair, Ngarimu ((Ngati Whatua o Orakei). Draft Maori Heritage Report. February 2007.