SUMMARY: This paper outlines the early unsanitary conditions in Auckland town in the 1850’s to 1870’s and describes the various proposals to alleviate the problems. Depression delayed improvement and not until 1908 was the Oraeki Scheme embarked upon. Discharge was to the Waiotemata Harbour at Okahu Bay. The scheme was commissioned in 1914.

With increasing city expansion, the waters around the Oraeki outfall became polluted and considered a menace to public health. In 1929 the Auckland and Suburban Drainage Board’s newly appointed Chief Engineer, H.H. Watkins, recommended abandoning the Oraeki outfall and replacing it with treatment works on Browns Island, some 2.5km offshore. The works would be connected to the reticulation system by a submarine sewer.

Controversy raged for several years and politics took over, the Browns Island Scheme eventually being overturned, even though construction had commenced. An overseas panel of experts appointed by the Board recommended the Manukau Scheme with treatment in large oxidation ponds and discharge to the Manukau Harbour in Mangere. This was adopted and commissioned in 1960.

The paper describes the odour and midge difficulties which soon arose. The plant had had two major upgrades since then, fixed growth reactors (FGR) replacing trickling filters in 1981, and removal of the oxidation ponds and replacement of the FGR’s with activated sludge reactors as part of the 2003 Project Manukau.

Keywords: Oraeki Scheme, public health, protests, engineering personalities, Browns Island, Manukau Scheme

1. EARLY UNSANITARY CONDITIONS

Prior to any attempts by its early settlers to put in place a proper sewerage scheme, the central area of Auckland was drained naturally by the Ligar Canal which ran down Queen Street to the Waiotemata Harbour. Because of poor oversight of ‘nightsoil’ collection and the ready disposal of horse droppings, the condition of the canal was deplorable. Work on constructing a sewer up lower Queen Street, while commenced in 1854, proceeded very slowly. A piped water supply from the Domain Springs exacerbated these conditions. As late as 1870 it was described by the NZ Herald as “That abomination, the Ligar Canal, is still a pestiferous ditch, the receptacle of every imaginable filth, bubbling in the noonday sun”.

The Ligar Canal was finally covered completely in 1873, and the sewer, understood to be a brick structure ovoid in shape and of some two metres height, extended further up Queen Street. Interestingly, an upgrade of the Queen Street landscape in 2008 commemorates the Ligar Canal by a footpath-level trail of solar powered lights supposedly following its course.

General sanitary conditions, aptly described by Bush¹, were still deplorable and in 1878 under pressure from the public, Auckland City Council requested the advice of a visiting British hydraulics engineer, William Clark, who recommended a temporary scheme comprising an intercepting sewer which would terminate at Stanley Street, from whence chemically treated effluent would be pumped to discharge into adjacent St Georges Bay. In particular, the interceptors would eliminate the by-then notorious Wharf Outfall at the foot of Queen Street. Notwithstanding the relative economy of the scheme, city councillors did not act. By 1885 the country was enveloped by depression, killing off the desire to proceed with any scheme, even if of moderate cost.

The return of better times and mounting intolerance with the system of night-soil collection saw the commissioning in 1903 of Wellington civil engineer, R.L. Mestayer, who recommended the separation of stormwater and sewage, with sewage being piped up harbour to a septic tank at Cox’s Creek. Again cost dismayed Council and a second opinion was sought of English engineer, G. Midgley Taylor, who scorned the proposal as extravagant. He recommended discharge on the out-going tide of screened sewage, off Takaparawha Point at Okahu Bay at the harbour entrance. Council was confused by the conflicting advice and awaited the appointment in 1906 of the new City Engineer, Walter E. Bush.

¹ NZ Herald, 1870, and other sources.
2. ORAKEI SCHEME

Bush threw his support behind the Okahu Bay scheme. In 1908 Midgley Taylor was recalled to implement the scheme, and the Auckland and Suburban Drainage Board created to oversee the entire Orakei project. Construction then progressed well and the main outfall works were opened in March 1914 with appropriate ceremony.

Some of the detailed features of the scheme are interesting both technically and historically. Quite large diameter or sized sewers were built because of the enormous volumes of stormwater as well as sanitary wastes the sewers were required to convey to the outfall works.

The main intercepting sewer runs 13,500 metres at a grade of 1 in 3000 from Avondale in the west to Orakei. It is of ovoid, or egg-shape, cross section, gradually increasing from 1.05m height by 0.7m, to 2.6m by 1.75m. To carry the sewage from those areas not able to be drained by gravity into the main sewer, four pumping station were constructed as part of the scheme.

Figure 1. Main intercepting sewer to Orakei crossing Okahu Bay foreshore - Special Collection, Auckland City Libraries (NZ) 4.4429

The Orakei outfall comprised twin 1200mm diameter cast iron pipes 380 metres long on cast iron cradles, discharging 7 metres below ordinary low tide. The storage tanks were divided into three longitudinal compartments of total capacity 37,000 cubic metres.

In anticipation of the Tamaki foreshore roadway, not constructed at that time, the reinforced concrete roofs to the storage tanks were built strong enough to carry tram traffic, the electric tram system, extending to the suburbs of Auckland, having been inaugurated in 1902. While tram traffic never eventuated, the tanks sustain heavy road traffic today.

Today, a portion of the storage tanks have been converted into Kelly Tarlton’s Underwater World, where Auckland’s citizens, most of them unknowingly, view sharks where their sewage wastes were once held for tidal discharge. The screenings building – described by Bush “as a handsome brick building on a stone base - housed a detritus removal plant, of bucket dredge type, three sets of 100mm screens followed by mechanically cleaned 15mm screens, and a screenings incinerator with its conspicuous chimney. Many are the false teeth sets recovered (and sometimes claimed from those on display). In the earlier, quieter, less technological times an operator wended his way by bicycle the length of the holding tanks to the valve house (now part of a popular café) to manually open the outfall penstocks on each outgoing tide. The screenings building itself (sans chimney) is today the fashionable Hammerheads Seafood Restaurant.

When the Orakei Scheme opened, the population served was 88,693 of a total population of some 100,000. It was capable of extension to serve 300,000.

3. BROWNS ISLAND SCHEME.

With increasing city expansion, sewerage reticulation kept pace and, by 1920, it was apparent that the waters around the Orakei outfall and adjacent shores were polluted and the discharge of effluent there a menace to health. Also, the expanding reticulation saw an increasing number of sewage outfalls into both the Waitemata and Manukau harbours. The Drainage Board’s Engineer-Secretary Mr. H.H. Watkins was sent overseas in 1929 to study the various methods of sewage disposal then available. He investigated a large number of sewerage schemes and noted that the dilution method, untreated discharge into a large body of water, was the choice most commonly preferred and also the most economical system available.

Watkins’ report of December 1931 proposed to abandon the Orakei outfall and replace it with treatment works on Browns Island, some 2.5km offshore, with discharge of screened and settled sewage to an outfall in the adjacent Motukorea Channel. The works would be connected to the reticulation system by a submarine sewer.

Figure 2. Proposed Browns Island Scheme (top) and existing Orakei screenings building and outfall. Insert photo of HH Watkins Auckland Weekly News
There was, however, some opposition; principally from those parties who could see themselves likely to be affected by the discharge. Amongst these were the Tamaki Ratepayers and Residents Association, and the Tamaki Yacht Club, which postulated that conditions would be little better than the existing Orakei outfall. However, public dissatisfaction with the existing system, which by now was serving 158,000 and under considerable strain, muted these objections.

E.F. Borrie, Drainage Engineer to the Melbourne and Metropolitan Board of Works (aged 41) and G.A. Hart, who was about to retire as Wellington City Engineer, were commissioned to review the proposal and reported in February 1936. They endorsed the Browns Island scheme; but subject to float tests to confirm the anticipated movement of the effluent field. By May 1937 the completed float tests, independently checked, were reported on, confirming the efficacy of the proposed Browns Island outfall and dismissing the need for disinfection of the discharge, although it did recommend chlorination be available for use during prolonged periods of dry weather.

The delay caused by the review was costly as, with the Depression receding, the government subsidy on labour costs was withdrawn, checking the Board’s enthusiasm. Then the outbreak of World War II put all such projects on hold.

In 1943, with a successful conclusion to the war in sight, interest in the scheme revived. The Auckland & Suburban Drainage Board was dissolved and the Auckland Metropolitan Drainage Board was formed. The Board put forward a Bill for a metropolitan drainage authority, which was passed in 1944, notwithstanding a petition which branded the Browns Island proposal ‘a serious blunder and permanent disfigurement of the most beautiful harbour in the Pacific’.

4. CONTROVERSY OVER SCHEME

Although opposition seemingly waned, behind the scenes, however, trouble still stirred, stoking a controversy, ably chronically by Bush, that was to last another twelve years.

In addition to the directly affected critical organisations there was another dissenting party, the Drainage League, small and ineffectual initially; but to its ranks it attracted one Dove-Myer Robinson.

Robinson was a businessman, until that time little interested in civic affairs; but destined, through his initial interest in the sewerage controversy, to become the longest serving mayor in Auckland’s history.

Having attended one of the initial meetings of the Auckland and Suburban Drainage League (to give it its full name), he quickly became the League’s central and dynamic figure. The League’s goal was to prevent the Browns Island scheme coming to fruition and continued discharge of wastes into the recreational waters of the Waitemata Harbour.

Robinson worked on the public’s prejudices to “swimming in their own excreta”; he became conversant in sewage treatment methodology, and developed an allied interest in waste composting.

The League criticised the Browns Island proposal, formulated as far ago as 1931 and now 14 years old, as being obsolete, and stressing its similarity to the discredited Orakei Scheme. They hammered for alternatives to be considered.

The League’s overriding fear was that planning for the Browns Island scheme would proceed beyond the point of no return. However the inconvenient location of the proposed treatment plant on an island and the Board’s lack of skilled staff made progress slow. Watkins retired in September 1947, creating further hiatus.

Re-elected League president in 1947, Robinson expounded the idea of all sewage being directed to Westfield where sludge would be retrieved from sedimentation tanks and the effluent held in an artificial lake formed by building a low retaining dam beneath the Mangere Bridge. Profits would accrue from harvesting water hyacinths and mixing these with the settled sludge to form compost for sale.

In October 1947 the first case of a new epidemic of poliomyelitis (infantile paralysis) was noted. It was thought, but not conclusively proved, that bathing in polluted seawaters was the cause and bathing was prohibited at all inner-harbour beaches. By the end of November the first death had occurred. All Auckland schools closed and, by the time they reopened a month later than usual in March 1948, 113 positive cases had been hospitalised and there had been eight deaths.

5. ENGINEERING CONCERNS RE SCHEME

James P. Porter BSc MICE, aged 51, whose earlier upbringing had been in New Zealand and whose recent work experience was with the London County Council, which gave him familiarity with discharge of sewage to tidal waters, was appointed Chief Engineer on 6 June 1948. Porter found that little had been accomplished since the retirement of Watkins nine months earlier and no doubt was dismayed at the lack of experienced technical staff available.

Porter quickly set about reviewing the Browns Island scheme. His end of July report identified that, with the intervening population growth since the scheme’s inception, it would serve Auckland’s needs only if the Westfield industries treated their own wastes. Otherwise, the Browns Island scheme could serve only immediately
Porter then unveiled a modified Dual Scheme in January 1949, which retained the Browns Island proposal for the urban area tributary to the Waitemata, with a separate plant to serve the Manukau industries and the southern area.

The Auckland Harbour Board agreed discharge standards and the Department of Health approved these as 100 B. coli/100ml beyond “a half-mile of the shores” of the island, with such standards to apply other than on the eb tide.

As to the Browns Island proposal itself, while supportive of it, he was concerned at the lack of test borings and geological investigation of the submarine sewer route to the island. Submarine borings on the alignment of the Browns Island sewer were carried out in early 1949.

Porter still had concerns regarding the feasibility of the submarine sewer, particularly as the borings had identified an infilled valley on the sewer alignment. The advice of Sir William Halcrow, renowned British engineer, who had been retained to act on Auckland’s underground railway, was sought. He advocated a tunnel under the seabed with a light railway for construction of the sewer.

As to new staff, Ronald Hicks, a chemist, was appointed in May 1949 in recognition of the seriousness of the industrial waste problem. Aged 43, Hicks had been manager of sewage purification works at Hamilton, Scotland. As will be seen, he was to prove a ‘hick-up’.

The period 1949-1951 was consumed by political activity involving a commission of Inquiry into the Board’s scheme. The drainage commission completely endorsed Porter’s Dual Scheme and trampled on the League’s ambitions for ponds and recovery of nutrients by water hyacinths – indeed, going further, and condemning oxidation ponds.

By this time the need for a scheme was desperate, Orakei being only one of over two dozen outfalls discharging raw wastes into the Waitemata and Manukau harbours, fourteen of these serving industries around the Westfield - Penrose area including the freezing works, which alone were equivalent to a population of 300,000 persons.

However, the Board was not over all its hurdles yet. Hicks had broken ranks, publicly disagreeing with the Board’s scheme at the Local Bills Committee hearing in October 1951, saying that the scheme’s bacteriological standards would fall distinctly short of what was acceptable. Porter was livid – and pointed out that the effluent was to be discharged only on the outgoing tide and standards applied only to incoming tide.

Hicks was silenced. But there was additional criticism from some prominent local engineers - Ralph Worley, about to become the newly formed North Shore Drainage Board’s first consultant, and Hugh Vickerman DSO OBE, ex Deputy Chief Engineer of the Public Works Department and a past President of the NZ Institution of Engineers, both expressing grave doubt regarding the feasibility of construction of the submarine sewer.

6. DRAINAGE LEAGUE SCHEME

The Drainage League was awakened and Robbie, as Robinson began to be popularly known, saw his chance, early in 1952, when a casual vacancy in the council occurred. He ran, his win ordaining that he be appointed to the Drainage Board.

Robbie then turned to advocating the League’s alternative scheme - providing for all sewage to be treated by oxidation ponds located between Puketutu Island and the Mangere foreshore in the Manukau Harbour.

Robbie aggressively depreciated Porter’s expertise, both at the Board table and in public. Matters came to a head when the City Council, in anticipation of the Browns Island scheme being implemented, proposed to utilise a planned trunk sewer serving the Glendowie area as a temporary septic tank with discharge at the Karaka Bay foreshore until such time as it could be connected to the submarine sewer to the island. The announcement that swimming at Karaka Bay would be prohibited galvanised a large public meeting protesting the proposal. Board engineering officers Mynott and Rowntree had to bear the brunt of uncivil criticism expressed at the meeting.

Then doubt again arose regarding the submarine sewer, Sir William Halcrow’s major report to the Board in September saying the proposal was probably reasonable as long as the probability of earth tremors was low. The Board’s staff began to lose confidence, particularly when tenders for initial works greatly exceeded estimates.

Following considerable turmoil at Board level, in March 1953 the Board reviewed competing schemes in a debate which extended over two days. The meeting reaffirmed the Browns Island scheme and awarded to Etude et Enterprises Ltd, which had been invited to re-tender following unacceptable earlier tenders, a contract for construction of access works, the submarine sewer and the Browns Island outfall in the sum of £1,914,332.

In order to achieve such progress, the Board had taken on additional engineering staff. Charles C. Collom BSc (Eng) MICE, later to become Chief Engineer, took up his appointment as Senior Civil Engineer in November 1951. Along with the appointment of a number of young graduate engineers then and in early 1952, including the
writer, this gave rise to a buoyant morale in the engineering office.

Robinson continued his criticism of the scheme and particularly of Porter, going so far as to move the Board request a public investigation into the affairs of the Board over the period of Porter’s tenure. Even at the ceremony marking the commencement of construction, he expressed an aside to Collom ‘that the scheme could still be stopped’. 3

At the 1953 local body elections several League candidates including Robbie, were appointed to the Board and at its first meeting in February 1954 Robbie was elected chairman.

7. OVERSEAS PANEL OF EXPERTS

Immediately Robertson lead the board into an intensive review of all aspects of the then adopted seven-fold scheme including the submarine tunnel, since abandoned in favour of a seabed trench. Most board members appreciated that proper technical consideration was beyond their competence and, in the face of wavering confidence by staff, opted to slow down the Browns Island scheme and seek review by an overseas panel of experts.

From a short list of 21 nominations prepared by staff, the March meeting of the Board selected a panel of four engineers, three from the west coast of the United States, two of which had previously worked together, one from England and one chemist from Britain. There was considerable allegation of bias regarding selection as the US engineers had a heavily weighted background in development of oxidation ponds, Dr David H. Caldwell’s firm Brown & Caldwell having designed sewage treatment plants based on this process for several Californian communities. Also, he had had a past close working association with the most senior member of the panel, Emeritus Professor Charles G. Hyde, who became the informal chairman of the panel.

The selection of A.M. Rawn, Chief Engineer and General Manager of Los Angeles County Sanitation District and an internationally renowned expert in tunnelling for ocean outfalls, was free of criticism, as was the choice of John T. Calvert, senior partner John Taylor & Sons, London. The fifth member of the panel was English chemist and former sewage works manager Dr Harold Wilson.

Notwithstanding the shadow over selection, the panel worked very fast delivering within a month of arrival on the 18 April an interim opinion on the proposed scheme to the effect that it could not comply with the official discharge standards set by the approving authorities.

Calvert, in a minority report, advocated a reduction in standards, even though those adopted were now to apply at bathing beaches rather than adjacent to the outfall, and supported the Browns Island Scheme, as against others, on the grounds of cost, ability to proceed immediately and on the principle he favoured of dealing with wastes of an area within its own watershed. He also expressed concern regarding risk of smells from oxidation ponds of the size proposed in the alternative League scheme. As to reduced standards, all except Calvert said it would require further testing which would take up to a year. Calvert said there was a reasonable chance but the only way to be certain is to put the scheme into operation and find out.

Porter’s position had become untenable. He had been humiliated by the Board and its antagonistic chairman. At the March meeting he was stripped of his role as Chief Executive Officer and Hicks was vested with the right to report directly on sewage purification and treatment. At its meeting on 19 May 1954 Porter tendered his resignation. At the same meeting the Board resolved not to proceed with its Browns Island scheme.

8. MANUKAU SCHEME

Meanwhile the panel laboured industriously and by 1 July had completed its report. 4 On 7 July the Board adopted the panel’s recommendation for the Manukau Scheme on lines very close to the conception of the Drainage League; viz. all sewage was to be treated in a plant on the shores of the Manukau and in four oxidation ponds lying between Puketutu Island and the mainland near Ihumatao.

A high quality effluent was expected, treatment comprising pre-aeration and grit removal, primary sedimentation, oxidation by trickling filters as required and recirculation through the extensive oxidation ponds, some 550 hectares in area, before discharge to the harbour on the outgoing tide. Sludge from the sedimentation tanks would be digested and captured methane gas used to generate electricity in dual-fuel engines, excess generation being fed to the national grid.
Brown and Caldwell, Consulting Civil and Sanitary Engineers of San Francisco were appointed consultants for the treatment plant and pumping stations.

Design work on the Manukau Scheme commenced in November 1955. The first contract, for the Hillsborough section of the main western interceptor, was awarded to Etude et Enterprises in compensation for the abandoned Browns Island works. The tunnel itself was the largest single local body project undertaken to that time, being 3.2km in length at an average depth of 50m and large enough to accommodate a narrow-gauge railway with a battery operated loco to haul the wagons of spoil loaded by the EMCO B12 rocker shovel at the tunnel heading. The tunnel face was broken down by manual drilling and explosives. The tunnel was backfilled after the laying of the 1350mm diameter concrete sewer pipe.

The Manukau Wastewater Treatment Plant itself was switched on at dawn on 24 September 1960 by the Board Chairman the Honourable Thos. Bloodworth, the writer, now having progressed to the position of Design Engineer (Special Works), indicating which button he should push to start the pumps at the Orakei Pumping Station thus diverting the flow to Mangere.

9. MANUKAU SCHEME PROBLEMS

Problems soon arose – the smells that Calvert thought could arise from such large ponds had hardly begun to annoy local residents when the midge *chironomus zealandicus* arrived *en masse*. The fact residents were assured, and indeed knew, that midges predated the construction of the plant did nothing to improve their Christmas of 1960.

A 700 strong meeting of Mangere residents threatened to withhold the area’s levy to the Board. Caldwell returned in March 1961 at the Board’s request (and Robbie’s personal expense).

He addressed a public meeting of some 500, assuring it that he retained confidence in the pond system once it settled down and that the provision of sludge lagoons would alleviate odours from temporarily mal-functioning sludge digesters. He departed – as did the summer conditions conducive to midge breeding.

Summer of 1961-62 was very trying for the Board, with calls for a Ministry of Health Inquiry from the Manukau County Council.

The third summer 1962-63 saw the problem lessen at Mangere, but midges struck in such swarms at the 43 hectare ponds of the North Shore Drainage Board’s new plant at Rosedale Road that there were serious proposals to dispense with the ponds. Dr Donald Spiller, an entomologist with DSIR was employed to study the midge problem at Mangere. With the dredging of the ponds to a minimum depth of one metre, at which depth there is insufficient light to foster midge emergence, and with increase in biochemical loading to the ponds, both midge and smells abated.

There were dramatic improvements in the water quality of both the Waitemata and Manukau harbours, even with loadings to the plant that greatly exceeded expectations.

The legacy of the Drainage League is that both the Auckland and North Shore systems are based on oxidation ponds, as is the Bromley works in Christchurch and that many other community treatment systems are like based. In fact, as of 1986, ninety-eight communities in New Zealand with populations greater than 1000 were being served by oxidation ponds.

Another gift to Auckland as a consequence of the drainage controversy was Robinson’s six-term tenure as mayor, a total of eighteen years’ service to the city.
Notable among contractors involved with the scheme other than Etude et Enterprises, were Wilkins & Davies Construction Co Ltd and mechanical sub-contractors Mason Bros Ltd on construction of the plant proper; New Zealand Earthmovers Ltd on oxidation pond embankment construction; and Green & McMillard Ltd on trunk sewer construction.

The overall scheme is described by Collom, who revisited the plant operational problems in 1964. By this time the number of pumping stations in the scheme, described by the author of this paper, had increased from the original four to 36, twenty-three being in operation or under construction.

A nation-wide depression in the mid-seventies deterred industrial growth so that, in the event, only four reactors were built.

Figure 6. Chief and Principal Officers of Drainage Board, 1963 Sparrow Photo

The plant operated satisfactorily over the next twenty years; although with close attention having to be given to both pond loading and mudge control. These ponds were the largest in the world in full-time service, only some industrial ponds treating seasonal agricultural wastes being larger.

10. PLANT 1974 UPGRADE

Progressive increasing loadings to the plant necessitated a major increase in the land-based facilities. In 1974 the Board commissioned a report by Caldwell Connell (an Australian affiliate of Brown and Caldwell) which recommended replacement of the rock-filled trickling filters with nine large high-capacity plastic media Fixed Growth Reactors.

A nation-wide depression in the mid-seventies deterred expenditure and also slowed down industrial growth so that, in the event, only four reactors were built.

The Fixed Growth Reactors were cylindrical concrete structures, about the same diameter (53.3m) as the trickling filters but about five times their height. Each contained about 34 million small plastic media units. These polypropylene spoked rings, 97mm diameter by 51mm depth, were random packed into each reactor. Provision was made for both natural and, if needed, forced ventilation of the reactors. With such aeration, primary effluent applied to the reactors would be purged of dissolved and colloidal impurities by the zoogeal growth which would build up on the media.

Overall design of the upgrade was undertaken by Caldwell Connell and local consultants Be Carter Hollings and Ferner. The main contractors were Bitumix Ltd and McMillan and Lockwood. The latter firm was familiar with such undertakings having built the both the Palmerston North Sewage Treatment Plant designed by Brown and Caldwell and D.L. Steven of Christchurch, and the Hamilton Pollution Control plant designed by Steven & Fitzmaurice. McMillan and Lockwood even persuaded the Auckland Regional Authority, now the owner of the plant, to accept an alternative design for the reactors, utilising a free-standing post-tensioned prestressed cylinder on a sliding base in lieu of wall panels fixed to the base slab. Construction was complete by 1981 at a cost of $92.5M.

A minor but interesting controversy arose regarding the media used in the Fixed Growth Reactors. The supply contract was awarded to AHI Chemical Engineering Services for Filterpak media as marketed in the USA by Mass Transfer Inc. Because of the volume required, alone valued at $5.4M, AHI set up a local manufacturing plant. Strict import control was in vogue at this time and when similar Fixed Growth Reactors were proposed for extensions to the Bromley Plant in Christchurch. AHI opposed the importation of Flocor, a modular crate-type plastic media favoured by the writer’s practice, which had the design commission, because of its more open structure with a lesser propensity to blockage. Only strenuous appeal at government ministerial level won approval to import the media which was shipped in flat sheets and assembled into its crate form locally.

Gradual and progressive settlement and compaction of the random media in the Auckland reactors caused poor drainage and ponding of the applied primary effluent. Also unforeseen was the undesired efficiency of the tower-like structures to strip out odours which were inherent in the trade wastes which flowed into the plant from industrial sources as diverse as meat wastes to fertiliser manufacture. These odours were serious enough to require later covering of the FGR units. The direction of the forced ventilation was then reversed and extracted air passed through the original rock trickling filters for odour removal.

The Christchurch plant at Bromley experienced similar odour troubles, although without effluent ponding, and had to resort to a similar response.
Auckland’s growth continued, as did the wastewater load to the treatment plant, and a wide-ranging study\textsuperscript{10} of future needs for additional treatment and disposal options was undertaken by the Auckland Regional Authority (ARA), which had taken over metropolitan drainage responsibilities in 1964. By 1987 the plant was treating a tributary population of 630,000, with an industrial and commercial load equivalent to an additional 700,000.

### 11. PROJECT MANUKAU

Consequent to local government reorganisation in 1989 the plant has, since 1992, been owned and operated by Watercare Services Ltd., a local council organisation, and renamed the Mangere Wastewater Treatment Plant. Watercare recognised that a major plant upgrade was going to be necessary as a consequence to poor pond performance and potential future loading to the plant. It embarked on an extensive public consultation programme in planning the upgrade of the treatment plant. It took the approach that it would implement the most desired outcome the consultative process identified.

Wastewater 2000, as the consultative process was styled, culminated in Project Manukau as described below.

Project Manukau has seen the progressive removal of the oxidation ponds and their treatment capacity replaced by nine large BNR (biological nitrogen removal) activated-sludge reactor-clarifiers.

Each ‘doughnut’ shaped reactor-clarifiers comprises an inner 52m diameter circular clarifier surrounded by peripheral aerobic and anaerobic activated sludge compartments. Overall diameter is 78m and water depth 7.7m. Each sits on a concrete base of 1100m\textsuperscript{3}, formed in one pour.

Other process changes and upgrades to effluent quality include pre-primary influent milli-screening, effluent filtration and ultraviolet disinfection. The effluent is held in a storage basin for discharge on the outgoing tide. Improved capture and treatment of solids includes primary-sludge gravity thickening, centrifuge sludge-dewatering, and lime stabilisation. Sludge lysis (ultrasonic vibration to release moisture) was also added for a time; but its use has been discontinued, as it was found to be ineffective.
Some residual midge problems remain with the open effluent channel and the effluent storage basin; but the upgrade has considerably reduced both midge and odour complaints. There has been a marked improvement in harbour water quality, particularly in bacteriological terms and the foreshore area previously used by the ponds has been returned to recreational use.

The exposed nature of the effluent channel and, particularly, the effluent storage basin met the desire of Maori for “contact with the earth” before discharge. However, these shallow, slightly polluted, fresh water areas are ideal for midge-breeding, necessitating control by chemical spraying. To eliminate the on-going cost of midge control, Watercare intends direct discharge to permanent harbour waters, so removing the midge habitat.

The Project Manukau upgrade to the Mangere Wastewater Treatment Plant became fully operational in terms of its resource consents in October 2003 at a cost of $460M.11

It was a sign of the times that the community’s environmental aspirations superseded concern over costs – a vastly different attitude to the frugality of the previous 150 years.

12. ACKNOWLEDGEMENTS

Acknowledgement is made to Auckland City Libraries for use of photographs and to Watercare Services Ltd for use of material and photographs provided.

REFERENCES

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(10) Auckland Regional Authority. Auckland Area Sewerage Study; Summary Report, (August 1987)


See over page for Auckland Sewerage Timeline
<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
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<tr>
<td>1860's</td>
<td>Nightsoil collections inadequate. Queen Street main drain, the Liger Canal, called 'a pestiferous ditch'.</td>
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<tr>
<td>1873-1878</td>
<td>Liger canal finally covered in and Queen Street sewered.</td>
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<td>1878-1914</td>
<td>British Engineer William Clark recommends an intercepting sewer eliminating Wharf Outfall at foot of Queen Street.</td>
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<td>1903-1944</td>
<td>Auckland population 100,000. Eminent London engineer, Mr G Midgley Taylor submits plans for the Orakei Scheme.</td>
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<tr>
<td>1914-1920</td>
<td>Orakei Outfall opens. Reticulated sewage empties into the Waitemata Harbour at Okahu Bay.</td>
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<tr>
<td>1920-1928</td>
<td>By this time there is a number of sewage outfalls into the Waitemata and Manukau harbours.</td>
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<td>1928-1944</td>
<td>H. H. Watkins, Engineer-Secretary to Drainage Board, recommends that Browns Island be developed as a site for sewage treatment facility.</td>
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<td>1944-1945</td>
<td>The Auckland Metropolitan Drainage Board plans to proceed with the Browns Island proposal, but is met with strong opposition.</td>
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<td>1945-1947</td>
<td>Suburban Drainage League formed to oppose the Browns Island Scheme.</td>
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<td>1947-1952</td>
<td>Poliomyelitis (infantile paralysis) outbreak, thought to be associated with contact with polluted bathing waters, provides incentive to hasten progress.</td>
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<td>1952-1953</td>
<td>Drainage Board awards contract to construct access tunnel and submarine sewer for Browns Island Scheme.</td>
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<td>1953-1954</td>
<td>Dove-Myer Robinson elected chairman of the Drainage Board. Board suspend work on Browns Island Scheme and appoints panel of overseas engineering experts to review scheme.</td>
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<td>1954-1955</td>
<td>Manukau harbour is recommended as the best disposal option for a more comprehensive treatment facility for greater Auckland on a site at Mangere.</td>
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<tr>
<td>1956-1960</td>
<td>Manukau Sewage Purification Works opens in September at estimated cost of £15M. Oxidation Ponds cover more than 500 hectares – then largest in the world.</td>
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<tr>
<td>1962-1970</td>
<td>While environmental quality of the upper Manukau mudflats improves considerably; periodic odour nuisances from the plant continue.</td>
</tr>
<tr>
<td>1970-1974</td>
<td>Pond system is reaching its treatment capacity, and planning commences for increasing plant treatment capacity.</td>
</tr>
<tr>
<td>1974-1981</td>
<td>Treatment capacity increased by commissioning new Fixed Growth Reactors at cost of $92.5M.</td>
</tr>
<tr>
<td>1981-1987</td>
<td>Growth continues. Connected population now 630,000 with additional commercial and industrial equivalent population of 700,000.</td>
</tr>
<tr>
<td>1992-1998</td>
<td>Project Manukau, a $460 million upgrade, including return of oxidation ponds to the sea and incorporating activated sludge, gets underway.</td>
</tr>
<tr>
<td>1998-2003</td>
<td>The upgraded Mangere Wastewater Treatment Plant was officially opened in April 2003.</td>
</tr>
</tbody>
</table>