4 DRAINAGE PROBLEMS AND REMEDIAL MEASURES 1892 - 1940

4.1 POLLUTION

The growth of Melbourne during the second half of the nineteenth century was accompanied by a deterioration in sanitary conditions : human wastes were discharged directly into open drains; cesspools, ill-kept privies and earth closets abounded; and night-soil was dumped in close proximity to residential areas (see, for example, Refs 1 to 4). A Royal Commission appointed to examine the sanitary conditions in Melbourne reported in 1889 that *"Almost every watercourse or lagoon within the metropolitan area is ... used as a receptacle for sewage. Although the general mass of night-soil is kept out of the channels, the liquid sewage flowing in them is foul and dangerous to health"* (Ref 3). The Yarra was described as an *"open sewer - inky black with foul gasses emanating from it"*, and the channels which conveyed sewage across the West Melbourne Swamp were described as being *"foul beyond description"* (Refs 1 and 3). In addition, some rivers and creeks were grossly polluted by wastes from slaughter-houses, bone-mills, boiling-down works and fellmongeries. The general condition of the creeks and drains was such that it prompted one observer, writing in a Sydney periodical, *The Bulletin*, to refer to the city as 'Marvellous Smelbourne' (Ref 5). It is not surprising that diptheria and typhoid were rampant and that infant mortality was high.

Like most other creeks in the inner metropolitan area, the lower reaches of Moonee Ponds Creek were heavily polluted. In his report to Parliament *On the Sanitary Condition and Sanitary Administration of Melbourne and Suburbs*, Gresswell (Ref 6) noted that :

> *The Moonee Ponds Creek is a shallow tidal creek with sandy bed, covered thickly (a foot or two deep) with sewage-sludge, and forming a main trunk outlet for sewage from Essendon, Flemington and Kensington, and Footscray on the one side, and from Brunswick and North Melbourne on the other.*

Not surprisingly there were frequent complaints to the Railways Department, who owned the land through which the lower reaches of the creek flowed (for details see Figure 9-6B), about the unwholesome nature of the watercourse. In March 1889, for example, a deputation from the Flemington, Kensington, and North Melbourne Councils complained about the disgraceful state of the creek, which, in their opinion, was endangering the health of the local residents, and requested the Railways Department to clean out the creek. The Railways Department refused, however, claiming that it was the responsibility of the municipalities in which the polluted water had originated. The Department took a similar stand some twenty-five years later when the Public Health Department complained about the insanitary nature of the creek. On this occasion it was suggested that the maintenance of the creek was the responsibility of the local authorities and also the Public Works Department which had constructed the channel. The Public Works Department, for their part, maintained that the Railways Department should clean out the creek because ponding behind the Railway Gravitation Bridge's *"forest of piles"* was the main reason for the deposition of the foul-smelling wastes. The debate concerning responsibility for the maintenance of the creek remained unresolved, with the result that little, if any, action was taken. A report in *The Age* of 9 June 1921, gives a good indication of the state of the lower part of the creek in the early 1920s:

> *A FILTHY SUBURBAN SEWER*
>
> *Complaints by Kensington People*
>
> *A serious epidemic of diptheria is raging in North Melbourne and Kensington district, and residents are attributing the cause to the filthy state of the Moonee-Ponds Creek, which runs through these suburbs. For many years this stream has been a source of complaint, not only from people living in the vicinity, but from residents of the suburbs further out, who have to pass over it in the railway trains when travelling to and from the city. The creek is channelled from Flemington to within about two chains of the railway line at North Melbourne, but thence upward, where it runs - or creeps - through railway property, it is a mere gutter of filth. The only time it is ever cleaned is when flood waters come down and scour the deposits away, but that scouring comes too rarely and too irregularly. At times the foul odor from this stagnant stream is carried over the thickly populated part of Kensington, which begins quite close to the creek.*

Conditions gradually improved during the 1920s and 1930s as the urban areas within the basin were connected to the Metropolitan sewerage system. The Melbourne and Metropolitan Board of Works, which was constituted by Act of Parliament in 1890, undertook a program of sewer construction in the inner suburbs during the 1890s and by 1900 parts of North Melbourne, Flemington, and Kensington had been sewered (Fig 4-1; Ref 7). It was not until the 1920s, however, that the sewerage network had been extended to most of the urban areas within the basin (Ref 8). Even by this time many properties had almost certainly not been connected, and effluents from industrial premises were undoubtedly still discharged into the creek. Nevertheless, by the 1930s, the creek was no longer the open sewer that it had been in earlier years.

4.2 FLOODING

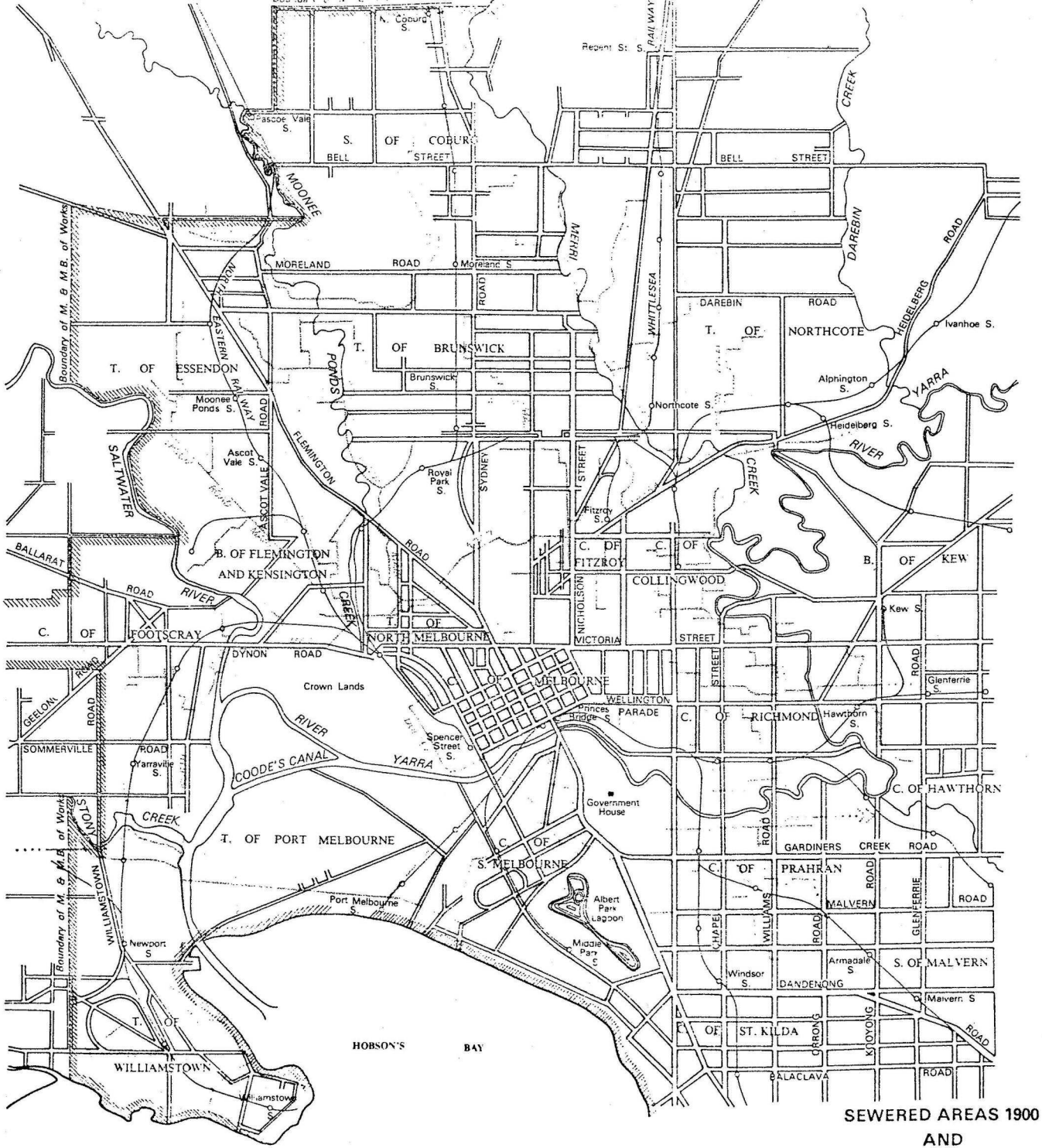
4.2.1 Reports of Early Floods. Severe floods are reported to have occurred along Moonee Ponds Creek in October 1842 and November 1849. A heavy storm on 26 October 1842 caused widespread flooding in the Melbourne area, and Garryowen (Ref 9) records that *"The crops around Melbourne suffered severely, and were in some places utterly destroyed, especially at Moonee Ponds, the Merri and Darebin Creeks..."*. On 29 November 1849 *The Argus* reported that :

> *Great quantities of farm produce, agricultural implements, casks, hides, etc continued to come down from the Moonee chain of ponds, and were secured at the bridge [Main's or Flemington Road Bridge]. Along the whole line of waters from this point to the base of Batman's Hill, the wreck of property, and the bodies of animals were strewed in melancholy profusion. Fat cattle, cows, calves, goats and pigs in scores were lying in all directions, and showed the suddeness of the invasion of the waste of water. So impetuous was the flood in the valley of Moonee Ponds, that large logs were deposited upon the causeway of Main's Bridge at a height above the ordinary level of the creek which would appear incredible from the width of its embanchure.*

Prior to the construction of the embankment around the Swamp and the excavation of the Moonee Ponds channel, the low-lying areas to the south of Flemington Road were also quite frequently inundated by high tides and by backflooding from the Yarra.

Despite the extremely low-lying nature of the land below Flemington Road and its known susceptibility to flooding, part of the area was subdivided into two-acre blocks in 1849 and 1851 (Fig 4-2). These blocks were subsequently further subdivided and developed for residential and industrial purposes. A number of the premises were undoubtedly flooded on December 19 1863, and the area was flooded again on 7 September 1870, when the waters *"came up Harris-Street as far as Curzon-Street"* and

> *Numbers of large logs of timber, which had been unloaded from vessels and stacked in the neighbourhood of the Melbourne Gas Works, were washed across the swamp and left strewn along the south-side of Shiel-Street, and a fine yacht was stranded on the Macaulay-Road opposite the same street.(Ref 10).*



SEWERED AREAS 1900
AND
SEWER NETWORK 1925

Source: Ref 7 and 8

Figure 4-1

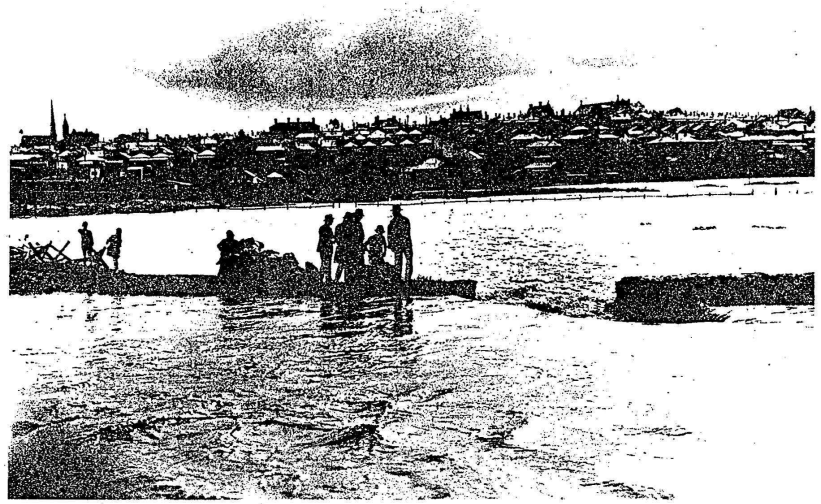
4.2.2 Flooding Behind the Embankments. The excavation in 1877 of the cuts to convey the waters of Moonee Ponds Creek to the Yarra and Saltwater Rivers, and the subsequent embanking of Moonee Ponds Creek from Flemington Road to below Arden Street, reduced the frequency and severity of flooding in the area, but also undoubtedly created a false sense of security. The local councils allowed subdivision to continue in the area between Racecourse and Macaulay Roads, and by the 1890s much of the area had been developed (Fig 4-2). Flooding continued to be a problem, however, because local stormwater was unable to enter the embanked channel during periods of high flow in the creek. Extensive flooding occurred on 12 July 1891, *The Argus* of the following day reporting that :

> *Below Flemington Bridge ... at least 50 houses have been completely surrounded by the flood-waters and a great deal of suffering and damage will probably be the result. Most of the people living there are working men, with families, the buildings being mostly small weatherboard cottages. The damage here is only indirectly a result of the flood in the creek, which from the bridge follows a straight canal bounded by the Coburg railway on one side and a retaining bank on the other. The flood-waters from further up the valley have so far been confined between these natural embankments, and the damage is purely a result of the local flood-waters. Flood-gates have been fixed at intervals on the canal bank to admit these local flood-waters, but as the canal is banked up by the flood in the Yarra and is further susceptible to tide influences these flood-gates have been quite useless, and the banks have served as a dam to retain them.*

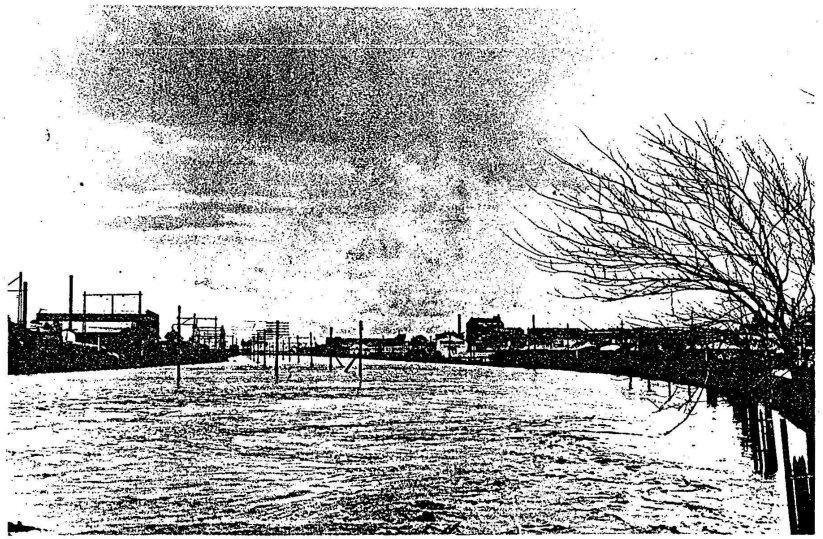
The Argus also reported that the water level behind the embankments had continued to rise after flood flows in the canal had begun to subside.

On a number of occasions flooding behind the embankments was aggravated by the malfunctioning or failure of the floodgates. On 19 June 1911, for example, a number of premises were flooded between Racecourse and Macaulay Roads, including the Kensington Preserving Company's works which had been built over the old course of the creek. According to the Railways Department, the water ponded behind the levee banks was deeper on this occasion than during either the July 1891 or May 1900 floods because "*the floodgates, where not missing altogether, were in such a state of disrepair as to allow practically free outlet for the floodwaters on to the low areas between Racecourse and Macaulay Roads, and Macaulay Road and Chelmsford Street*". A number of complaints were made to the Railways Department, but although the Railway authorities acknowledged that the channel of Moonee Ponds Creek and the levee banks were located on land owned by the Department, they disclaimed any responsibility for protecting the low-lying areas beyond the banks from inundation. They suggested that the maintenance of the floodgates was the responsibility of the Public Works Department. In an attempt to alleviate the problem the Melbourne City Council prohibited in 1918, under Section 274 of the Health Act 1915, the erection of any house or building on land adjoining the canal between Flemington Road and Arden Street (Ref 11; Fig 4-3). It is doubtful, however, whether this regulation was rigidly enforced because by 1931 most of the area was occupied by residential and industrial premises (Fig 4-2).

4.2.3 The Breaching of the Embankment: The Flood of August 1924. Flood flows in Moonee Ponds Creek were contained within the levee banks until the flood of August 1924 when the western bank was breached just upstream of the Racecourse Road Bridge (Plate 4-1). Floodwaters poured into Debneys Paddock (now filled and occupied by Housing Commission flats) and caused considerable damage to property in the area. The breach occurred at a point where a box containing high tension electricity cables had been buried the previous year by the Electricity Commission. Water had seeped along the line of the cable box, weakening the levee bank, and the bank collapsed during the flood peak.

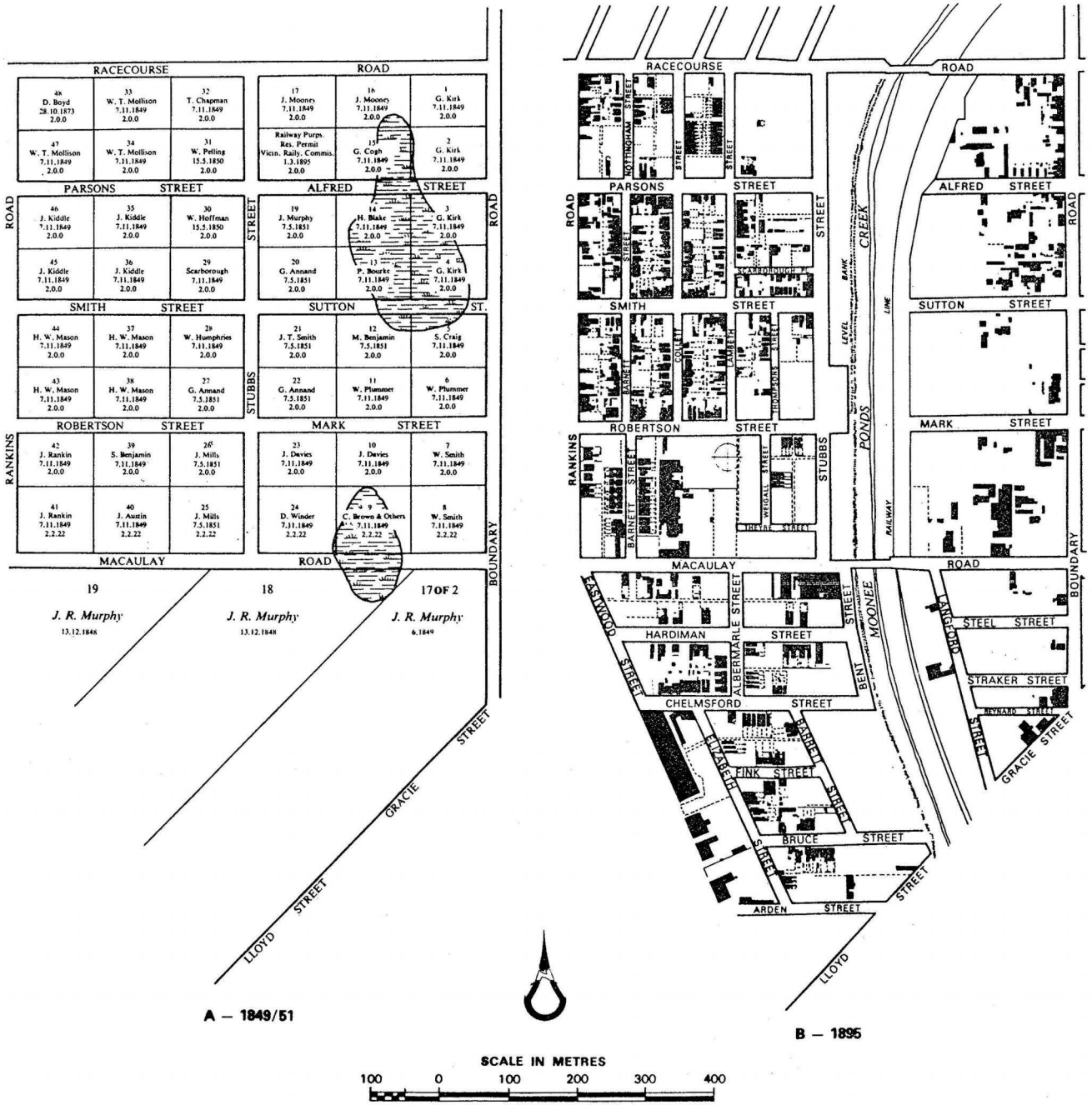


A Water pouring into Debneys Paddock through a breach in the embankment just upstream of Racecourse Road Bridge



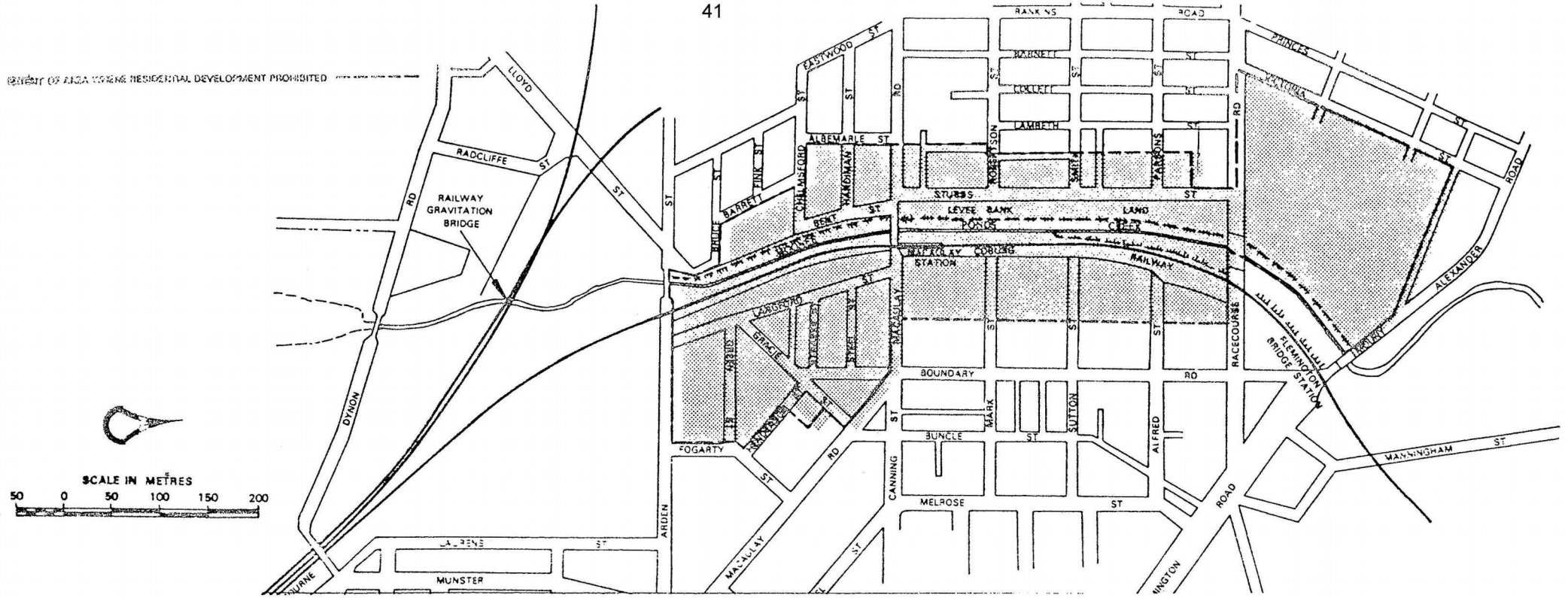
B View looking downstream from Racecourse Road Bridge

PLATE 4-1 The Flood of 24 August 1924



SUBDIVISIONAL DEVELOPMENT BETWEEN RACECOURSE ROAD AND ARDEN STREET

Figure 4-2



LOCATION OF AREA WHERE RESIDENTIAL DEVELOPMENT WAS PROHIBITED BY THE MELBOURNE CITY COUNCIL IN 1918

Figure 4-3

4.2.4 The Christmas Day Flood, 1933. Far greater damage was caused on Christmas night 1933 when the levee banks were overtopped. Extremely heavy rain from a thunderstorm began to fall about a quarter to five on Christmas afternoon and most parts of the basin received between 150 and 250 points of rain during the following hour (Fig 4-4; Table 4-1). The return interval of the storm in the Broadmeadows and Kensington areas was estimated to have been in the order of 1 in 200 and 1 in 300 years respectively. The axis of the storm was centred over the Moonee Ponds Creek basin (Fig 4-4) and flood flows were experienced along the length of the creek. Between 9.00 and 10.00 pm floodwaters overtopped the levees in a number of places (Table 4-2) and inundated the surrounding low-lying areas (Fig 4-5). Floodwaters which overtopped the banks of the creek above the Flemington Road Bridge flowed across Mt Alexander Road along the old course of the creek and flooded Debneys Paddock. Peak discharge in Moonee Ponds Creek below Flemington Road was estimated to be in the order of 7 000 to 8 000 cusecs.

At the height of the flood some 190 houses and 45 factories in the lower part of the basin were inundated (Plate 4-2) and several hundred people had to be evacuated. Apparently many of the occupants paid little attention to the localised flooding that accompanied the torrential rain because flooding of this nature recurred frequently, but:

Were startled when without warning, a great volume of muddy water burst into their homes and rose four feet in 15 minutes.

A panic alarm was raised that the earthen bank had given way in three places - at the foot of Hardiman Street, off Chelmsford Street, and near Racecourse Road. The canal was running a banker at high speed, and had spread over the flats on the east side.

But the bank had not burst, the flood waters having actually poured over the top of the levee.

Women rushed from their houses with their children and struggled waist deep in swirling water. Husbands hastened to get their wives and children to higher ground.

Many people leaped from beds into three feet of water. Others were terrified to find water suddenly sweeping over the bed clothes. The roar of the flood in the canal added to the panic.

On the other side of the bank the avalanche of water cascaded directly into two terraces of wooden houses in Bent Street and Stubbs Street.

Within 20 minutes it rose so high the occupants who had not been able to escape were forced first to take refuge on the window sills and later to climb on to the roofs of their verandahs.

In Hardiman and Chelmsford Streets, which fall down toward the canal, the position was soon equally serious.

Rescue parties were quickly at work, and men floundered through the water carrying women and children to safety. Neighbors helped neighbors, and women pluckily joined in the efforts of parents to save children who had been caught in the flooded homes.

(The Herald, 26 December 1933)

Damage in the area was estimated to be in the order of £ 30 000. Further upstream, the floodwaters undoubtedly eroded the vertically-sided banks along some reaches, and at Hope Street, Brunswick, a footbridge was washed away (Plate 4-2 C).

TABLE 4-1 RAINFALL TOTALS AND INTENSITIES DURING THE STORM OF 25/12/33

PLACE	POINTS	IN	RATE PER HOUR	ESTIMATED† FREQUENCY
* Flemington	283	45 mins	377 points	300 years
* Flemington	296	24 hours	-	-
* Greenvale	249	24 hours	-	-
* Essendon	155	24 hours	-	-
* Melbourne (Weather Bureau)	146	1 hour	146 points	60 years
* Coburg	177	-	-	-
* Coburg	155	50 mins	186 points	150 years
o Pascoe Vale	110		-	-
/ Broadmeadows	206		-	-
/ Broadmeadows	200	30 mins	400 points	200 years
/ Campbellfield	98	30 mins	196 points	23 years
/ Campbellfield	106	45 mins	140 points	-
o Keilor	20	90 mins	14 points	-
o Brunswick	188	60 mins	188 points	130 years
o Brunswick	208	140 mins	87 points	-
o Sunbury	32	15 mins	128 points	-
o MMBW Head Office	114	65 mins	105 points	23 years

* Weather Bureau gauge

o From Board of Works self-recording gauge.

/ Privately owned gauge

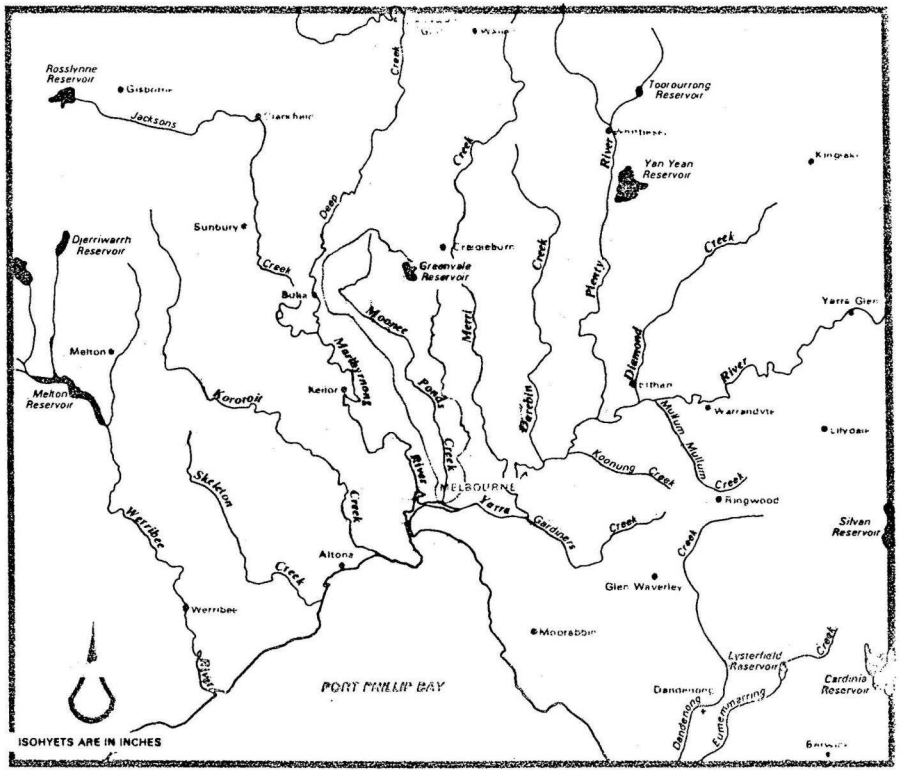
†"Estimated frequency" is to be regarded as of very doubtful accuracy as the records on which it is based do not cover a sufficiently long period of time.

Source: Internal MMBW Report by the Engineer for Rivers and Streams on Cover No 4310/ODP (3)

4.2.5 The Flood of late November/early December 1934. Between 29 November and 1 December 1934 heavy rain fell over the eastern and northern part of the Melbourne region giving rise to severe flooding along the Yarra River and Merri and Gardiners Creeks. Moonee Ponds Creek, however, was not severely affected. Although the amounts of rain received over much of the Moonee Ponds Creek basin were twice as high as those received during the Christmas 1933 storm (Fig 4-4), rainfall intensities were far lower. Peak discharge along the creek was estimated to have been no more than 2 500 cusecs, and flood flows were contained within the levee banks. However, moderate to severe flooding was experienced in the low-lying areas below Flemington Road (Plate 4-3) because the flood peak on Moonee Ponds Creek coincided with an exceptionally high tide of 6.70 feet. The high tide ponded water in the embanked channel, preventing local stormwater runoff from draining away. The resulting flood in the low-lying areas beyond the levee banks was only six inches lower than that of the Christmas 1933 flood (Plate 4-3). An MMBW report suggested that had such a tide coincided with the 1933 flood (when the tide level was only 2.09 feet) the water ponded behind the levee banks would have been in the region of eight to nine feet deep rather than only three to four feet deep.

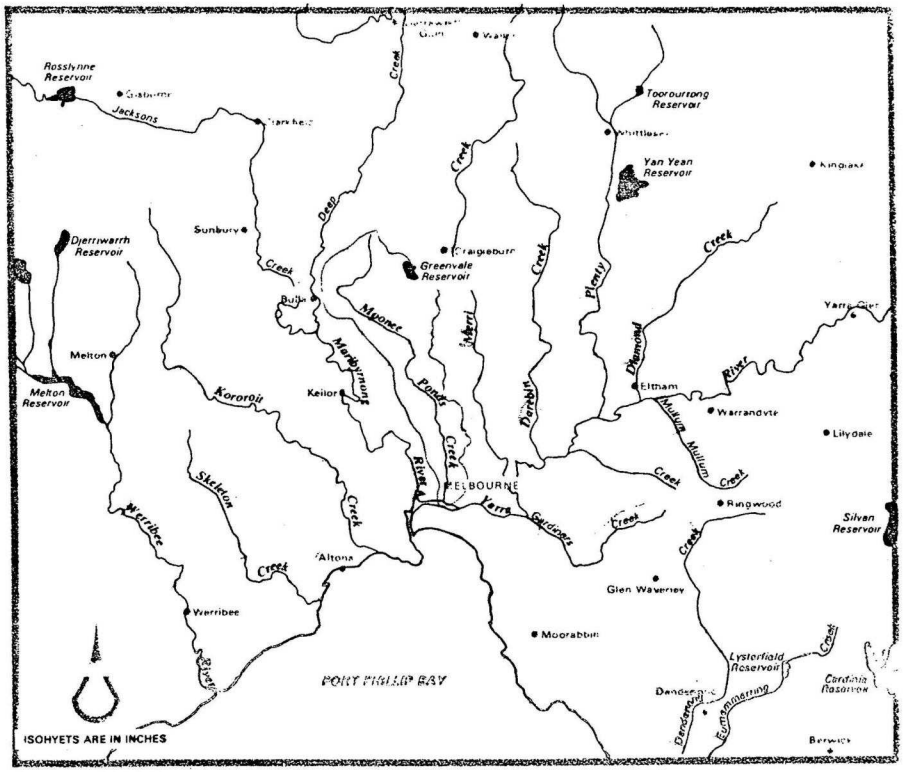
TABLE 4-2 LOCALITIES WHERE THE LEVEE BANKS WERE OVERTOPPED

KENSINGTON BANK	LENGTH OF LEVEE OVERTOPPED	MAXIMUM DEPTH OF WATER OVER LEVEE
100 ft to 500 ft upstream from Arden Street	400 feet	1 ft 3 in
Below Macaulay Road 100 ft to 600 ft	500 feet	1 ft 3 in
Above Macaulay Road to 1000 ft upstream	1000 feet	1 ft 9 in
Below Racecourse Road	750 feet	6 in
MELBOURNE BANK		
Macaulay Road Bridge upstream	800 feet	1 ft
Below Macaulay Road 100 ft to 400 ft	300 feet	9 in
Below Arden Street	Isolated spots	Few inches



SCALE 1:500,000

1 HOUR DURATION
CHRISTMAS DAY 1933

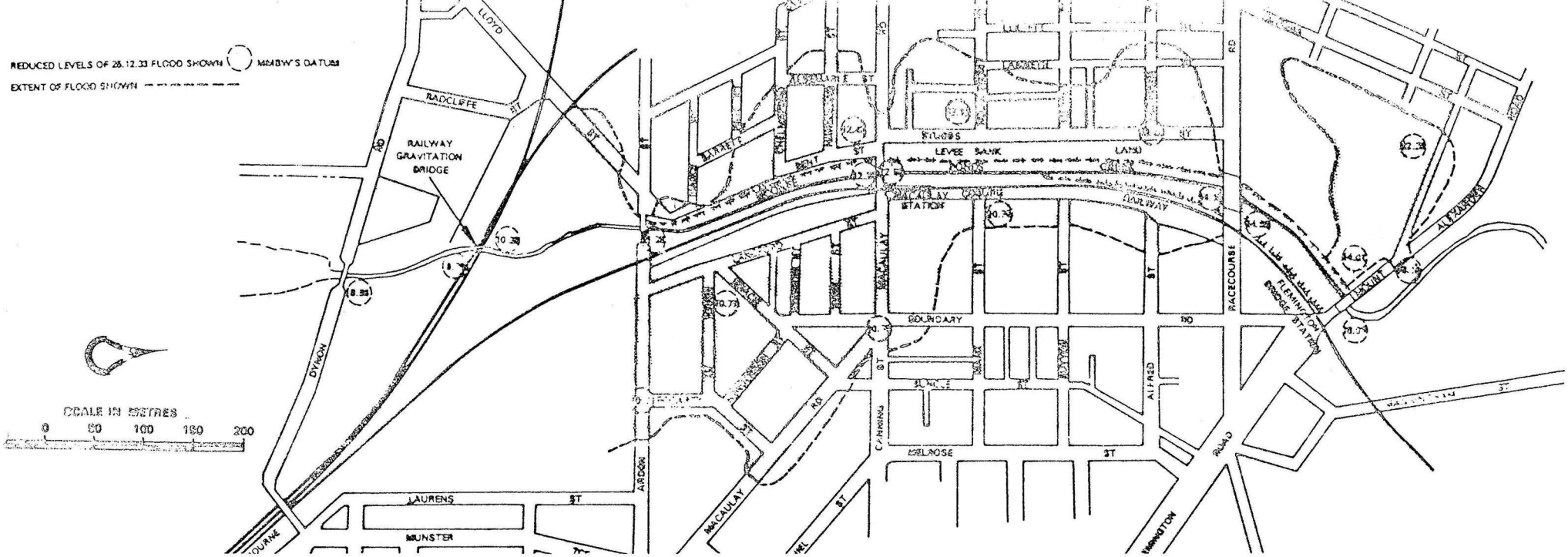


SCALE 1:500,000

48 HOUR DURATION
29 NOVEMBER 1934 TO 1 DECEMBER 1934

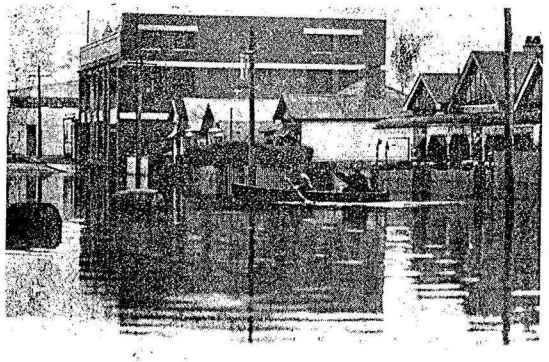
ISOHYETAL MAPS FOR THE STORMS OF CHRISTMAS DAY 1933 AND NOVEMBER / DECEMBER 1934

Figure 4-4

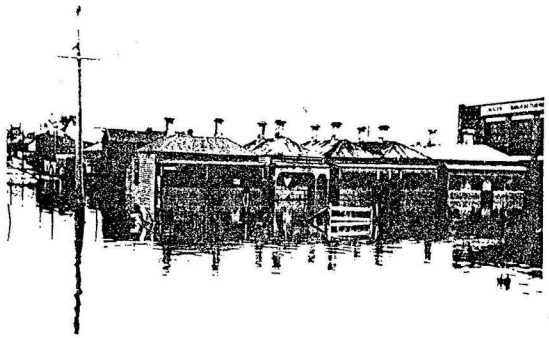


AREA INUNDATED BY THE CHRISTMAS DAY FLOOD OF 1933

Figure 4-3



A Albemarle Street, Kensington, Boxing Day 1933

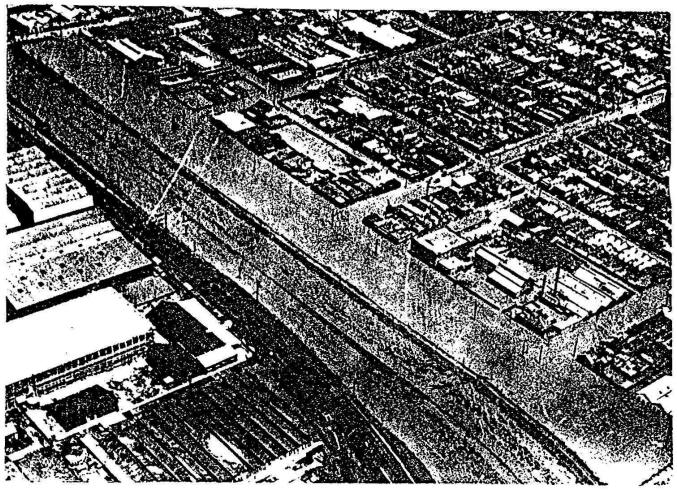


B Stubbs Street, Kensington, Boxing Day 1933

C The remains of the Hope Street footbridge

PLATE 4-2 The Christmas Day Flood, 1933

"Courtesy: Herald and Weekly Times Ltd.



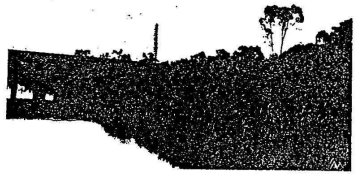
A Aerial view of embanked channel and inundated area between Racecourse and Macaulay Roads, early December, 1934

BROAD BACKS WERE NEEDED in Macaulay today when families, whose homes were flooded, set out to investigate the extent of the damage.

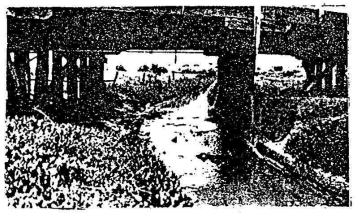
B Stubbs Street, Kensington, 1 December 1934
"Courtesy: Herald and Weekly Times Ltd."

PLATE 4-3 The Flood of late November, 1934

4.2.6 Contributory Factors. Throughout the period from the 1880s to the early 1930s the problems of flooding along the lower reaches of Moonee Ponds Creek was aggravated by a number of factors. Siltation and vegetation growth, which reduced the hydraulic capacity of the channel (Plate 4-4) and blocked drain outlets, were constant problems. Considerable quantities of silt and debris were trapped by the piles of the bridges that crossed the channel, causing floodwaters to head-up at these points. This problem was most acute at the Railway Department's Gravitation Bridge (Fig 4-6; Plate 4-5), where the *"forest of piles and whalings"* caused a 12-inch head-up of floodwaters. As the question of responsibility for the maintenance and cleaning out of the creek was never satisfactorily resolved, little action was taken to clear accumulated sediment and debris.



A The Geelong Railway Bridge



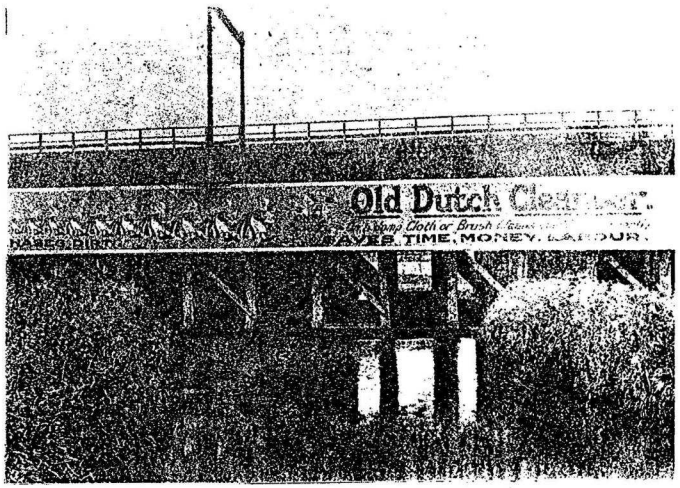
B Looking upstream from the Racecourse Road Bridge.

Plate 4-4 Vegetation growth along the embanked channel

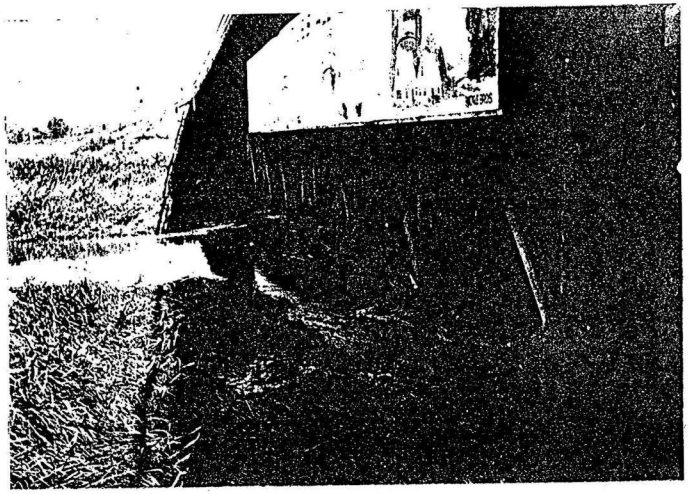
The passage of floodwaters was also impeded by the gradual in-filling of the Coal Canal and by modifications to the channel outlet. In 1924 work commenced on the excavation of the Appleton Dock and the construction of a wharf between the Victoria Dock and the entrance of the Appleton Dock. The construction of the new wharf blocked the outlet of the Moonee Ponds channel, and a new outlet into the Appleton Dock was cut (Plate 4-6, A, B & C), with some of the excavated material being used to reclaim part of the Coal Canal. The new outlet was extremely narrow and far from ideal (Plate 4-6 C). It was estimated that during the Christmas 1933 flood, when the outlet was partially blocked by two dredges and two temporary bridges (Plate 4-7), the flow through the cut was in the order of eight to nine knots per hour; conditions in the cut at this time were described as being *"more choppy than the Rip"*. In order to alleviate the situation, the Harbor Trust excavated a much wider and straighter outlet in 1935 (Plate 4-6 A & D).

4.3 FLOOD ALLEVIATION PROPOSALS

During the latter decades of the last century and the early decades of the present century, the division of responsibility for the lower reaches of Moonee Ponds Creek militated against the effective maintenance of the creek and the adoption and implementation of flood alleviation measures. The channel and levee banks between the Flemington and Dynon Road Bridges, and the northern part of the Coal Canal and adjoining land, were owned by the Railways Department, while the remainder of the Coal Canal and the outlet of the Creek was vested in the Harbor Trust (Fig 4-7). The Harbor Trust accepted responsibility for the maintenance of the sections vested in it, but the Railways Department consistently disclaimed responsibility for the embanked

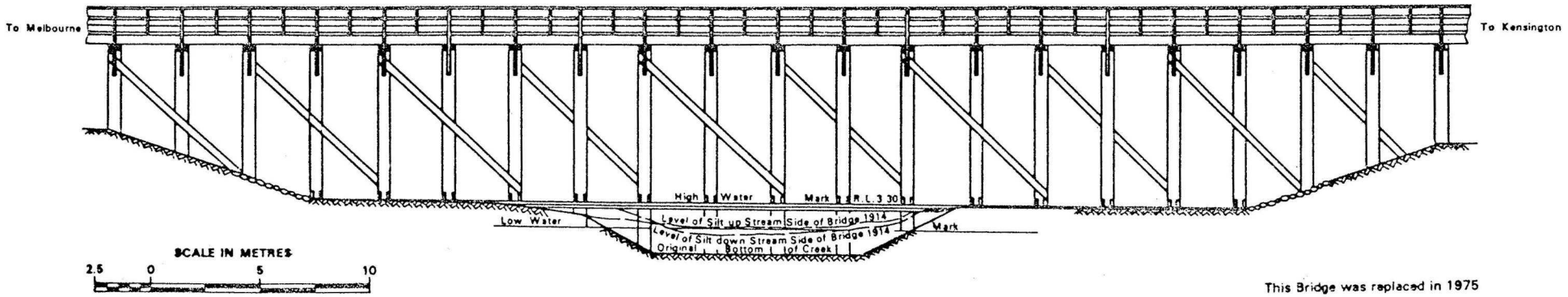


A — View looking downstream towards the bridge. Note the dense growth of vegetation along the sides of the channel.



B — Heading up of floodwaters — Boxing Day, 1933

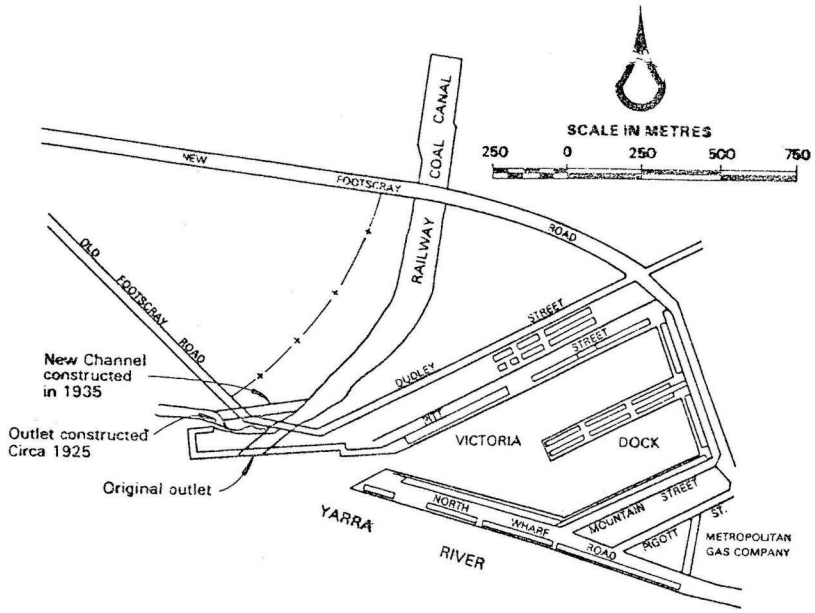
Plate 4-5 The Railway Gravitation Bridge



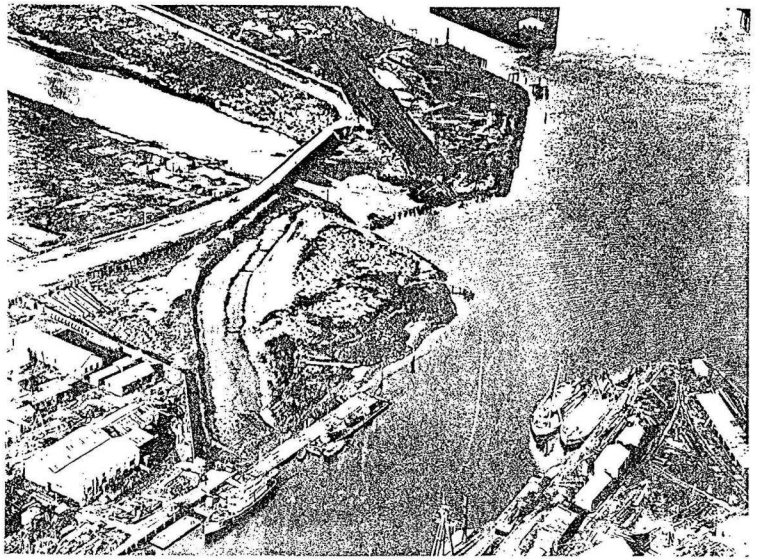
ELEVATION

THE RAILWAY GRAVITATION BRIDGE

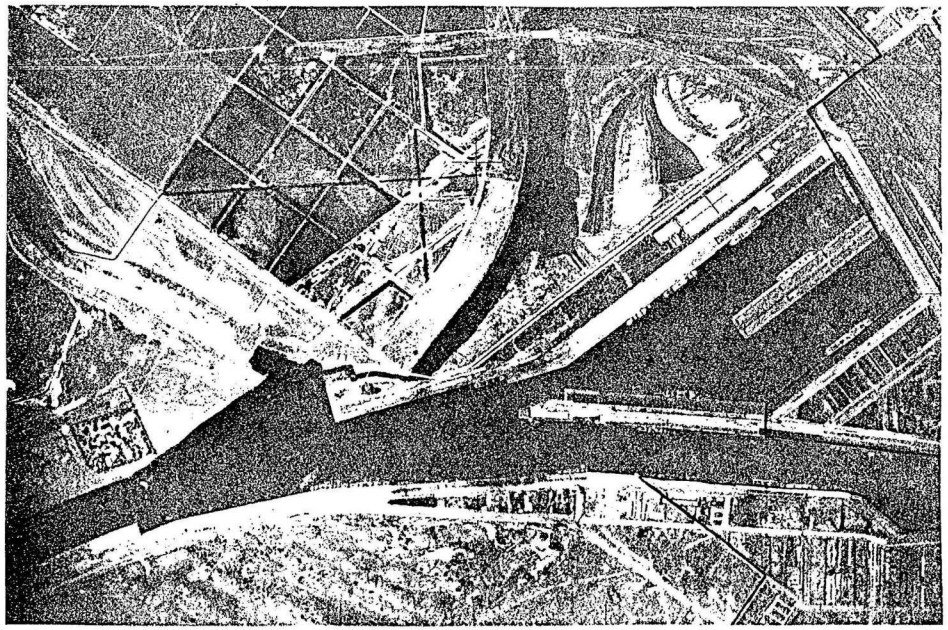
Figure 4-6



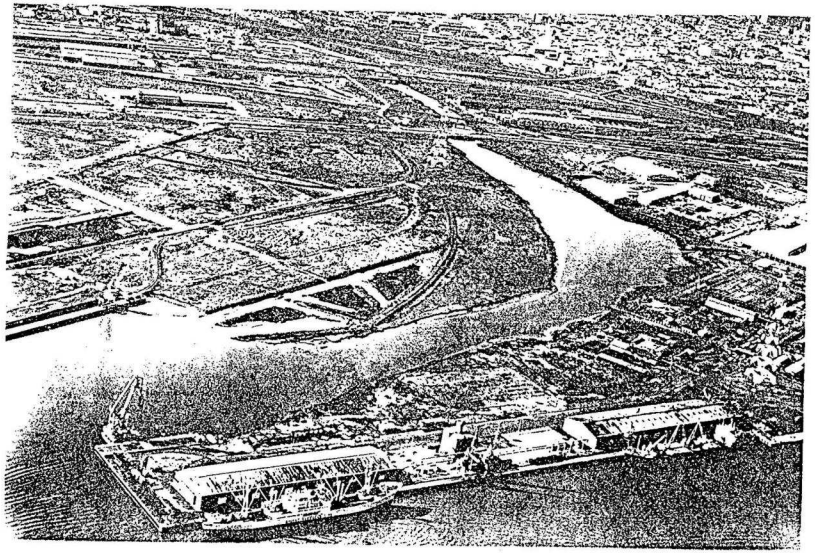
A. LOCALITY PLAN



B. 1925



C. 1931



D. 1972

PLATE 4-6 THE JUNCTION OF MOONEE PONDS CREEK WITH THE YARRA RIVER

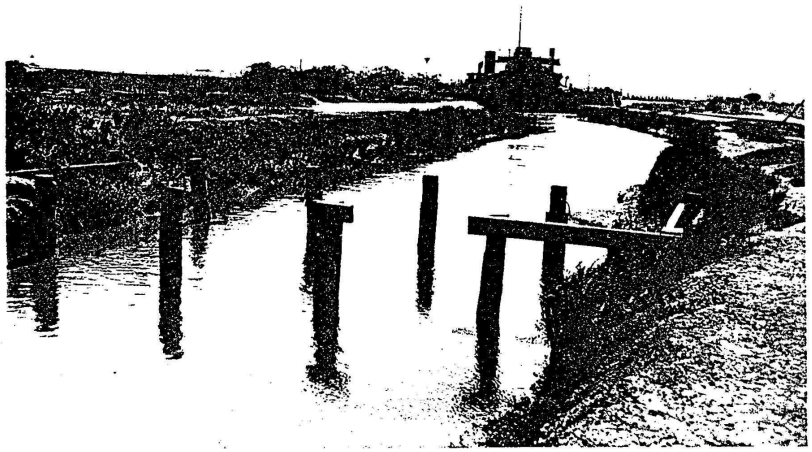


PLATE 4-7 The constructed oulet of Moonee Ponds Creek partially blocked by the dredge 'Lady Stanley' 12 January 1934. The piles in the foreground are all that remains of one of the temporary bridges that were washed away during the Christmas Day flood of 1933

channel between Flemington Road and Dynon Road, contending that maintenance along this section should be undertaken by the Public Works Department and the local councils.

The situation was further complicated in October 1923 when the Metropolitan Drainage and Rivers Act (No 3284) was passed. The Act, which became operative on 1 January 1924, entrusted the Board with "*making further and better provisions with respect to Main Drains, Main Drainage Works, and Rivers, Creeks, and Watercourses within the Metropolis*". Under the provisions of Section 11 (3) of the Act, Moonee Ponds Creek upstream of the south-western side of the Railway Gravitation Bridge was vested in the Board with the proviso :

> *that before defining the extent of the banks of that portion of the Moonee Ponds Creek between the south-west side of the bridge in existence at the commencement of this Act over the said creek and carrying the railway tracks of the North Melbourne gravitation sidings and Flemington-Road a joint report on the definition of such banks shall be obtained from the Surveyor-General, an officer in the Railways service, and an officer in the service of the Board.*

The Act also stated that should the Railways Department or Harbor Trust Commissioners construct any drain from any point on Moonee Ponds Creek south-west of the Gravitation Bridge to either the Yarra or Maribyrnong Rivers, such a drain could be declared to be a Main Drain by the Governor-in-Council and would thus vest in the Board of Works.

In 1925 the Board of Works commenced an investigation into the flood problem along the lower reaches of Moonee Ponds Creek (Ref 12). A number of cross-sections were surveyed, and between 1926 and 1928 sections of the creek were cleaned out (Refs 13 and 14). In 1930 seven alternative flood alleviation schemes were drawn up for consideration (Table 4-3). The Board's Engineer of Water Supply favoured either Scheme 3 or 4, both of which proposed that the outlet into the Yarra and the channel between the outlet and the Gravitation Bridge should be improved, that the berms of the existing lined channel between the Gravitation Bridge and Flemington Road should be trimmed, and that a new channel should be excavated between Flemington Road and Brunswick Road. The Engineer also supported the possible combination of one of these schemes with Scheme 5, which proposed that pumps should be installed to remove any water ponded behind the levee banks. Scheme 1, the construction of a retarding basin upstream, was dismissed as being unsound because of the elongate shape of the basin, while Scheme 2, the construction of a channel to the Maribyrnong River, and Scheme 7, the construction of a by-pass channel for waters from the upper part of the basin, were dismissed as being too expensive. Scheme 6, the construction of a tidal channel, was also considered to be too expensive, particularly as it would have required considerable alterations to some of the bridges, especially the Railway Graviation Bridge.

The schemes proposed in 1930 were not designed to alleviate flooding altogether, but to accommodate flows of up to 3 000 cusecs. It was estimated that a 3 000 cusec flood would have a 1 in 10 year recurrence interval by about 1940 if building development proceeded as anticipated. It was suggested that much of the low-lying land should be filled, and that the municipal authorities should establish suitable building levels and regulate floor levels for new factories. In a Board of Works memorandum discussing the proposals it was noted that before any work could commence in the section between the Flemington Road Bridge and the Gravitation Bridge a meeting with the Surveyor-General and the Railways Department would be necessary in order to define the banks, and that a conference with the Railways Department and the Harbor Trust should be convened to discuss plans for the improvement of the channel downstream of the Gravitation Bridge.

No action was taken until after the Christmas Day flood of 1933. As a direct result of the flood a Conference was held in August 1934 between representatives of the Melbourne City Council, the Board of Works, the Harbor Trust, the Railways Department and the Surveyor-General:

> *to inquire into and furnish an expert opinion on the best measures to improve the flood conditions in the Moonee Ponds Creek and adjacent land between Flemington Road and the confluence of the creek with the River Yarra.*

The Conference concluded that to reduce floods effectively in the section of the creek under consideration it was essential that :

1 *Adequate waterway be provided in all sections of the creek to take the anticipated rate of flood discharge that may be expected from the catchment, at such a grade as is available during an exceptionally high tide which may occur during the flood.*

2 *The flood waters in the creek be prevented from backing up along the local drains and from overtopping the levee banks, and so escaping on to the low-lying ground which is below creek flood level.*

3 *The local rain water, which collects outside the creek and is unable to flow into it by gravity owing to the flood water being above ground level, be removed. This may be effected by the provision of large low lift pumps to elevate the local waters and discharge them into the creek, or, alternatively, the land below flood level may be reclaimed, the buildings removed or raised, and then the whole of the low-lying area filled to above the creek flood level.*

This could be done either by -

(a) purchasing or taking the land, reclaiming and then selling it for building purposes; (the increased value of the land would help to defray the cost of the work), or

(b) prescribing certain areas as betterment areas, reclaiming them, and imposing a betterment rate in consideration of their permanently increased value.

Map Dated 1913

LAND CONTROLLED BY THE MELBOURNE HARBOR TRUST AND THE VICTORIAN RAILWAYS DEPARTMENT

Figure 4-7

TABLE 4-3 SUMMARY OF PROPOSED IMPROVEMENT SCHEMES

SCHEME	EFFECT OF IMPROVEMENTS	ESTIMATED COST (£)
1 A retarding basin in the upstream area	Scheme not practicable	
2 a and b. Diversion of creek to Maribyrnong River	Prevention of flooding from Brunswick Road to the Gravitation Bridge. Increased flooding in Maribyrnong River	a - 278 000 b - 273 000
3 Improvements to channel Section A (below Gravitation Bridge) - improvements to outlet	Reduction in flood level in Section B from zero at Gravitation Bridge to 2 ft at Flemington Bridge	25 860
Section B (Gravitation Bridge to Flemington Bridge) - trim and smooth earth berms on either side of pitched channel	Average reduction in flood level in Section C approximately 2 ft 6 in	
Section C (Flemington Bridge to Brunswick Road) - new earth channel with concrete - lined centre channel		
4 Similar to 3 but deeper channel to be excavated in Section C	Reduction in flood level in Section B the same as in Scheme 3. Average reduction in flood level in Section C approx. 4 ft. 0 in.	39 780
5 Pumps to be installed in Section B to prevent accumulation of local drainage outside the levee	Prevention of flooding in Section B if pumps are reliable	27 000 extra to Schemes 3 or 4.
6 Construction of a large tidal channel below the Flemington Road Bridge	Prevention of flooding in Sections B and C	103 300
7 Construction of a channel to keep water from the upper reaches in a separate channel to the drainage from the low areas	Prevention of flooding in Sections B and C	326 000

In order to achieve these objectives the Conference made the following recommendations (Ref 15) :

1 That the Melbourne Harbor Trust Commissioners improve the outlet of the creek by enlarging the section between Dudley Street and the Yarra River.

2 That the Victorian Railways Commissioners prevent the tipping of spoil and rubbish in the neighbourhood of the disused coal canal which would cause restriction of the waterway.

3 That the Melbourne and Metropolitan Board of Works call the Conference referred to in Section 247 (3) of the M.M.B.W. Act to report on the definition of the banks of the creek between the Railway Gravitation Bridge and Flemington Road, and the Governor in Council define the banks as reported by the Conference.

4 That the Melbourne and Metropolitan Board of Works define the maximum rate of discharge and surface gradient of flood waters in the section between the Flemington Road Bridge and the River Yarra and that the Melbourne Harbor Trust Commissioners, the Victorian Railways and the Melbourne City Council accept this definition and abide by it in any future work affecting the creek whether temporary or permanent which may be carried out by them.

5 That the provision of adequate waterway and the maintenance of the bed and banks of the creek between the Gravitation Bridge and Dudley Street is the responsibility of the public authority in whom the creek is to be vested.

Legislation is required to determine responsibility.

6 That, subject to 1 and 2, the Melbourne and Metropolitan Board of Works after the definition of the banks improve the section under their control by enlarging the waterway where considered necessary, and regular clearing of silt and weeds and the maintenance of the bed and banks as defined by the Governor in Council.

7 That improvements to local drainage in the area outside the banks is the responsibility of the Melbourne City Council and that they should give consideration to either the provision of a drainage pumping or reclamation scheme.

At a second Conference held in early December 1934, the Melbourne City Council stated that they were prepared to take responsibility for the drainage of the areas beyond the levee banks between Arden Street and Flemington Road, while the Melbourne Harbor Trust agreed to widen the outlet to the Yarra, and the Railways Department agreed to stop dumping fill into the Coal Canal.

At a meeting held in January 1935, the Board of Works was required to state the discharge for which works were to be designed and to determine the flow line for that discharge below the Flemington Road Bridge. In response to this request, the Board prepared designs for channels to accommodate discharges of 4 000 and 9 000 cusecs, the latter discharge being considered to have a recurrence interval of between 1 in 50 and 1 in 100 years. A 9 000 cusec scheme was recommended by the Board because it considered that this would be necessary if there was to be significant reduction in the flood problem. Nevertheless, it was appreciated that the expense involved would not be entirely justified on purely economic grounds.

The designs prepared by the Board included three alternative plans for channels with a capacity of 9 000 cusecs. One of these, which involved widening the channel and alterations to all bridges but no deepening of the channel was considered to be unsound. The second plan involved widening and deepening of the channel and modifications to a number of the bridges, while the third involved widening and deepening, but bridge alteration at Dynon Road only. Of these, the latter was preferred because it was less costly.

The 9 000 cusec plan recommended by the Board was presented to a third conference between the parties concerned in July 1935. The scheme was approved, but both the Harbor Trust and the Melbourne City Council felt that the estimated cost of £89 000 was out of proportion to the benefits that could be expected to accrue, and the Melbourne City Council presented an alternative scheme for a 6 500 cusec channel between Flemington Road and the Gravitation Bridge costing approximately £20 000.

At a fourth conference held in late July 1935 the representatives rescinded their decision made earlier in the month and approved the Melbourne City Council's proposal for a 6 500 cusec channel. The Council suggested that the existing channel should be cleared of silt which would be used to raise the levee banks by some three feet. The Board of Works was opposed to this plan pointing out that if the levee banks were overtopped, as they inevitably would be, the problem of flooding would be aggravated rather than alleviated. In response to the criticsm that its earlier plans were too expensive, the Board proposed a new scheme for a 5 000 cusec channel, similar in principle to the 9 000 cusec plan, but only costing £20 000.

The Board's proposed 5 000 cusec scheme was adopted at a conference held in September 1935. The Board obtained a loan for the works from the State Government in February 1936 and the Board's Water Supply Committee gave approval for the work to commence in March 1936. The work was completed by September 1937 when tree planting on the batters was in progress.

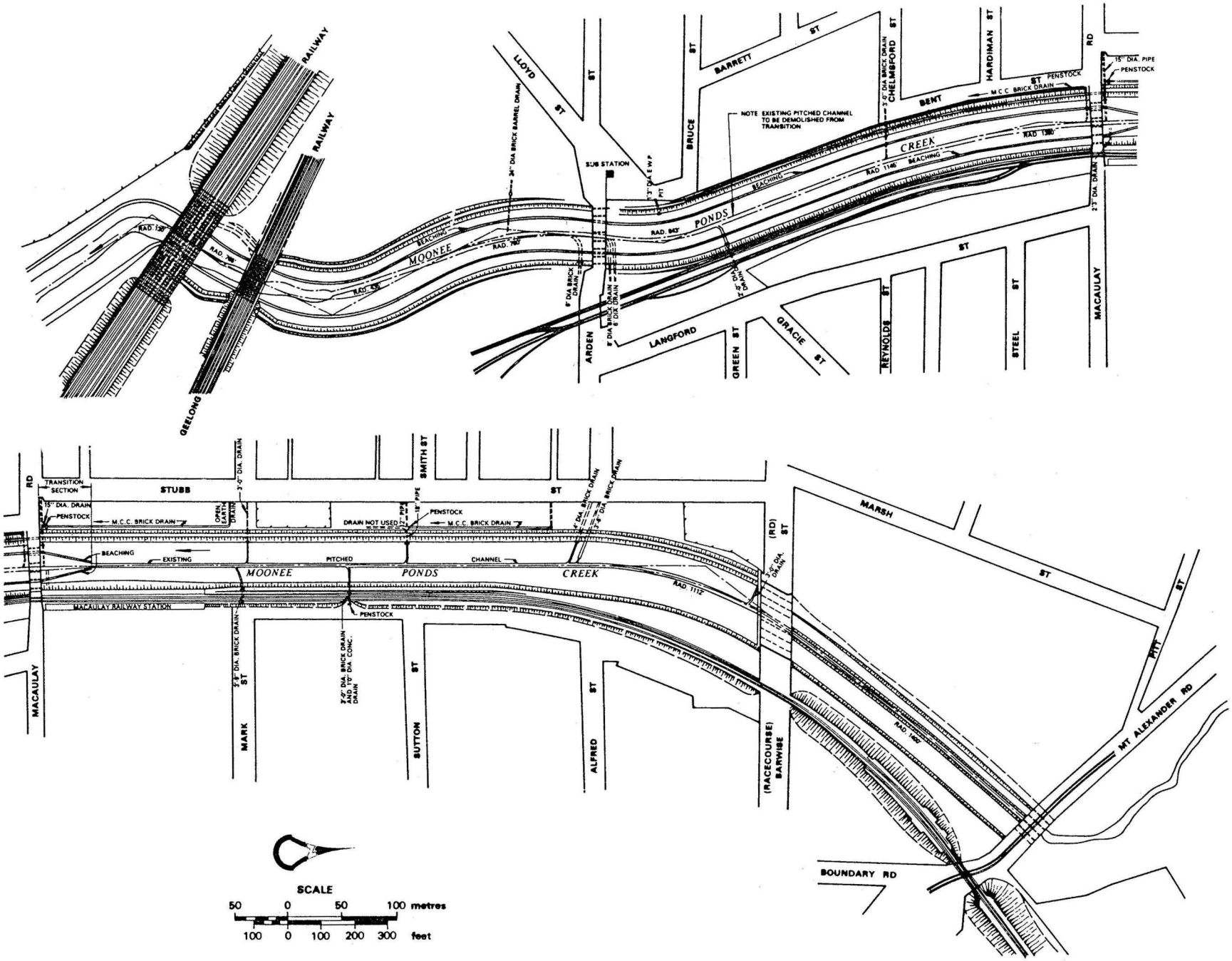
The State Government was prepared to advance 2 000 for improvements to Moonee Ponds Creek downstream of Dynon Road, but this offer was not taken up because agreement could not be reached concerning responsibility for this section of the creek. The question of the definition of the bed and banks in the section between the Gravitation Bridge and Flemington Road had also not been resolved, a situation that persists to the present day.

4.4 THE 5 000 CUSEC CHANNEL

The 5 000 cusec scheme which was adopted and implemented along the lower reaches of Moonee Ponds Creek did not require any significant changes to be made to the existing channel between the Flemington and Macaulay Road Bridges (Fig 4-8). The pitched centre channel was retained although some minor modifications were made and the berms were reshaped. Downstream of Macaulay Road, however, a 95-foot to 105-foot wide tidal channel was excavated (Plate 4-8). Stones from the pitched centre channel were used for the beaching along the sides of the tidal channel. The 5 000 cusec design was based on a tide of RL 5.0 feet in the Yarra and for a freeboard of two feet between the top water level of a 5 000 cusec flow and the top of the levee bank.

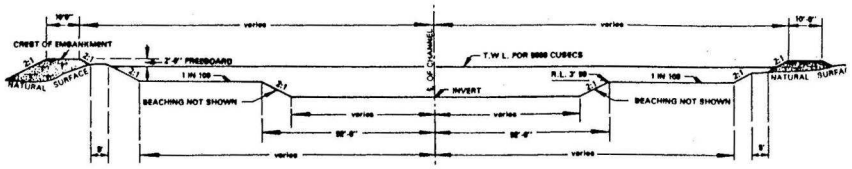
In 1938, as an integral part of the 5 000 cusec channel project, the Melbourne City Council installed five pumping stations to remove storm runoff from the low-lying areas behind the levee banks. The location and layout of the five stations is shown in Figure 4-9, and the areas drained by each station and the times required for the pumps to clear a 10-year flood are given in Table 4-4. The penstocks were manually closed when the creek began to rise, while the rising water in the street drains behind the penstocks automatically activated the pumps by means of float switches.

Two other projects associated with the 5 000 cusec channel were the excavation of a

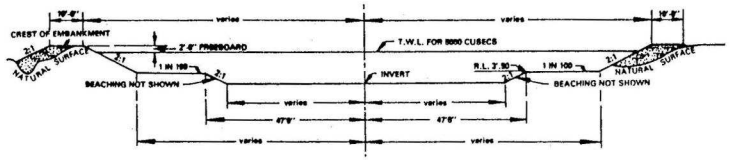


THE 5,000 CUSEC CHANNEL: PLAN

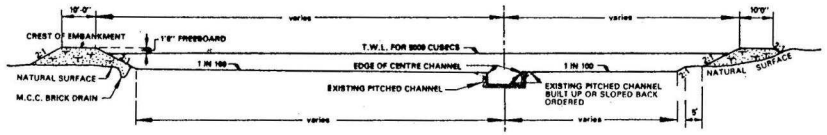
Figure 4-8A



BETWEEN GRAVITATION BRIDGE AND ARDEN STREET



BETWEEN ARDEN STREET AND MACAULAY ROAD



BETWEEN MACAULAY ROAD RACECOURSE ROAD

THE 5,000 CUSEC CHANNEL: TYPE SECTIONS

Figure 4-88

TABLE 4-4 MELBOURNE CITY COUNCIL PUMPING STATIONS: AREAS DRAINED AND TIMES REQUIRED TO CLEAR A 10-YEAR FLOOD

STATION NO AND LOCATION	AREA DRAINED ACRES	NUMBER OF EXISTING PUMPS	TIME TO CLEAR 10-YEAR FLOOD (hrs)
1 Smith Street/ Stubbs Street	22	1	2.6
2 Macaulay Road/ Stubbs Street	47	2	2
3 Macaulay Road/ Langford Street	22 1/2	1	2
4 Langford Street/ Gracie Street	75 1/2	2	5
5 Sutton Street	23	1	2.7

new outlet to the Yarra (Plate 4-6), and the modification of the Railway Gravitation Bridge. In order to reduce the heading-up of floodwaters and the trapping of debris at the bridge the Railways Department removed some of the whalings of the bridge and relocated a number of the braces at a higher elevation above the channel.

4.5 DRAINAGE PROBLEMS UPSTREAM OF FLEMINGTON ROAD

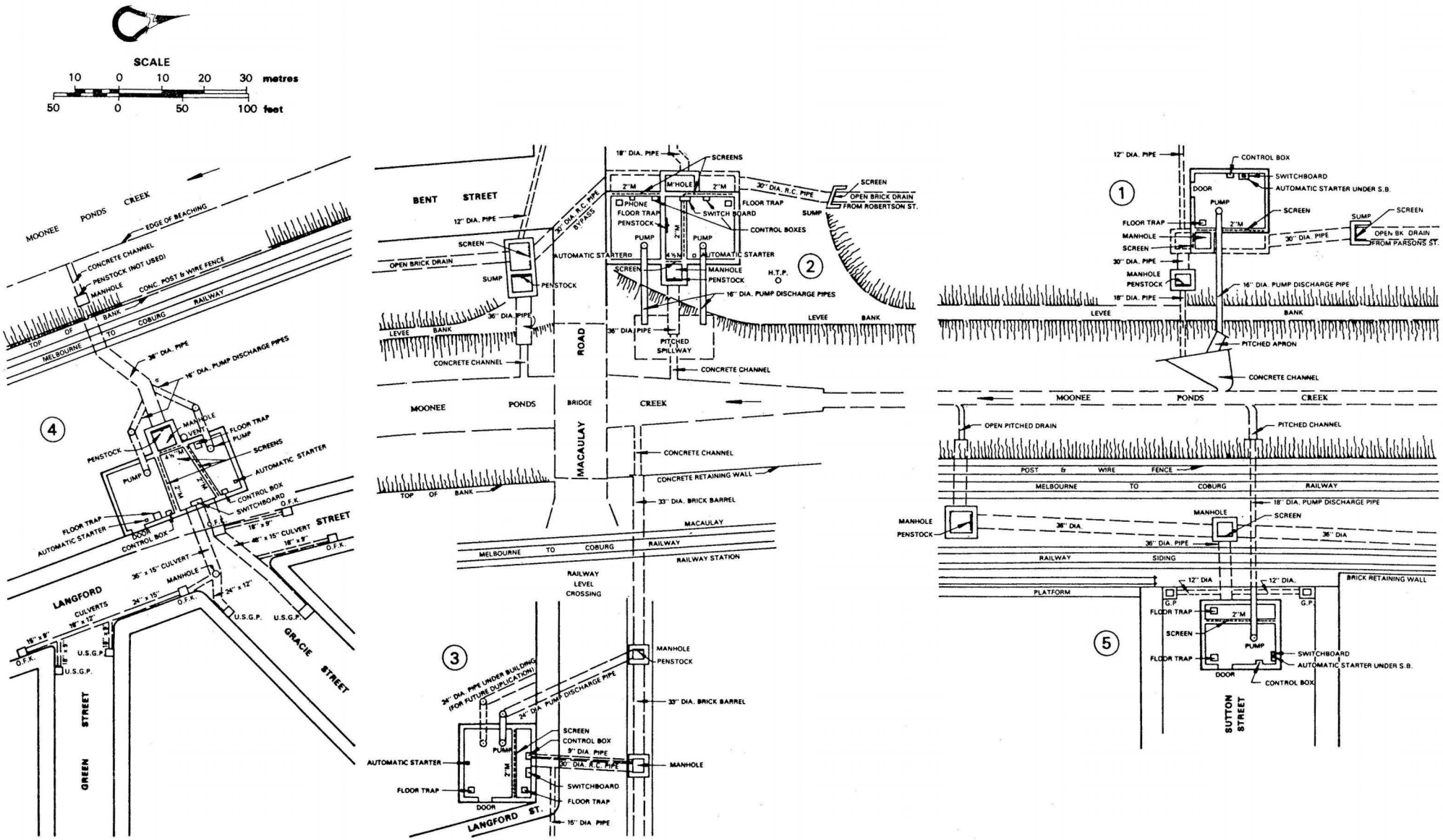
4.5.1 Sand Extraction and Bank Erosion. During the 1930s bank erosion became quite a serious problem at a number of points along the middle reaches of Moonee Ponds Creek, the result of natural stream processes accelerated by sand mining activities (Plate 4-9) along the creek and by the greater volumes and rates of runoff from the developing residential areas. The majority of the sand mining operations were illegal, although the Board of Works did give permission to the Essendon City Council to remove sand in the early 1930s. Permission was subsequently withdrawn in 1935. The removal of the sand was accompanied by accelerated bank erosion and by deposition further downstream. Along some reaches deposition raised the bed of the creek to such an extent that the banks were overtopped by relatively minor flows. The major problem, however, was erosion. The excavation of sand from the banks, and the construction of access ramps and tracks down to the creek bed, made the banks extremely vulnerable to erosion during flood flows, while the excavation of depressions in the bed of the creek (Plate 4-9A) and the deposition of sand bars, deflected flows towards the banks, resulting in undercutting and slumping.

Although sand mining activities had pronounced effects locally, the expansion of the built-up area and the resultant increase in volumes and rates of runoff was probably a more important factor contributing to serious and extensive erosion observed along the middle reaches of Moonee Ponds Creek. One contemporary report noted that at a number of points between Primrose Street and the eastern end of Vanberg Road in Essendon the creek had shifted more than thirty feet in the previous fifty years. On a number of allotments adjoining the creek fences were undermined and washed away, strips of land were washed into the creek, and houses were threatened (Plates 4-10 and 4-11). At some sites wooden retaining walls were built in an attempt to arrest the erosion (Plate 4-12).

The erosion of privately owned land bordering the middle reaches of Moonee Ponds Creek proved to be a recurring problem. At the time of initial alienation subdivision had been permitted down to the water's edge (Fig 4-10), or more specifically, to the edge of the low-flow channel. When the land was further subdivided for residential purposes there was no attempt by the local councils to create drainage reserves. Thus, along many reaches of the creek, the steep and easily eroded banks were located well within allotment boundaries.

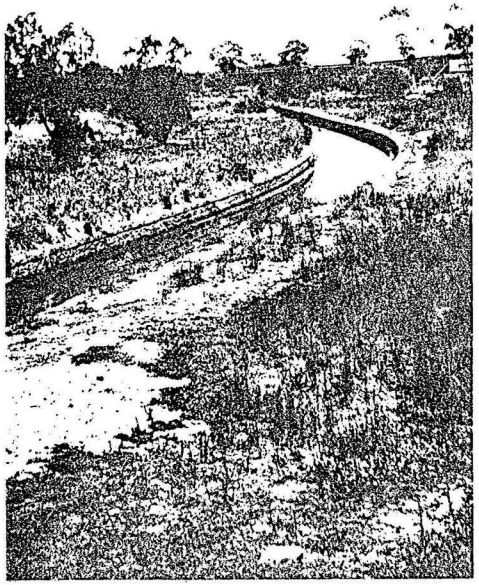
4.5.2 Filling of the Floodplain. In the two decades prior to World War Two the floodplain of Moonee Ponds Creek between Flemington and Ormond Roads and in the vicinity of Moonee Valley Racecourse was modified by filling. Part of the Moonee Valley Racecourse was laid out on filled land adjacent to the creek, and an embankment was constructed along the outside of a bend between Dean and Wilson Streets cutting off a swamp that probably marked the course of a former channel (Fig 4-11). A retaining wall was built along the creek immediately north of Dean Street in 1930, but a plan to cut across the neck of the bend between Dean and Wilson Streets did not materialise.

The filling of the floodplain between Ormond Road and Flemington Road by land developers reduced storage capacity and affected flood flows (Plate 4-13). The modification of the floodplain in this area was of concern to the Board because of the potential effect on flood flows entering the 5 000 cusec channel at the Flemington Road Bridge. However, the Board was unable to take legal action to prevent the filling except within a 25-foot wide strip along the creek banks. Under Section (b) of the Board's By-

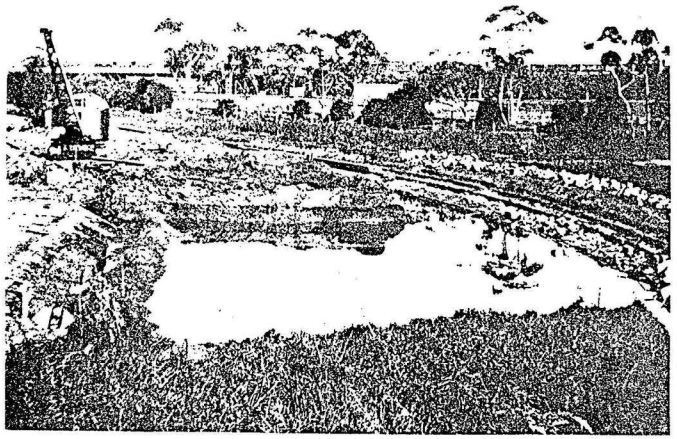


THE MELBOURNE CITY COUNCIL'S PUMPING STATIONS

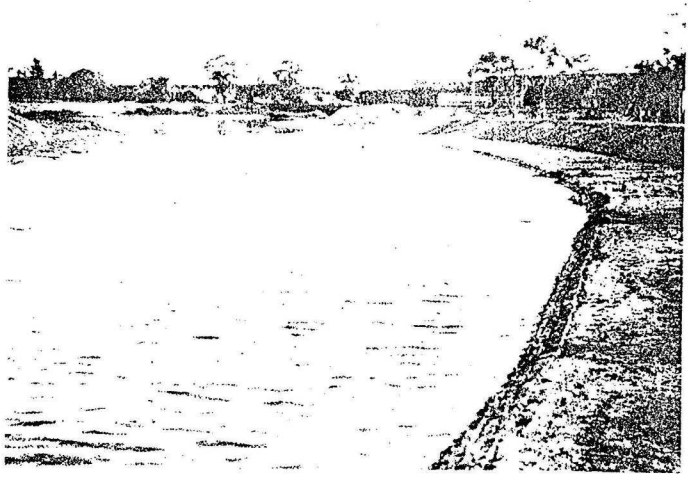
Figure 4-9



A Prior to the construction of the 5 000 cusec channel



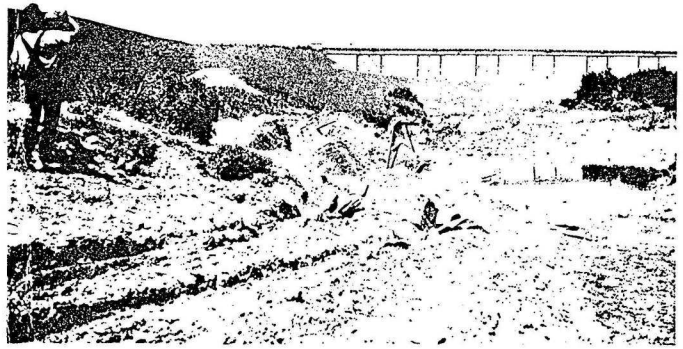
B The construction of the tidal section of the 5 000 cusec channel



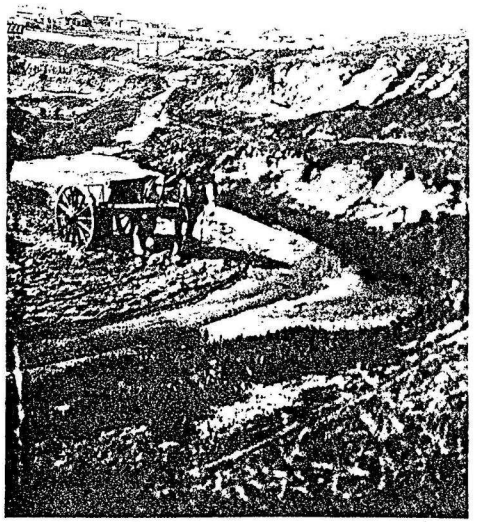
C The tidal section of the 5 000 cusec channel

PLATE 4-8 The Moonee Ponds channel between Arden Street and the Railway Gravitation Bridge

A Sand removed from the creek bed: locality unknown



B Screening sand near the Railway Trestle Bridge Broadmeadows



C Sand being removed near Bent Street, Moonee Ponds. The old Wilson Street Bridge can be seen in the background

PLATE 4-9 Sand removal from Moonee Ponds Creek during the 1930s

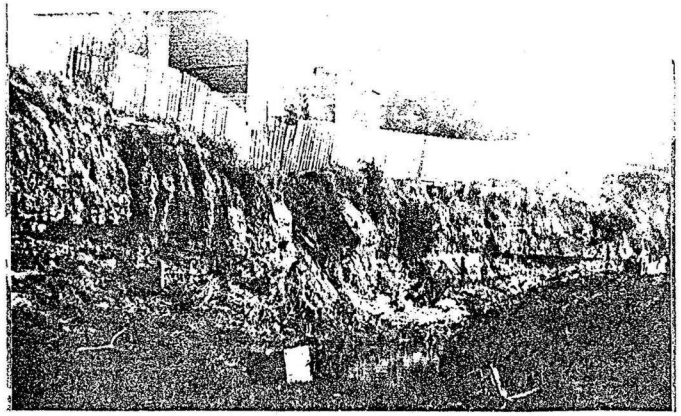


PLATE 4-10 Fence and house on Vanberg Road, Essendon threatened by erosion. May 1935

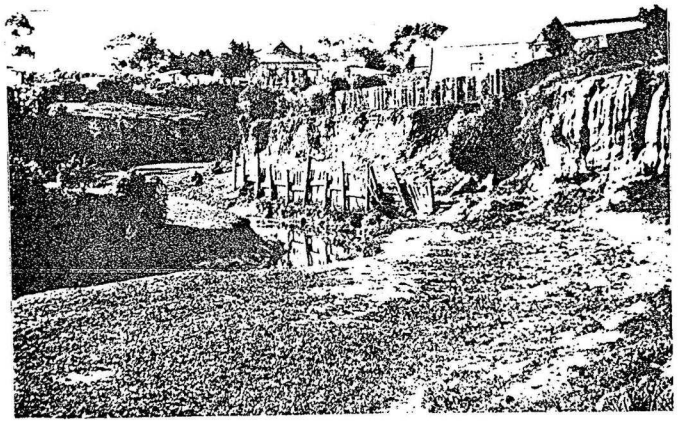


PLATE 4-11 Eroded banks and retaining fence downstream of Salisbury Street, Moonee Ponds, September 1935

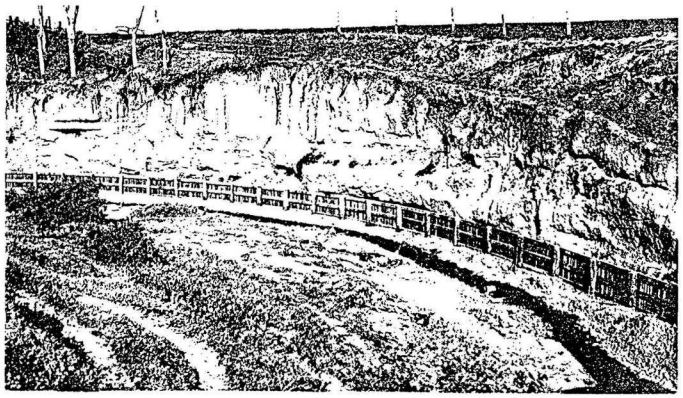
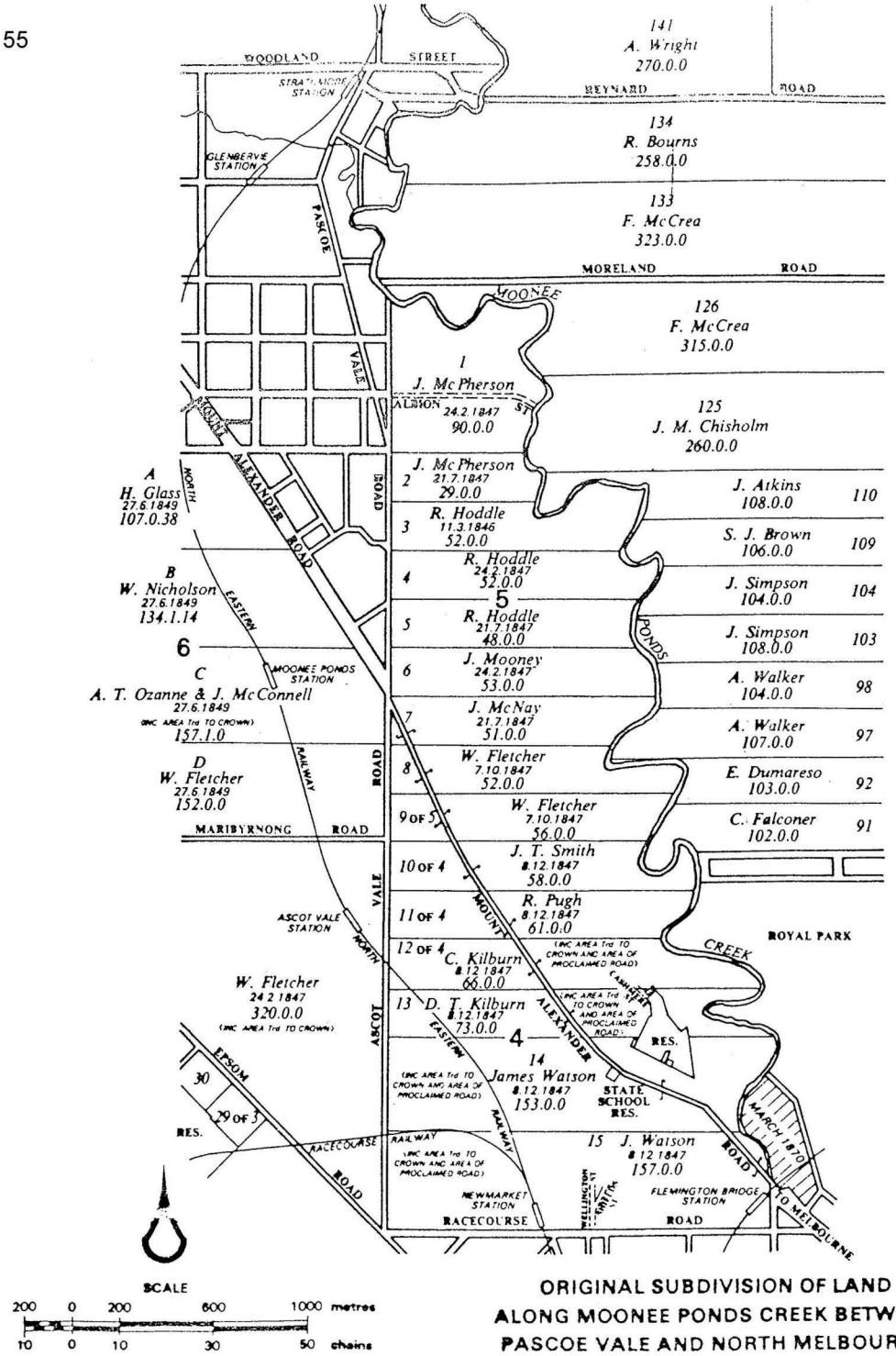


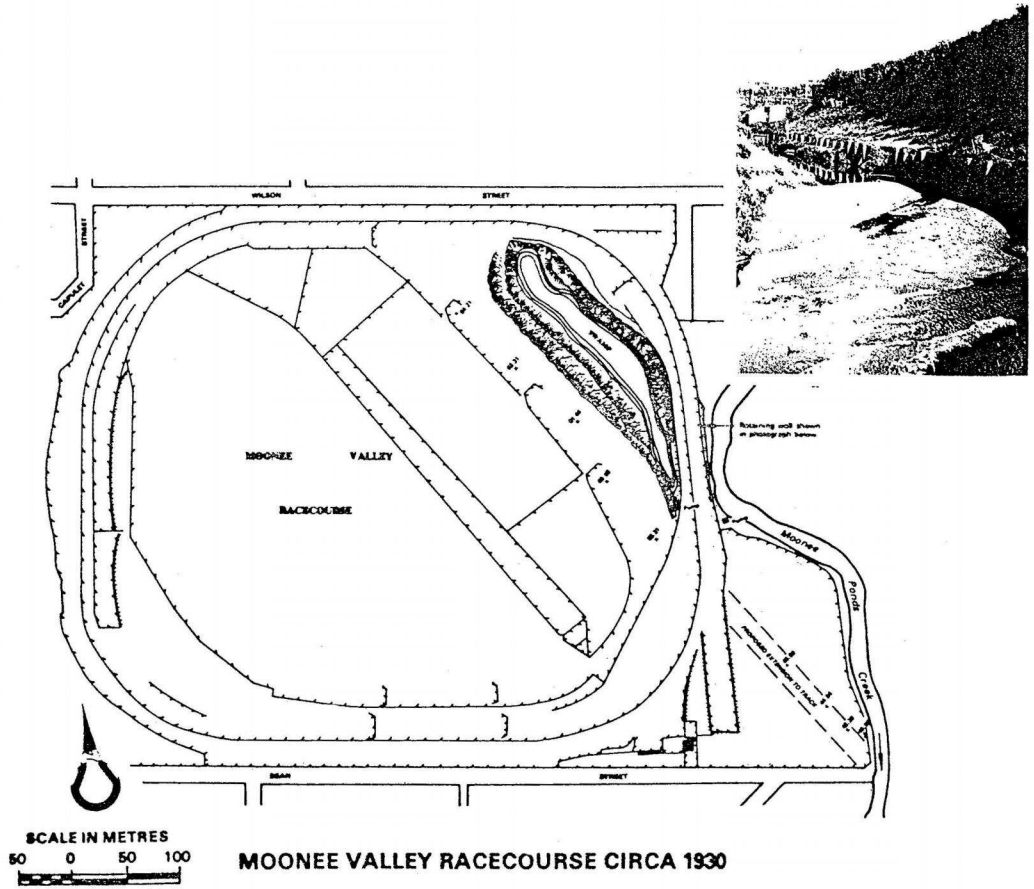
PLATE 4-12 Eroded bank and retaining fence built by the MMBW Reynard Street, Pascoe Vale 1934



ORIGINAL SUBDIVISION OF LAND ALONG MOONEE PONDS CREEK BETWEEN PASCOE VALE AND NORTH MELBOURNE

Source Parish Plans

Figure 4-10



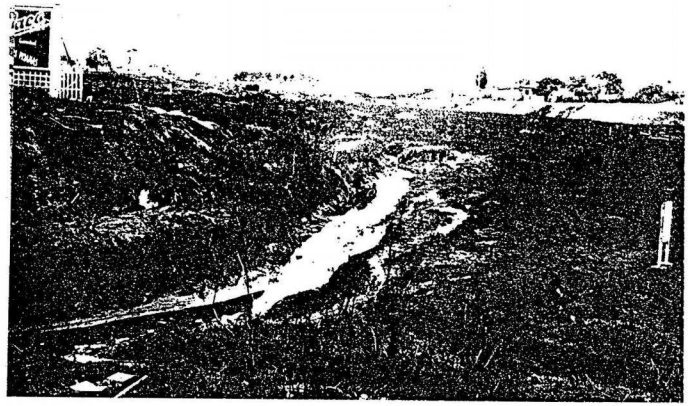
MOONEE VALLEY RACECOURSE CIRCA 1930

Figure 4-11

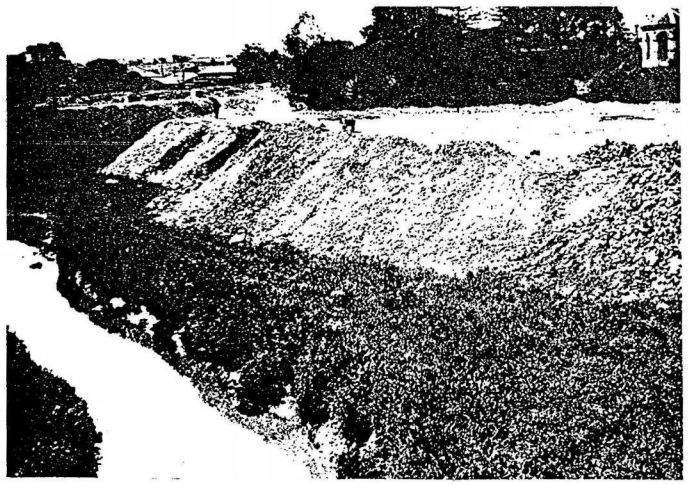
Law No 25, which was gazetted in December 1927, all persons or corporations were prohibited from depositing or discharging material into or within 25 feet of any river, creek or watercourse specified in the First Schedule of the Metropolitan Drainage and Rivers Act 1923.

4.6 WORKS ON TRIBUTARIES

As the urban area expanded within the lower and middle parts of the basin during the latter part of the nineteenth century and the early decades of the present century (Fig 1-5), the local councils undertook improvement works along some of the tributary watercourses. The Melbourne City Council undergrounded the Arden Street drain from the Moonee Ponds Channel to just east of Bridge Street as early as 1887 (Fig 4-12) and duplicated this drain along the southern side of Arden Street in 1907. Most of the early works, however, involved the construction of pitched channels to improve the sanitary state of the creeks and to reduce erosion. Increased runoff from the suburban areas had accelerated erosion along a number of watercourses. Leach (Ref 16), writing in 1907,



A 1929



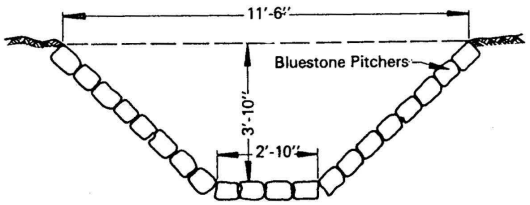
B c. 1936

PLATE 4-13 Filling of the floodplain just upstream of Flemington Road Bridge. Note depth gauge recorder in the foreground

LOCATION OF DRAINAGE WORKS
TRIBUTARIES OF MOONEE PONDS

refers to the badlands and canyons of Coburg (see also Ref 17), and describes vertically-sided eroded sections up to 20-feet deep. The severity of erosion along some of the tributary watercourses is clearly illustrated in Plate 4-14. The photographs, which were taken during the 1930s, show that both vertical and lateral erosion was extremely active. Along a number of creeks private properties were threatened, because, as in the case of Moonee Ponds Creek itself, subdivision had been permitted down to the water's edge. In improvement schemes along the smaller creeks the whole of the channel was often pitched (Fig 4-13), but along the larger watercourses only a pitched centre channel tended to be constructed (Fig 4-14). On Melville Creek, a stone weir was built at the end of the pitched channel below McLean Street Bridge to reduce velocities and retard erosion. At a bend on Melville Creek just downstream of Everett Street, erosion was so bad that a cut was made across the neck of a bend in 1935.

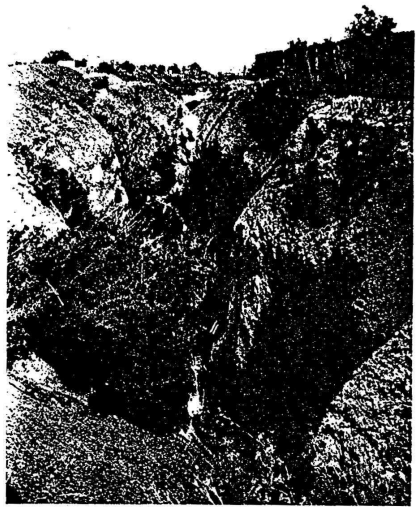
Under the Metropolitan Rivers and Drainage Act 1923, the Board assumed responsibility for creek maintenance along the tributaries of Moonee Ponds Creek, replacing the local councils. Between 1926 and 1940, the Board of Works carried out improvement works along some of the tributary watercourses; some sections were cleaned out, some were lined with pitchers (Plate 4-15), while underground drains were constructed along others. Underground drains were installed as a permanent solution to the erosion problem and for sanitary reasons. They were constructed along sections of the Royal Park, Melville, Hope Street, Albion Road, Coonans Road, and Five Mile Creek Main Drains (Fig 4-12). Detailed locality plans and details of the various drain designs are given in Appendix A. Of particular interest are the horseshoe drains that were constructed along parts of the Royal Park and Melville Drains (Plate 4-16). The shape of this type of drain was ideally suited to the morphology of the deeply incised Melville Creek. Of historical interest is the fact that parts of the Melville Drain were constructed by the pneumatic core process, whereby the formwork consisted of a long inflated rubber tube which supported the concrete until it set (Plate 4-17). This process, which was first used by one of the Board's contractors in 1928 on the Westley Street Drain in Hawthorn, was not a great success because the finished work tended to be irregular and mis-shapen, and its use was discontinued.



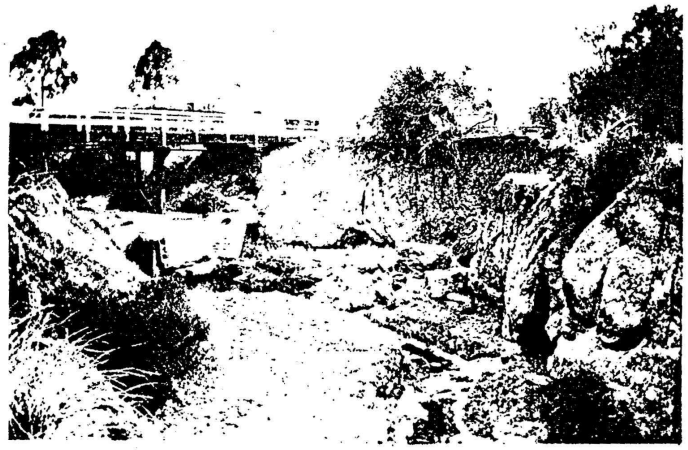
TYPICAL SECTION EXISTING DRAIN
FROM 1008'-10" TO 1173'-1"

TYPICAL PITCHED DRAIN — ALBION STREET MAIN DRAIN

Figure 4-13



A Coonan's 'gully' at Moreland Road, Brunswick



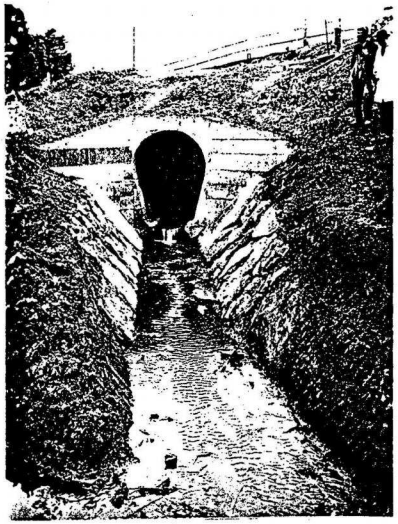
B Melville Creek, Brunswick

PLATE 4-14 Erosion along Melville and Coonan's Creeks in the 1930s

A Near Hesleden Street before construction

B Near Hesleden Street after construction

A Royal Park Drain: Outlet at Moonee Ponds Creek



B Melville Main Drain

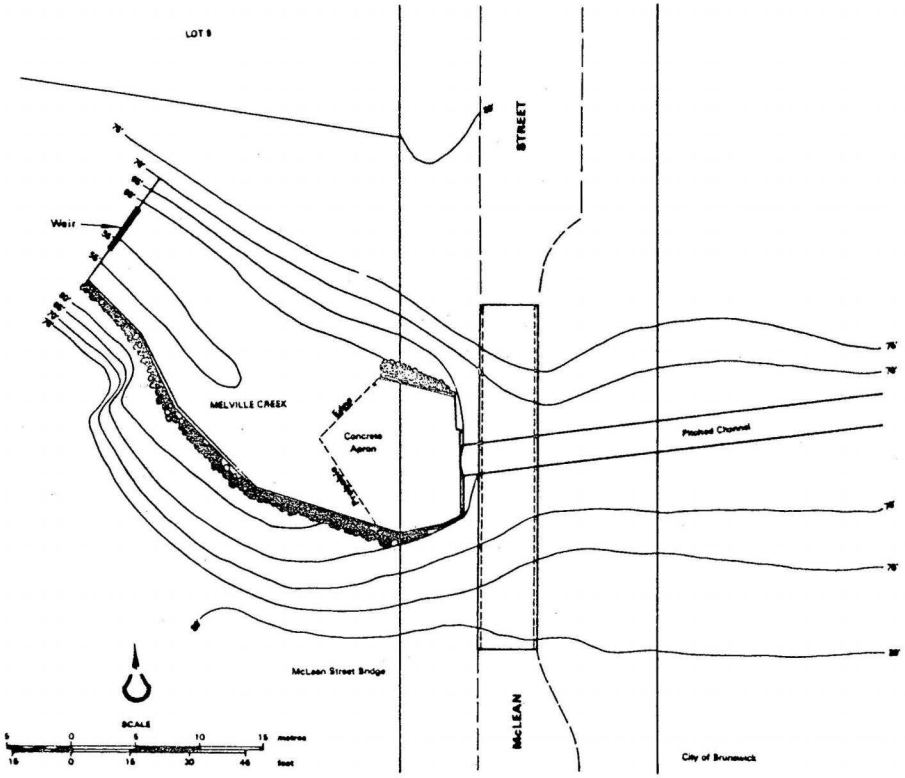
PLATE 4-16 Horseshoe drains

C Upstream from Napier Street before construction

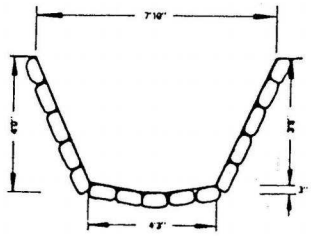
D Upstream from Napier Street after construction

PLATE 4-15 Improvement Works along Five Mile Creek:
Before and after construction

PLATE 4-17 The pneumatic core process. Locality unknown



PLAN OF McLEAN STREET BRIDGE



PITCHED CHANNEL- AV. CROSS SECTION

MELVILLE CREEK AT McLEAN STREET BRIDGE

Figure 4-14

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