5 DRAINAGE PROBLEMS AND REMEDIAL MEASURES 1941-1967

5.1 EROSION

5.1.1 Introduction. In the post-war years bank erosion continued to be a major problem along the middle reaches of Moonee Ponds Creek between Broadmeadows and Ormond Road. It was undoubtedly exacerbated by the more frequent flood flows that accompanied the spread of urban development within the basin during the 1950s and 1960s (Fig 1-5). As a result of bank erosion, fences were undermined and swept away, parts of allotments were lost, and in some localities houses and other buildings were threatened. Not unexpectedly, there were numerous complaints to the Board of Works from local residents and local Progress Associations. As in the 1930s, the Board responded by repairing badly eroded sections as the need arose. At some sites boulders were placed along the toe of the bank to prevent further erosion, while at others the lower parts of the banks were beached and the upper parts smoothed and grassed. Financial constraints and shortages of manpower[1] prevented the Board from undertaking works of a more extensive and permanent nature along the creek during the 1940s and early/mid-1950s (Ref 1). Such resources as were available were utilised for what were deemed to be more important projects within the metropolitan area.

In 1953 the Board of Works produced a plan for the realignment of Moonee Ponds Creek between Francis Street, Broadmeadows, and Flemington Road. The plan, together with plans for a number of other creeks in the metropolitan area, was formulated in conjunction with a planning scheme for the Melbourne and Metropolitan area that the Board of Works was commissioned to prepare in 1949. The proposed alignment of the improved creek is shown in Figure 5-1 and type sections in Figure 5-2.[2] The main objectives of the plan were to alleviate bank erosion and to eliminate a number of pools that became stagnant during dry weather and were considered to be a health hazard.

It was proposed that the channel would be constructed in two stages : stage one would be designed to accommodate one-third of a flood of expected 10-year frequency from a fully developed catchment, and stage two would be designed to accommodate two-thirds of such a flood. The Rational Method was used to calculate the discharges. The formula adopted was :

$$Q_{10} = 640\ A^{0.8}$$

where Q = discharge in cusecs and

A = area of catchment in square miles

which was the formula that had been derived for the Gardiners Creek catchment in a fully developed state. The computed flood discharges for Moonee Ponds Creek are given in Table 5-1.

The proposed plan was never executed, presumably because of financial constraints. Instead, a number of relatively small-scale improvement works were undertaken along those reaches where erosion was most severe, particularly where houses and other buildings were being threatened. Details of these projects, which were implemented in the late 1950s and early 1960s, and details of some of the minor protection works undertaken in the 1940s and early 1950s, are given below.

[1] The shortage of manpower and materials was so acute that few tenders were received for some Board contracts (Ref 2).

[2] The line of the proposed channel is shown in greater detail on Water Supply Drawings Nos W S 53-0-33, -35, -36, -37, -38 & -39 which are attached to Cover 4310/ODP(4).

TABLE 5-1 COMPUTED FLOOD DISCHARGES FOR MOONEE PONDS CREEK

PLACE	1ST STAGE		FINAL STAGE		10-YEAR FREQUENCY	
	cusecs	(cumecs)	cusecs	(cumecs)	cusecs	(cumecs)
Flemington Road	5 000	(141.6)	10 000	(283.2)	15 000	(424.8)
Brunswick Road	4 900	(138.8)	9 800	(277.5)	14 700	(416.3)
Moreland Road	4 500	(127.4)	9 100	(257.7)	13 600	(385.1)
Francis Street	4 000	(113.3)	7 900	(223.7)	11 900	(337.0)

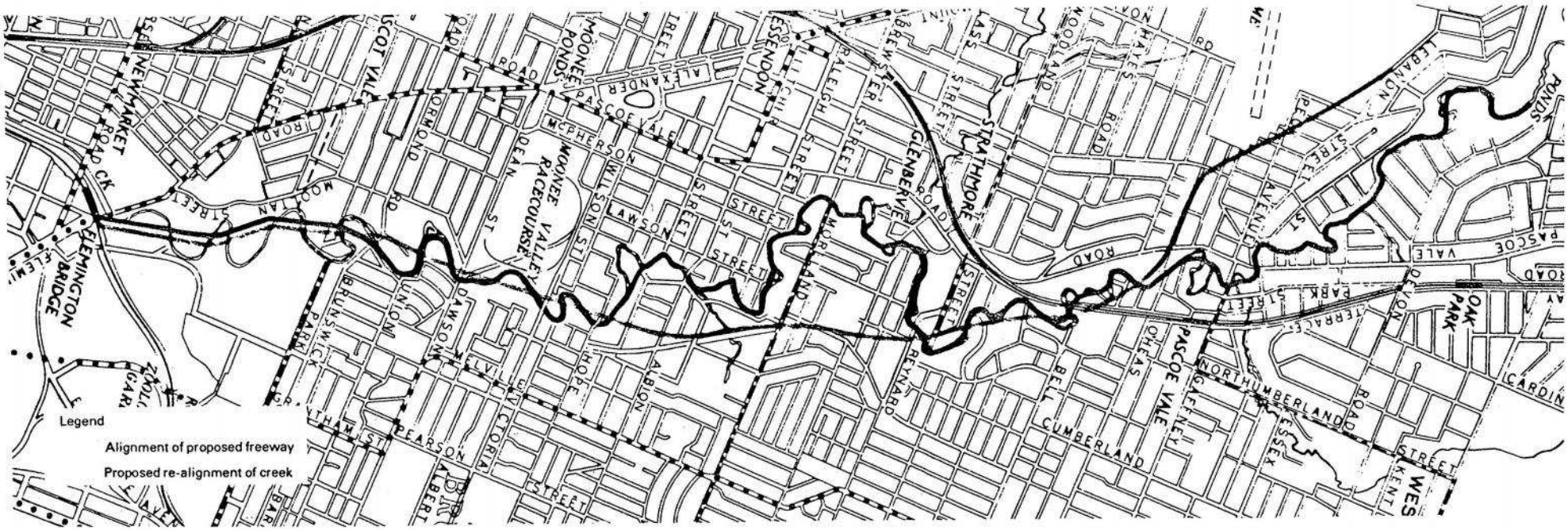
5.1.2 Minor Bank Protection Works. The location of areas of active bank erosion in 1949 and 1953, and of works completed up to 1953, are shown in Figure 5-3. A typical example of the type of bank erosion that generated complaints to the Board of Works is shown in Plate 5-1. The photograph, which was taken in late 1952, shows bank erosion near The Boulevard, Pascoe Vale, just downstream of Reynards Street Bridge (Fig 5-3). Recent bank slumping is evident, and surface runoff has cut a gully into the bank. Bank erosion by surface runoff was reported at a number of points along the creek; on some allotments it could be directly attributed to runoff from the roofs of buildings.

Bank repair works were undertaken at a number of sites along the middle reaches of the creek, but three examples will suffice to illustrate the general nature and scope of these minor projects. In 1946, the Pascoe Vale Central Progress Association drew the attention of the Board of Works to the problem of erosion along the creek adjacent to Gaffney Street in Pascoe Vale. Following inspection, the Board decided to excavate and shape a length of badly eroded bank, and to place beaching stones along the toe of the bank (Fig 5-4A). The work was commenced in January 1947 and completed two months later.

In 1948, erosion on the outside of a bend of the creek at Hodgins Nursery in Pascoe Vale threatened to undermine a shed on the property. A tentative plan to cut across the neck of the bend was mooted, but was rejected because of the cost involved. Instead, the bank was excavated and filled, beaching stones were placed along the toe of the bank, and the channel was deepened (Fig 5-4B). Similar work was carried out along a reach of the creek at the rear of some allotments on Kernan Avenue (Fig 5-4C) where a house was threatened by the rapid erosion of the bank. The effectiveness of the repair work is illustrated in Plate 5-2 which was taken in 1955. The bank is well-grassed and fluvial erosion has been arrested. The beaching stones that were placed at the toe of the bank are no longer visible, having been covered by grass and silt. However, as can be seen from the photograph, the upper part of the bank is being eroded by runoff from the allotments.

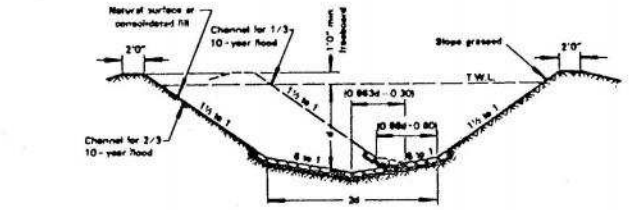
5.1.3 Major Improvement Works. Complaints about bank erosion from property owners living along the middle reaches of Moonee Ponds Creek continued to be received throughout the 1950s and 1960s. In addition, a number of complaints were received from local residents who were concerned that the vertical, crumbling banks were a hazard to children. It had become increasingly apparent that unless remedial measures were taken, the situation would deteriorate further as development proceeded within the basin.

Between 1959 and 1966 the Board of Works undertook a number of major improvement works to protect the most seriously affected reaches. These works involved the

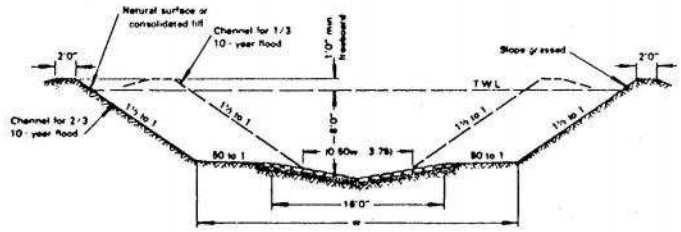


PROPOSED ALIGNMENT OF MOONEE PONDS CREEK BETWEEN FLEMINGTON ROAD AND FRANCIS STREET, BROADMEADOWS

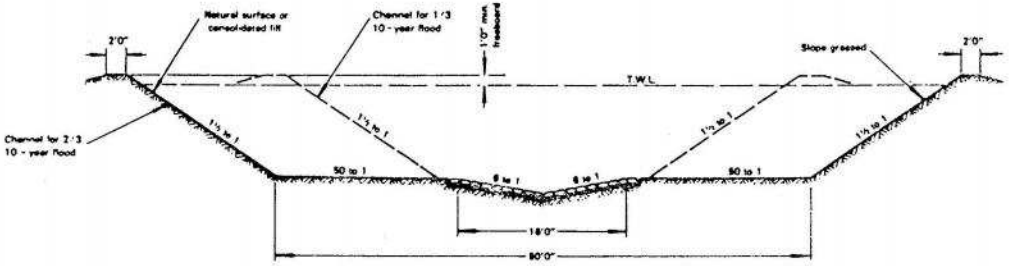
Figure 5-1



CHANNEL TYPE A
(Variable width and depth 'd' >8'0")



CHANNEL TYPE B
(Variable width w>50'0")



CHANNEL TYPE C
(Variable depth)

TYPE SECTIONS FOR THE PROPOSED CHANNEL BETWEEN FLEMINGTON ROAD AND FRANCIS STREET, BROADMEADOWS

Figure 5-2

PLATE 5-1 Bank erosion near The Boulevard, Pascoe Vale, 1952
Note gully cut into bank by surface runoff

PLATE 5-2 Partly rehabilitated bank at the rear of Kernan Avenue, Pascoe Vale, 1955

straightening and partial hard-lining of the creek, and in two localities meander loops were cut off. The location of the various works is shown in Figure 5-5 and the costs involved (excluding the costs of land purchase) in Table 5-2. In a number of cases the need to acquire land for the works added to the total cost of the project. It also often resulted in a considerable delay between the granting of approval for a particular project and the start of construction as legal transactions were completed.

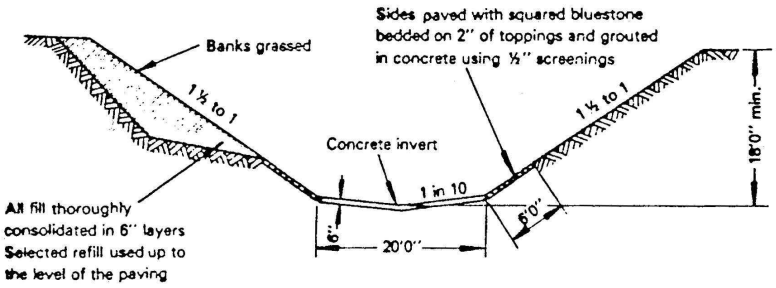
TABLE 5-2 COST OF IMPROVEMENT WORKS (£)

Pattison Street	Essendon and Brunswick	14 018
Hilda Street	Essendon and Brunswick	20 634
Waxman Parade	Essendon and Brunswick	3 016
Moreland Road	Essendon and Coburg	26 238
Somerset Street	Broadmeadows and Coburg	6 679
Waxman Parade Deviation	Essendon and Brunswick	17 534
Donald Avenue	Essendon and Brunswick	44 670
Avoca Cres. - Gaffney Street	Broadmeadows and Coburg	95 288

5.1.3

(a) **Improvements at Hilda Street, Essendon.** Complaints about erosion along Moonee Ponds Creek in the vicinity of Hilda Street, Essendon (Figs 5-3 and 5-5) date from early 1947. In June 1956, the City Engineer of Essendon reported to the Board of Works that the banks at Hilda Street were being severely eroded and commented that the erosion was being aggravated by debris in the creek which raised the water level and diverted the flow. The City Engineer requested that the Board of Works should immediately inspect the area with a view to implementing remedial measures. The severity of the erosion and the precarious position of the houses at the eastern end of Hilda Street is clearly shown in Photographs A and B in Plate 5-3.

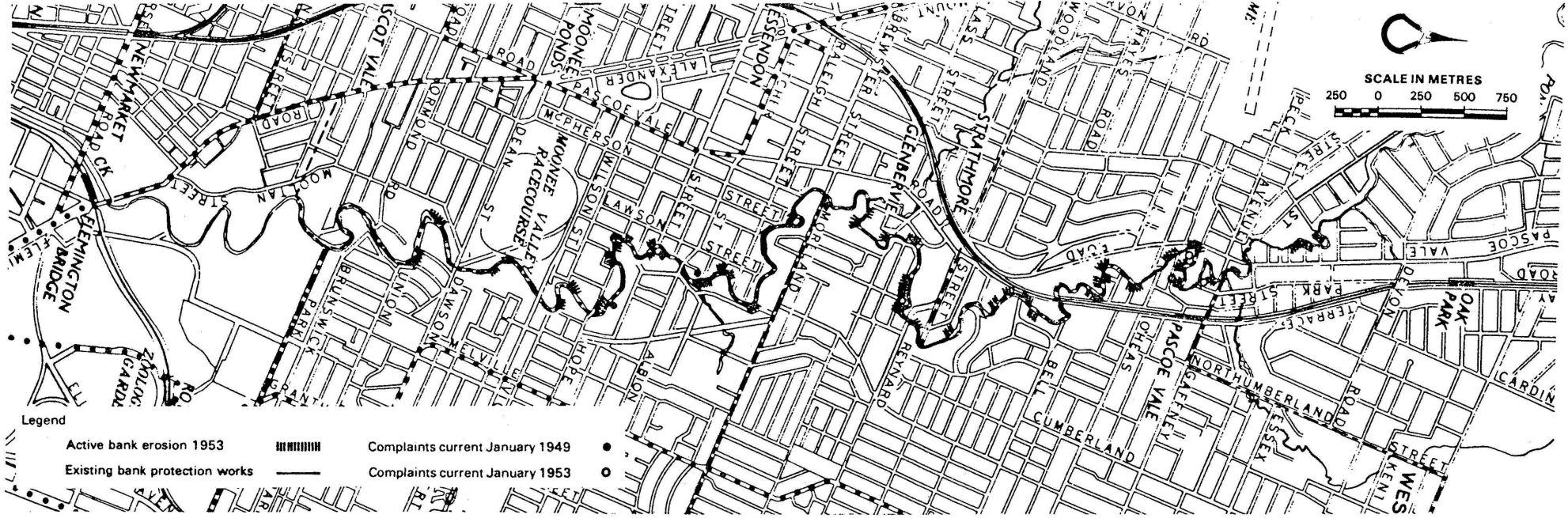
The Sewerage Committee of the Board of Works gave approval for the construction of improvement works along this section of the creek in December 1958. Work commenced on the project in August 1959 and was completed by mid 1960. The creek was realigned, moving it away from the houses that were endangered on Hilda Street (Plate 5-4). The new channel was constructed with a 20 ft-wide concrete invert, and the toes of the banks were lined with bluestone pitchers (Fig 5-6). The channel banks were shaped to a slope of 1½ to 1, filling being added where necessary. The appearance of the section in August 1960, immediately after construction, is shown in Plate 5-3C and D, while Plate 5-3E and F shows the channel in 1980.



TYPE CROSS SECTION

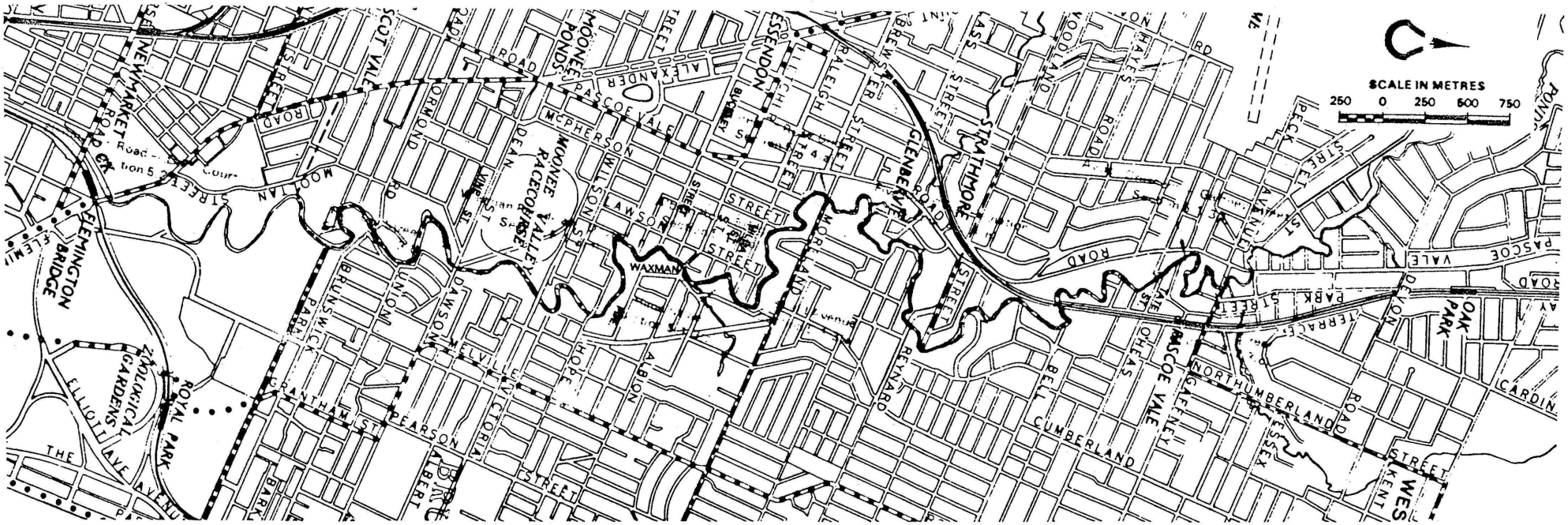
IMPROVEMENTS AT HILDA STREET, ESSENDON: TYPE SECTION

Figure 5-6



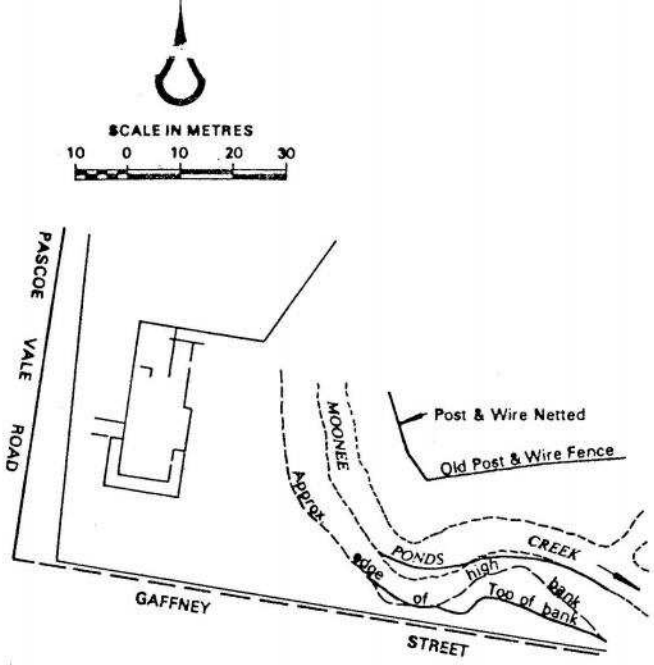
LOCATION OF BANK PROTECTION WORKS AND AREAS OF ACTIVE EROSION IN 1953

Figure 5-3

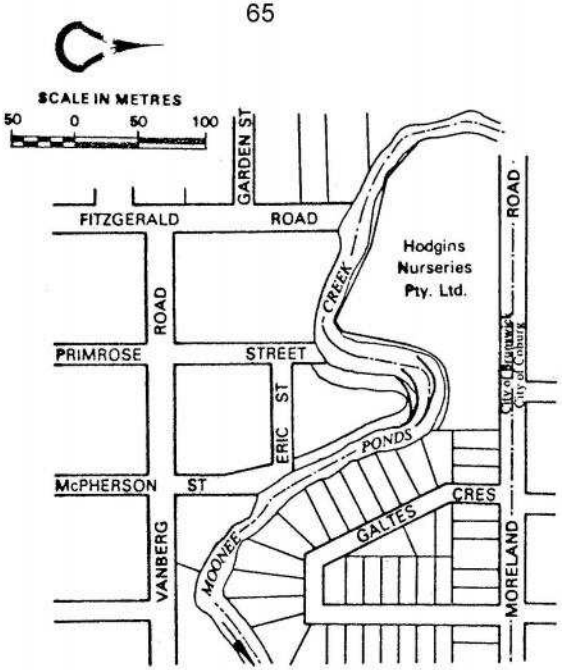


LOCATION OF MAJOR IMPROVEMENT WORKS UNDERTAKEN ALONG ALONG MOONEE PONDS CREEK BETWEEN 1958 AND 1966

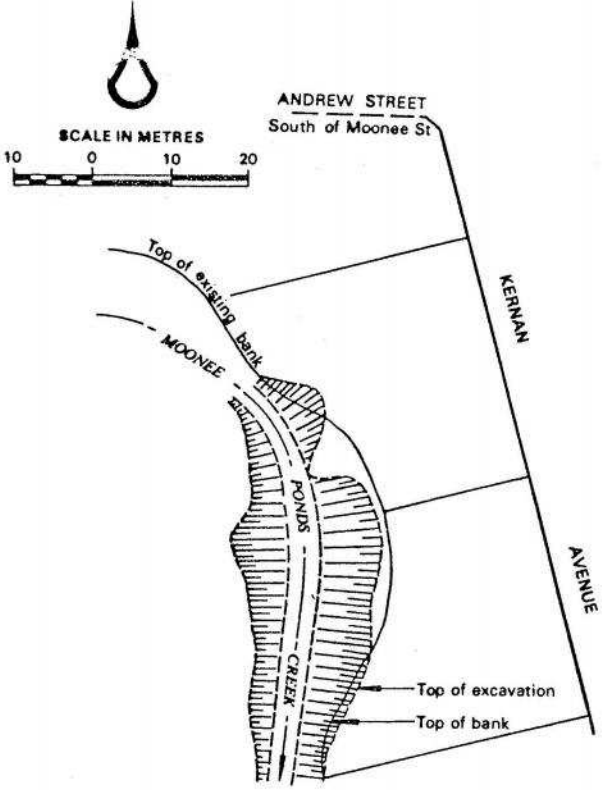
Figure 5-5



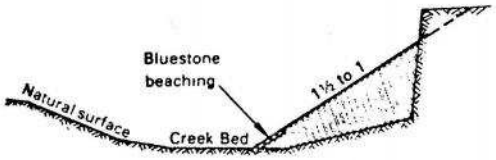
LOCALITY PLAN



LOCALITY PLAN

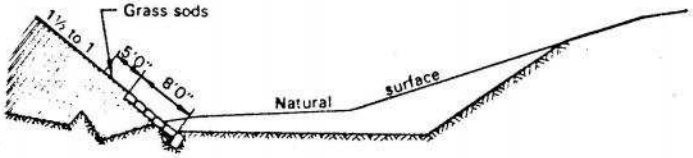


LOCALITY PLAN



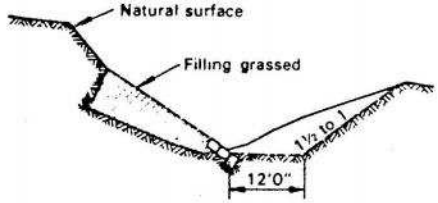
TYPE CROSS SECTION

A- GAFFNEY STREET, PASCOE VALE



TYPE CROSS SECTION

B- HODGINS NURSERY, PASCOE VALE

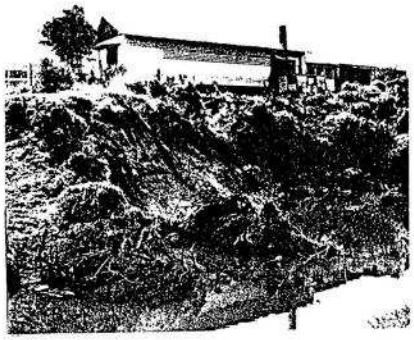


TYPE CROSS SECTION

C- KERNAN AVENUE, PASCOE VALE

EXAMPLES OF MINOR REPAIR WORKS

Figure 5-4



A Bank erosion, 1954

B Bank erosion, 1954

C View looking downstream in 1960 immediately after completion of improvement works

D View looking upstream in 1960 immediately after completion of improvement works

E The same view as in C in 1980

F The same view as in D in 1980

PLATE 5-3 Bank erosion and improvement works at Hilda Street, Essendon

No record of design calculations for the Hilda Street improvements, and also for a number of subsequent improvements, has survived. It would appear, however, that the Rational Method formula that was proposed in 1953 was used (see Section 5.1.1), and that it was assumed that the southern two-thirds of the basin would be developed (see Drawing No W S 53-0-164 now 4310/0-43, and Reference 3).[1] On this basis, a design discharge of some 7 000+ cusecs (198 cumecs) is obtained.

Such a discharge lies approximately midway between the discharges from flows with one-third and two-thirds of a ten-year recurrence interval, the design frequencies proposed in 1953. The accuracy of this method of calculation is, however, extremely dubious; estimates of flows obtained from the Unit Hydrograph method are between one-third to a half lower.

Since the completion of the Jacana Retarding Basin in 1967, flow characteristics along Moonee Ponds Creek downstream of the basin have been considerably modified. Estimates of design discharges and frequency at Hilda Street, using the Unit Hydrograph method, and assuming current planning zoning, are given in Table 5-3.[2] It will be noted that both full bank flow and design flow (i.e. flow with 0.5 m freeboard) are in excess of 1 in 100 year frequency, while flow at the top of the lined portion has a less than 1 in 5 year frequency.

TABLE 5-3 IMPROVEMENTS AT HILDA STREET : DISCHARGE CAPACITY AND FREQUENCY ESTIMATE

Estimated Discharges					Full Bank Flow				Flow with 0.5 m Freeboard				Flow at top of Lined Portion			
Q * 100yr	Q 5 yr	Q m/s	V m	Depth Freq	Approx	Q m/s	V m	Depth Freq	Approx	Q m/s	V m	Depth Freq	Approx			
142	78	230	3.2	5.5		100	190	3.1	5.0		100	22.3	2.6	1.32		5

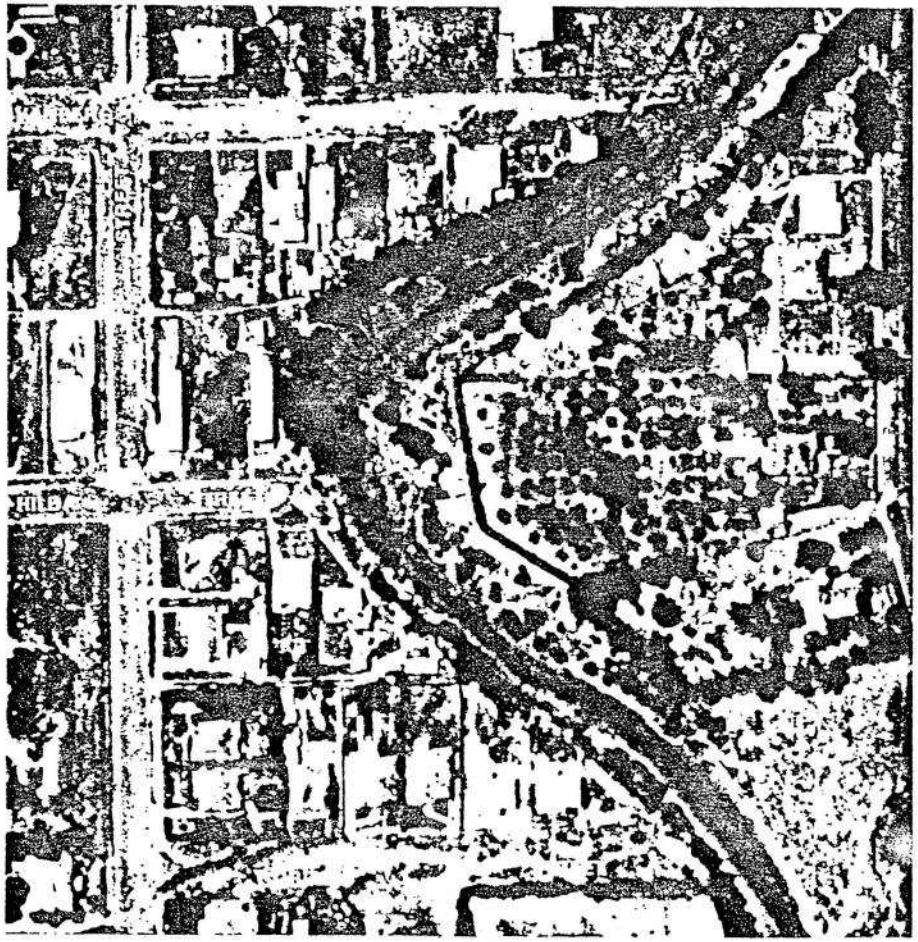
(* Q in cumecs)

(b) **Improvements at Pattison Street, Essendon.** There were a number of complaints during the 1950s about bank erosion to the south of Dean Street Bridge, Essendon. As at Hilda Street, property owners were naturally concerned that their allotments were being eroded, and there was also concern that the eroded banks constituted a hazard to children. In 1957, the City Engineer of Essendon drew the attention of the Board of Works to erosion that was taking place at the rear of a number of allotments on Pattison Street (Fig 5-7A; Plate 5-5A). Approval for remedial works was given by the Board's Sewerage Committee in December 1958 (at the same time as the Hilda Street works were approved), and construction commenced in

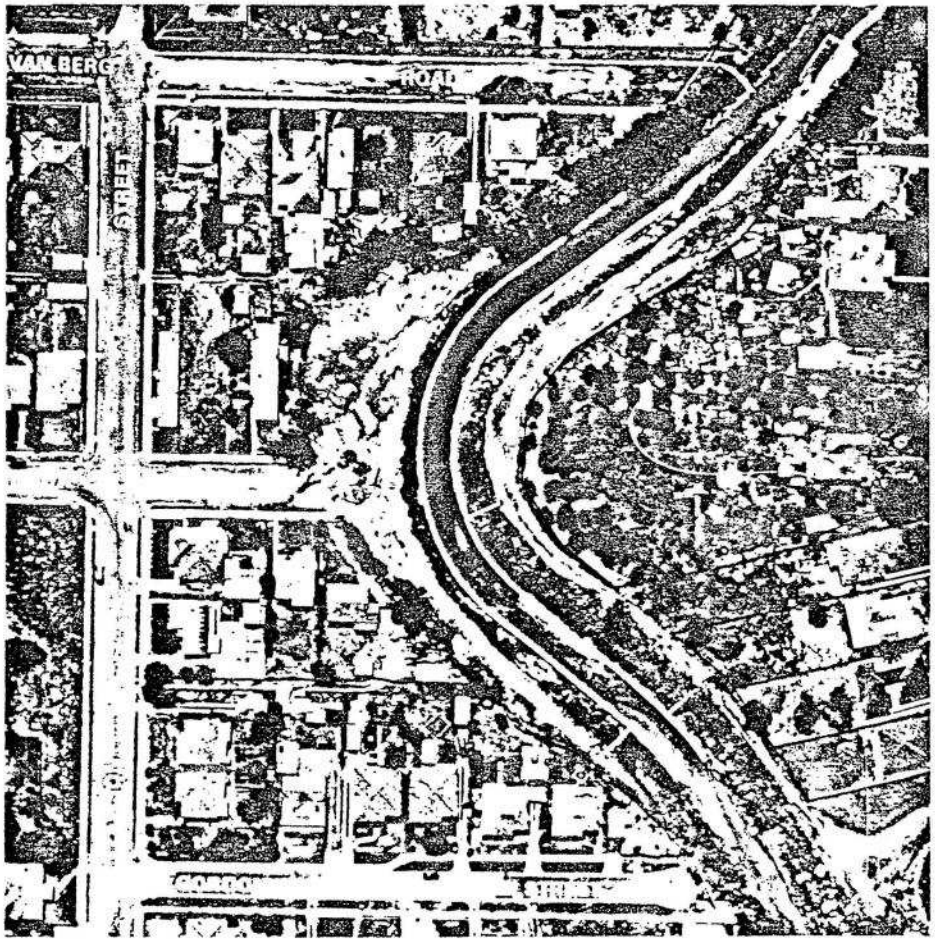
[1] It is interesting to note that the assumed developed area approximately coincides with the area zoned for industrial and residential purposes in the current planning scheme.

[2] For computational details, see Appendix B.

IMPROVEMENTS AT HILDA STREET ESSENDON BEFORE AND AFTER CONSTRUCTION



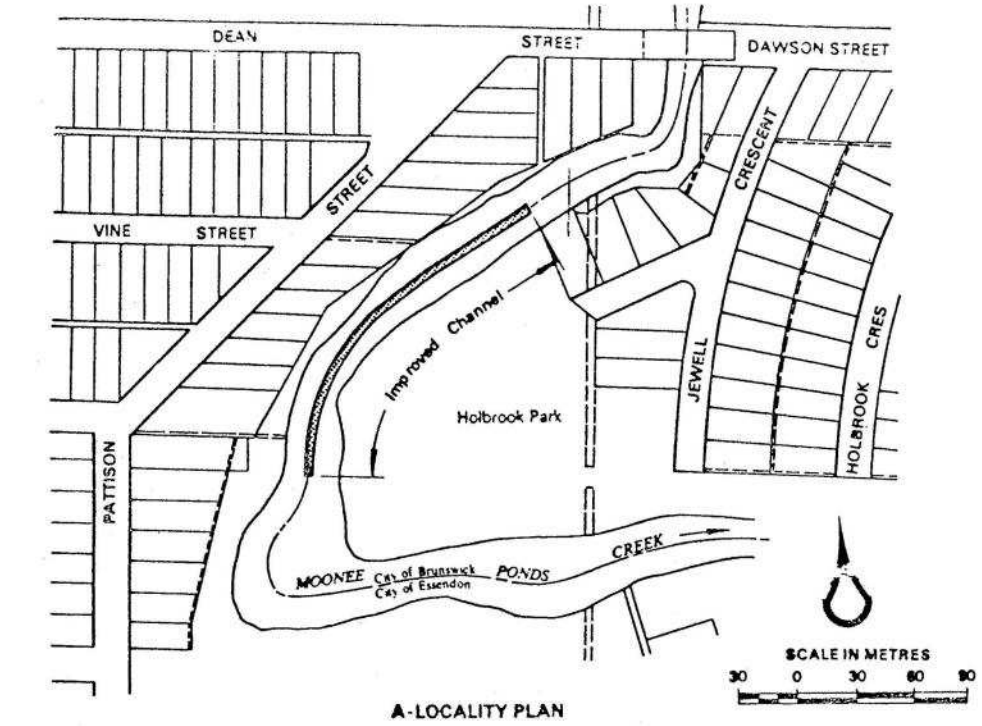
A-1958



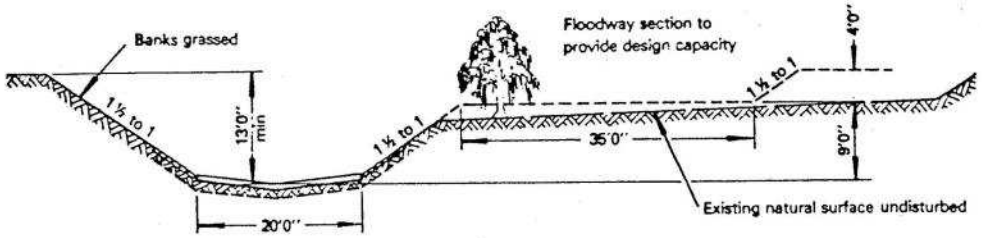
B-1960

METRES 25 0 25

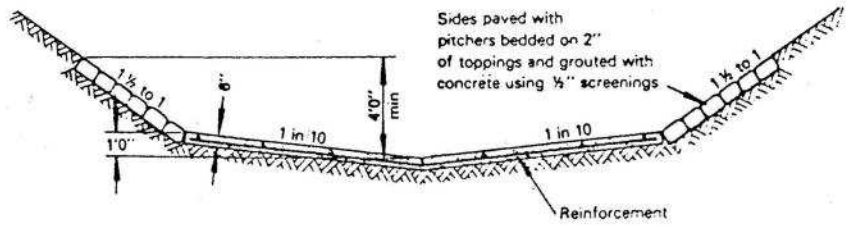
Plate 5-4



A-LOCALITY PLAN



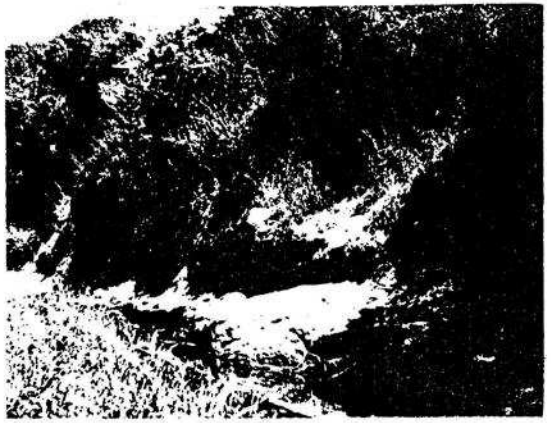
B-TYPE CROSS SECTION



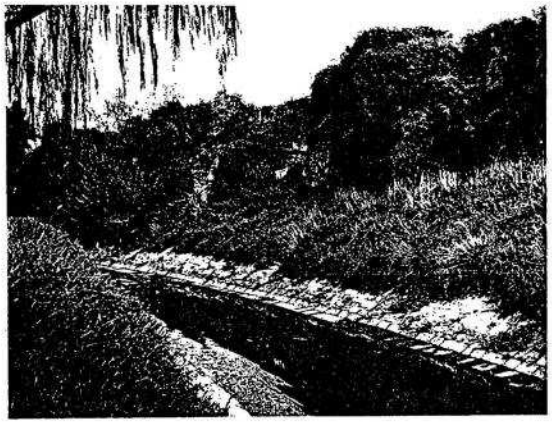
C-DETAIL OF INVERT

IMPROVEMENTS AT PATTISON STREET, ESSENDON

Figure 5-7



A Erosion at the rear of No 14 Pattison Street, November 1955



B The lined channel, 1966

PLATE 5-5 Erosion and improvements at Pattison Street, Essendon

September 1959. The channel was slightly realigned to move it away from the eroding western bank, the invert of the new channel was concrete-lined, and bluestone pitchers were placed above the concrete lining (Fig 5-7B and C). The form of the new channel is shown in Plate 5-5B. This photograph was taken in 1966, and it can be seen that by this time quite thick vegetation had become established along the banks of the creek.

The design discharge for the improved section, based on the '1953 formula', is estimated to have been approximately 4 500 cusecs (127.4 cumecs), which represented one-third of a ten-year flood.

This section of the creek was further modified in 1972 when improvement works were carried out between Evans Street and Gordon Street, Essendon (see Section 8-2). The original improvement works were incorporated into the new design.

(c) **Improvements at Somerset Street, Coburg.** Between 1940 and 1958 a strip of land up to 40 feet wide was eroded from the outside of a bend of Moonee Ponds Creek immediately downstream of the Gaffney Street Footbridge in Pascoe Vale (Fig 5-8). By 1958 the east bank had migrated to within a few feet of the back fences of properties in Somerset Street (Plates 5-6A and 5-7A). Quite understandably, the Board of Works received a number of requests from the property owners for protection works to be undertaken.

Orders were issued by the Board of Works for improvement works to commence in December 1961, and the job was completed during 1962. The creek was realigned, moving it away from the eroded bank and property fences (Fig 5-9A; Plates 5-6 and 5-7). An embankment was constructed along the eastern side of the new channel (Fig 5-9B) and the depression between the embankment and the old bank of the creek was gradually filled (Plate 5-6B). The invert of the new channel was not concrete lined, but the lower six feet of the banks were pitched, with the bottom pitcher resting on a toe stone below the level of the invert (Fig 5-9C). It is estimated that the new channel had a capacity of 544 cusecs (15.4 cumecs); flows in excess of this utilised the natural floodplain.

Within four years of the completion of the works, considerable quantities of silt had been deposited in the new channel and weed growth on the depositional material was prolific (Plate 5-6B). The siltation was almost certainly caused by ponding during flood flows, the watercourse downstream of the improved section being of inadequate capacity. The lined section of the creek was subsequently cleaned out and the weed growth and silt removed from the banks (Plate 5-6C). In late 1975, the section was further modified when it was incorporated into the improvement works undertaken between Gaffney Street and Margaret Street (see Section 8-4). The invert was concrete lined, the bluestone pitchers were replaced by concrete, and an access ramp was constructed (Plate 5-6D).

(d) **Improvements at Waxman Parade, Brunswick.** During the early/mid-1950s, frequent complaints were made about erosion along Moonee Ponds Creek between Albion Street and Fanny Street, Essendon. As reference to Figure 5-10A will show, the steep banks of this section of the creek were located well within the boundaries of some of the allotments, and not surprisingly, fences and gardens were frequently undermined (Plates 5-8A and 5-9A).

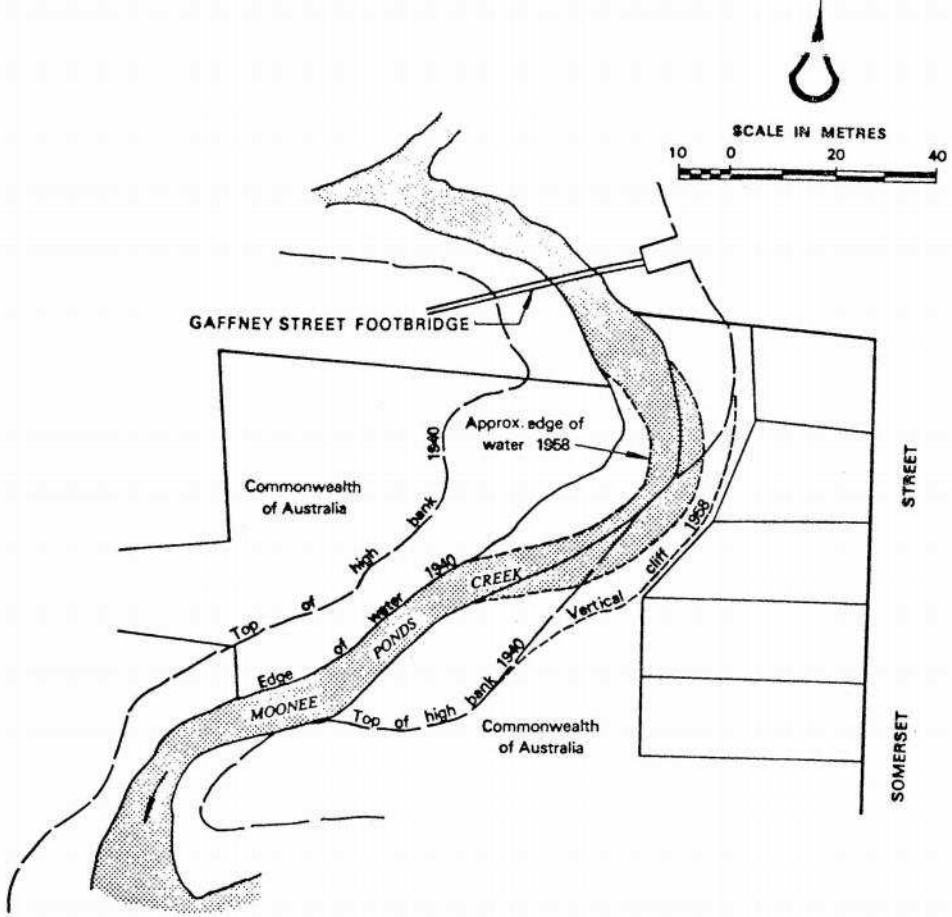
In 1957 a request to subdivide land on the southern side of Waxman Parade prompted the Board of Works to prepare a number of alternative plans for creek improvement in the area. The alternative schemes considered were :

(i) The deviation of the creek through Board land to the rear of subdivisions on the southern side of Waxman Parade.

(ii) The deviation of the creek along Waxman Parade and across Crown Land at the front of the subdivisions; this would have required the acquisition of a number of allotments.

(iii) The improvement of the creek along its existing alignment.

(iv) The construction of an underground drain along Waxman Parade.



LOCALITY PLAN

LATERAL MIGRATION OF THE CHANNEL AT SOMERSET STREET, COBURG

Figure 5-8

The plan to deviate the creek around the rear of the allotments was favoured by the Board, but no immediate action was taken.

In late 1959, the Board's Engineer-in-Chief recommended that minor remedial work be carried out along a short section of the creek immediately upstream of Waxman Parade. Work commenced on the project in mid 1960. The creek was straightened and the old course filled (Fig 5-10A; Plate 5-8A and B). The banks at the ends of the new section were pitched and the invert at these points concrete lined.

In early 1962, the Board decided to implement Scheme 1 of the alternative proposals for creek improvement put forward in 1957. A deviation was cut through

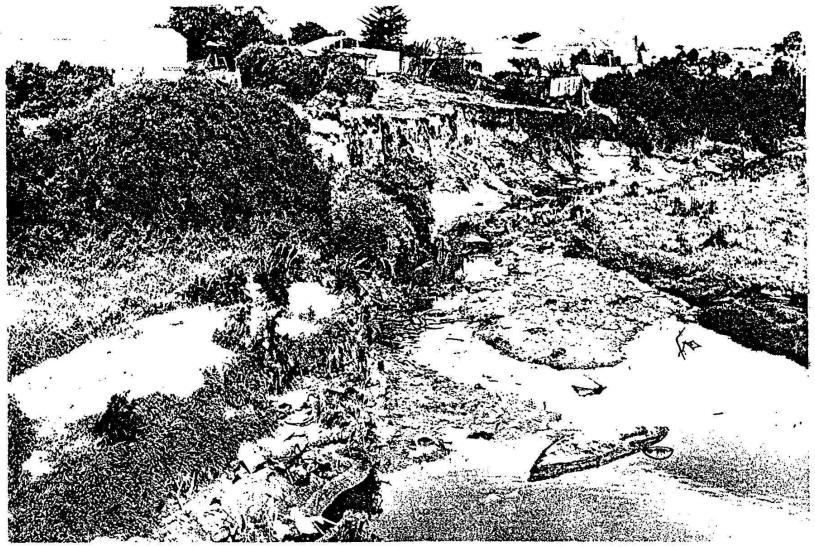
IMPROVEMENTS AT SOMERSET STREET COBURG BEFORE AND AFTER CONSTRUCTION

A-1960

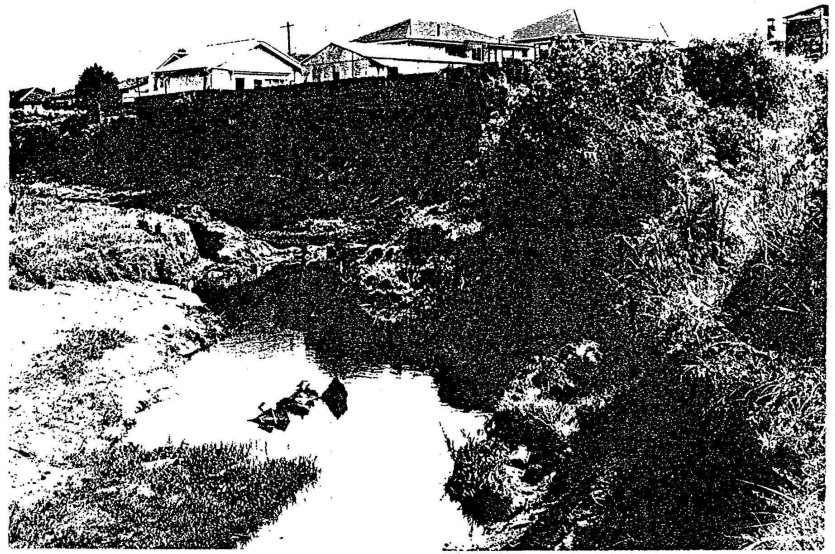
B-1963

METRES 50 25 0 50

Plate 5-7

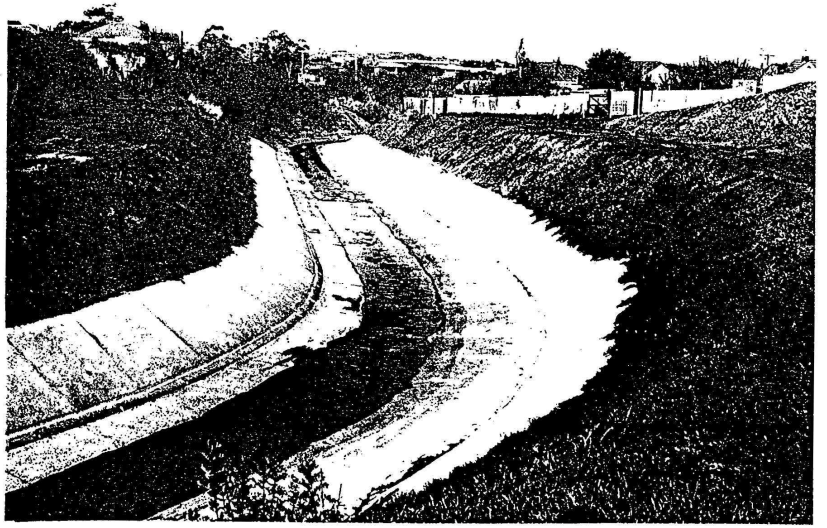


A Bank erosion at the rear of Nos 97 and 103 Waxman Parade in 1954. View looking downstream



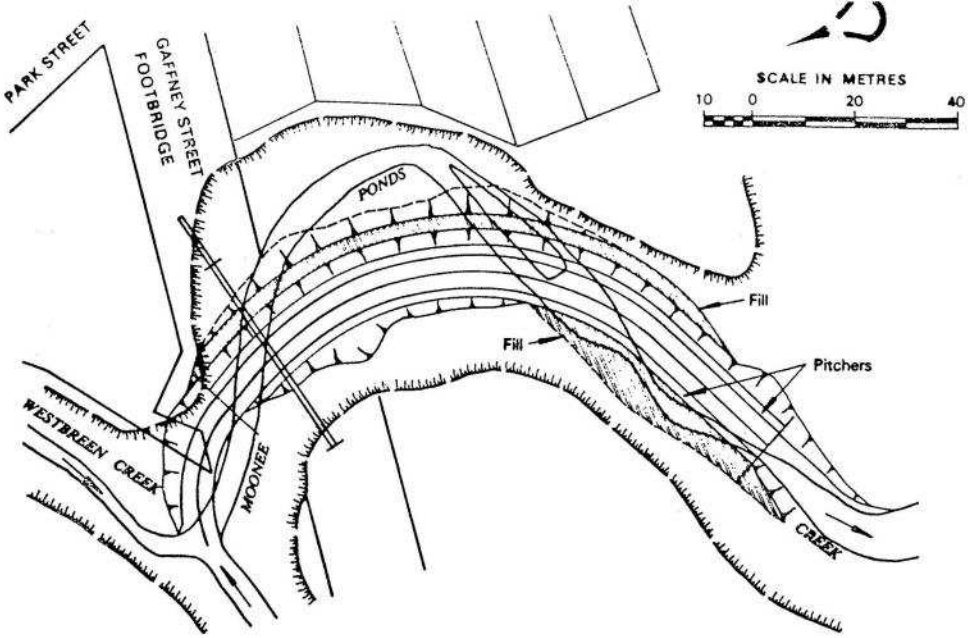
B Bank erosion at the end of Salisbury Street in 1954. View looking downstream

C The improved channel immediately after completion in 1960. View looking downstream

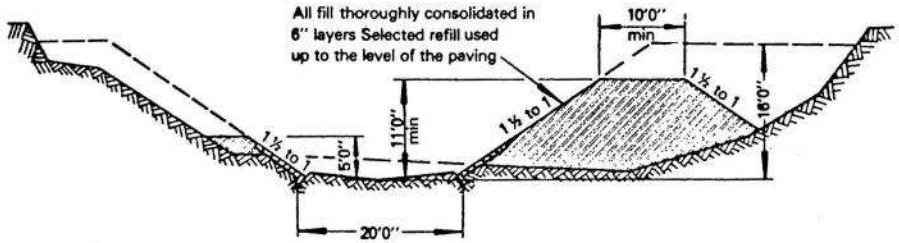


D The same reach as in C in 1975

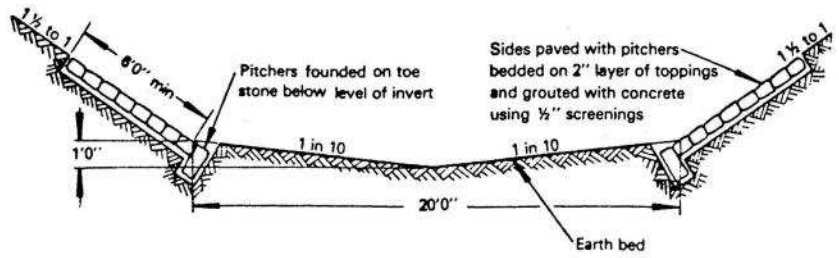
PLATE 5-8 Bank erosion and improvement works at the rear of Waxman Parade, Brunswick



A- LOCALITY PLAN



B- TYPE CROSS SECTION

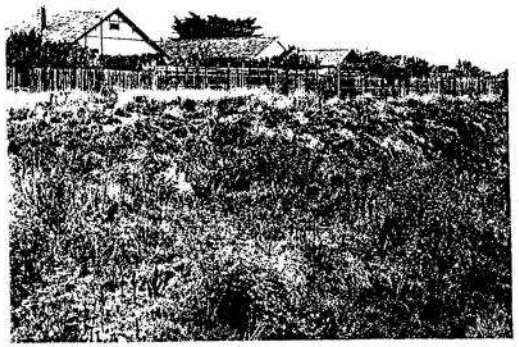


C- DETAIL OF INVERT

IMPROVEMENTS AT SOMERSET STREET, COBURG

Figure 5-9

A Bank erosion, 1955



B The silted, weed-infested improved channel in 1966. The bluestone pitchers are just visible

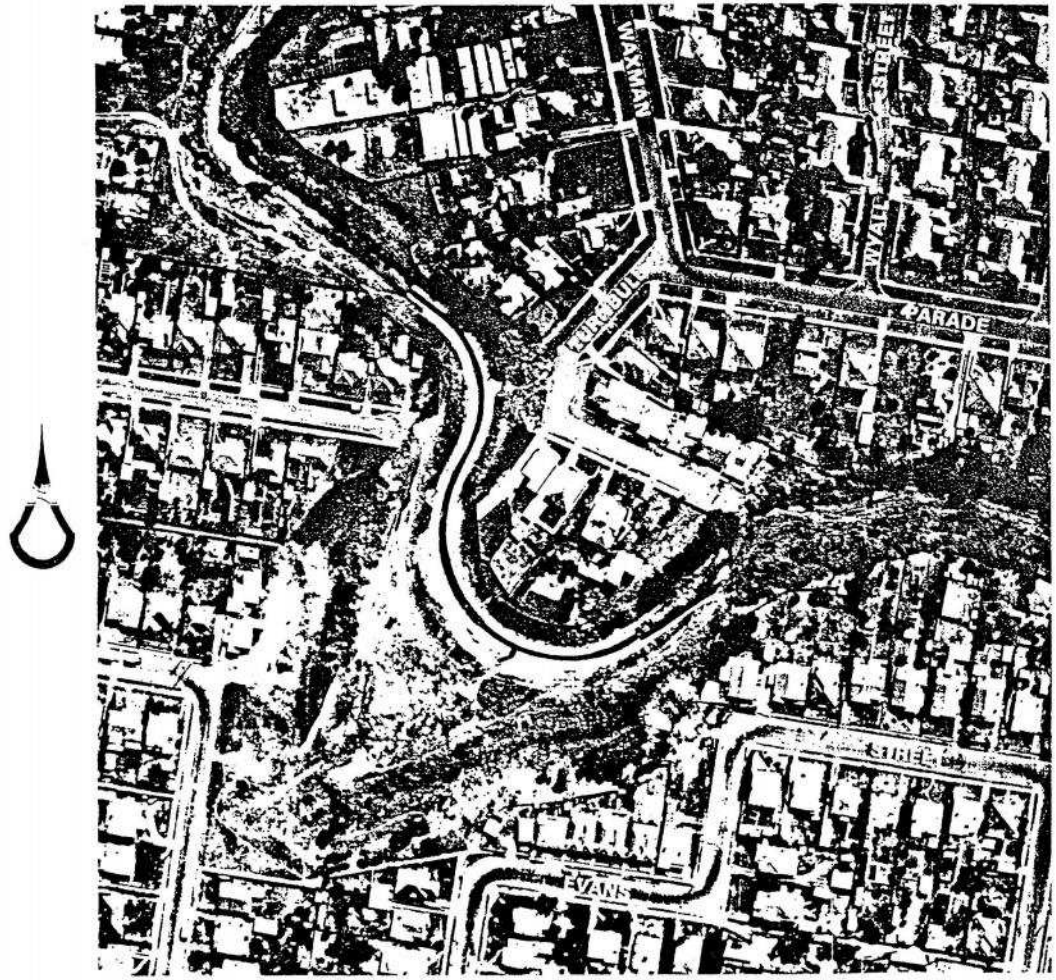
C The cleaned-out channel in early 1975

D The partially concrete-lined channel in mid 1980

PLATE 5-6 Bank erosion and improvement works at Somerset Street, Coburg. Views looking downstream from Gaffney Street Footbridge

WAXMAN PARADE DEVIATION BEFORE AND AFTER CONSTRUCTION

A-1958



B-1964

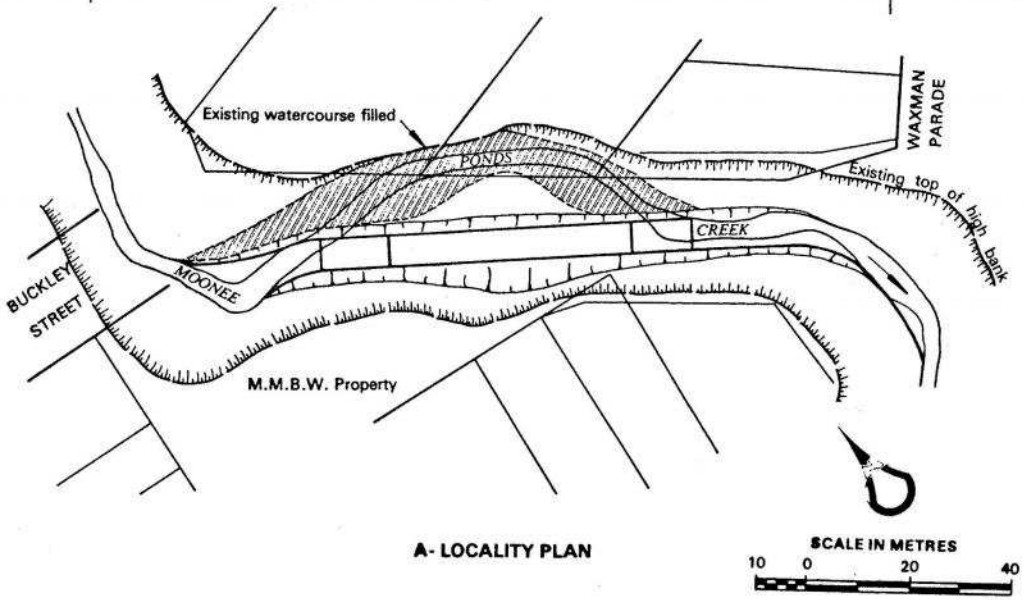
METRES 40 20 0 50

Plate 5-9

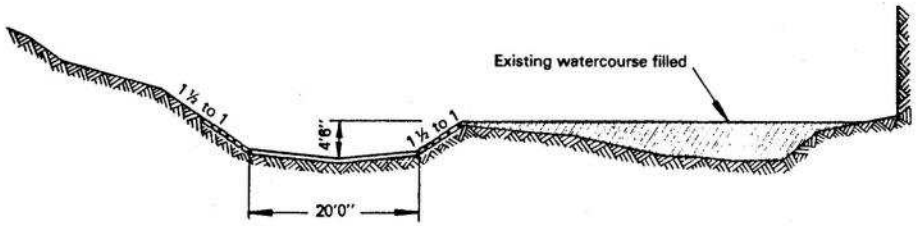
the neck of the land behind Waxman Parade (Plate 5-9; Fig 5-11A). The invert of the new channel was concrete lined, drop structures were placed at the downstream end (Fig 5-11B), and the banks were partially lined with bluestone pitchers. Design discharge for the channel, which has since been superseded, was 4 500 cusecs (127.4 cumecs) or one-third of a ten-year flow. The old course of the creek was blocked off by an embankment and gradually filled.

In 1972, the deviation, and the improvement works immediately upstream, were modified when the creek was improved between Evans Street and Gordon Street, Essendon (see Section 8-2).

(e) **Improvements at Donald Avenue, Essendon.** The steep banks between the western end of Donald Avenue and Hopetoun Avenue were extremly susceptible to erosion, particularly during floods. During the 1950s, the backs of several allotments along Donald Avenue were being eroded, and a house on a block of land



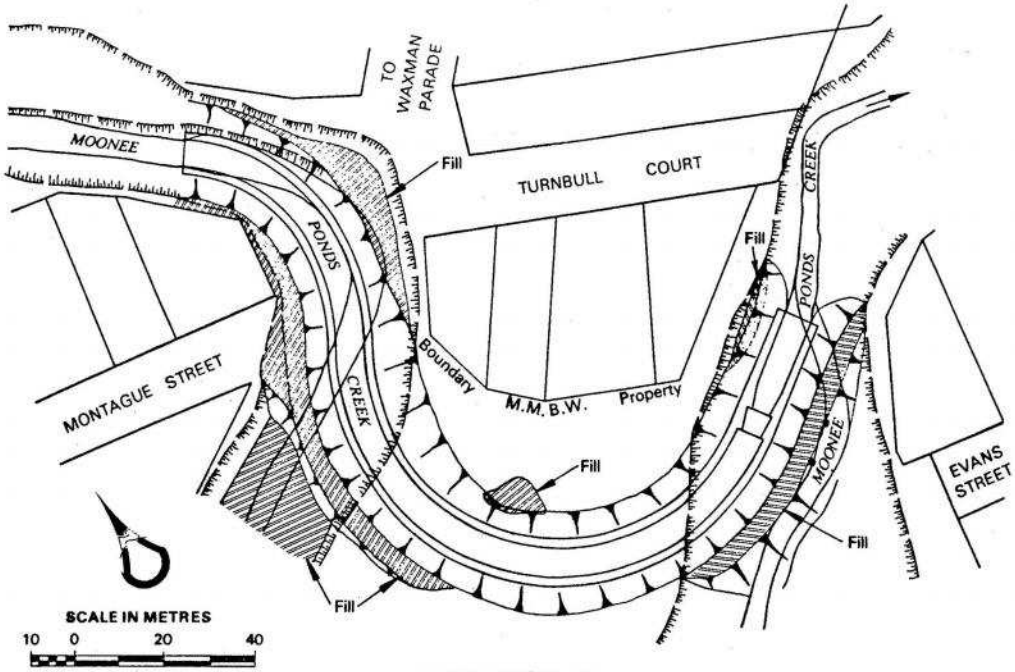
A- LOCALITY PLAN



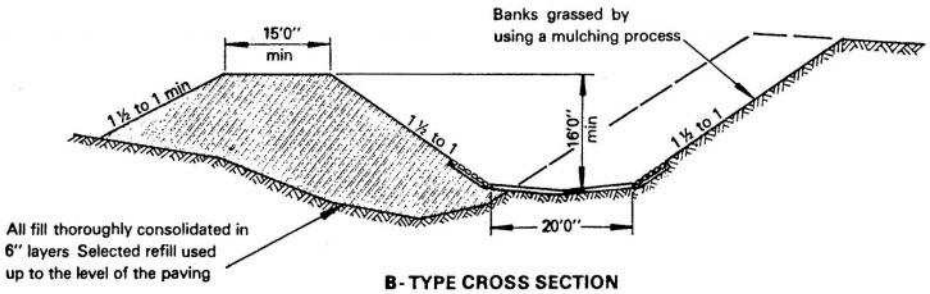
B- TYPE CROSS SECTION

IMPROVEMENTS AT WAXMAN PARADE, BRUNSWICK

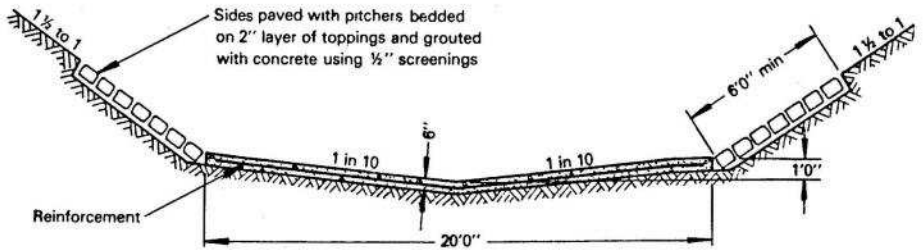
Figure 5-10



A-LOCALITY PLAN



B-TYPE CROSS SECTION



C- DETAIL OF INVERT

THE WAXMAN PARADE DEVIATION

Figure 5-11

IMPROVEMENTS AT DONALD AVENUE ESSENDON BEFORE AND AFTER CONSTRUCTION

A-1960

B-1966

METRES 50 25 0 50

Plate 5-11

at the end of Morrow Street was perilously close to the actively eroding bank of the creek (Plates 5-10 and 5-11A). Quite severe erosion accompanied the flood of 1960, and the residents of Donald Avenue forwarded a petition to the State Rivers and Water Supply Commission, who forwarded it to the Board of Works. The Board decided that improvement works were urgently required between Morrow Street and Vanberg Road, but the job was not issued to construction until June, 1963. The delay was due to the time required to obtain land necessary for the works from a number of property owners (Fig 5-12A).

The new channel was slightly realigned (Plate 5-11), moving it away from the rear of the allotments along Donald Avenue. The invert was concrete lined and the lower banks pitched (Fig 5-12). A considerable quantity of fill was required along the Essendon side of the new channel. The incised nature of this section of the creek makes access for machinery difficult; this hindered construction, and makes maintenance difficult (see Plate 5-12).

The original design discharge for the improved section is estimated to have been 4 500 cusecs (127.4 cumecs), which represented one-third of a ten-year flow. This

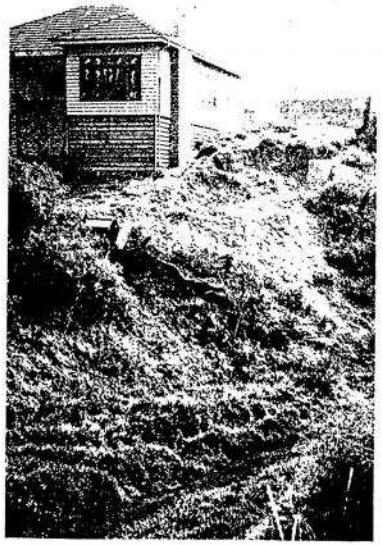
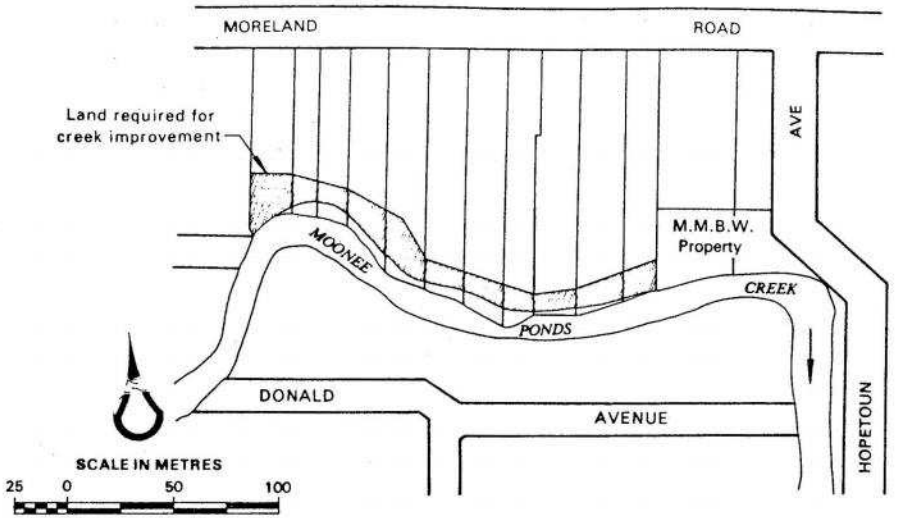
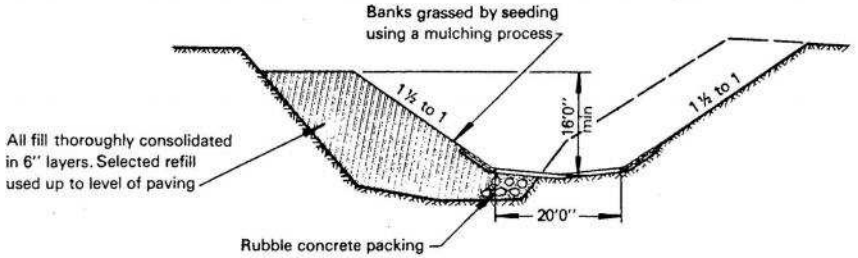


PLATE 5-10 House sited near the bank edge, Morrow Street, Brunswick

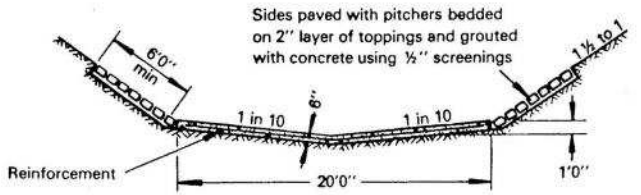
PLATE 5-12 Improvements at Donald Avenue: View looking downstream from Morrow Street in March 1980



A-LOCALITY PLAN



B-TYPE CROSS SECTION



C-DETAIL OF INVERT

IMPROVEMENTS AND LAND REQUIRED FOR IMPROVEMENTS AT DONALD AVENUE, ESSENDON

Figure 5-12

section of the creek has not been modified since construction, but the construction of the Jacana Retarding Basin in 1967 has considerably affected the flow regime through it. Estimates of discharge capacity and frequencies for the channel since 1967, based on the Unit Hydrograph method, are given in Table 5-4.

Full bank flow has a recurrence interval of greater than 1 in 100 years, while flow at the level of the top of the bluestone pitchers can be expected to occur, on average, at least once in every five years.

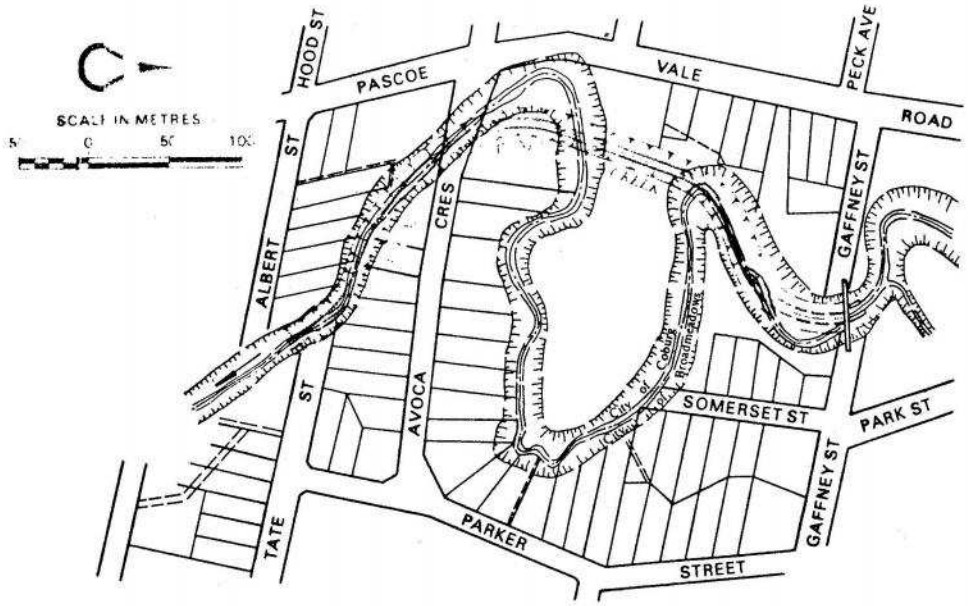
TABLE 5-4 IMPROVEMENTS AT DONALD AVENUE : DISCHARGE CAPACITY AND FREQUENCY ESTIMATES

Estimated Discharges			Full Bank Flow			Flow with 0.5 m Freeboard			Flow at top of Lined Portion			
Q * 100yr	Q 5 yr	Q	V m/s	Depth m	Approx Freq	Q	V m/s	Depth m	Approx Freq	Q	V m/s	Depth m	Approx Freq
142	78	182	3.0	4.9	100	148	2.9	4.4	100	22.3	2.6	1.32	5

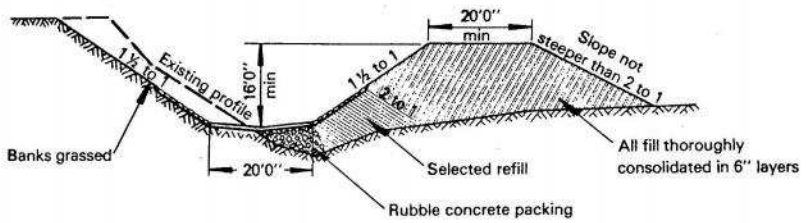
(* Q in cumecs)

(f) **Improvements from Avoca Crescent to Gaffney Street, Coburg.** Between Gaffney Street and Avoca Crescent the creek flowed in a tight loop (Fig 5-13A; Plate 5-13A), and quite predictably erosion was a recurring problem on the outside of the bends. In addition, flooding was also a problem (Plate 5-14). During the severe flood of January 1963 the land within the loop was inundated and the owner of the market garden located there reported that he had lost seventy-three fruit trees and

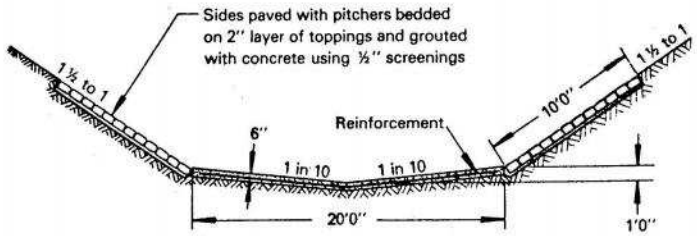
PLATE 5-14 Flooding upstream of Avoca Crescent, Coburg, 17 July, 1963



A- LOCALITY PLAN



B- TYPE CROSS SECTION



C-DETAIL OF INVERT

IMPROVEMENTS AT AVOCA CRESCENT, PASCOE VALE

Figure 5-13

IMPROVEMENTS BETWEEN AVOCA CRESCENT AND GAFFNEY STREET PASCOE VALE BEFORE DURING AND AFTER CONSTRUCTION

A-1963

B-1968

METRES 100 50 0 100

C-1979

METRES 40 20 0 50

Plate 5-13

5.1.4 Other Works

(a) **Improvements at Albion Street Bridge and Moreland Road Bridge.** The Country Roads Board constructed new bridges across Moonee Ponds Creek at Moreland Road and Albion Street in the mid 1950s (Fig 5-5). In order to protect the new bridges, and the approaches to the bridges, from erosion, the Board of Works agreed to reconstruct the channel at the two localities (Fig 5-14). The inverts of the new sections were lined with bluestone pitchers and the sides were shaped and grassed. The estimated cost of the work at Moreland Road was £16 000 and at Albion Street £8 000.

The original design discharge at Moreland Road Bridge is estimated to have been 9 100 cusecs (258 cumecs) which is the equivalent of two-thirds of a ten-year flow. Post Jacana discharge capacities and frequencies are given in Table 5-6

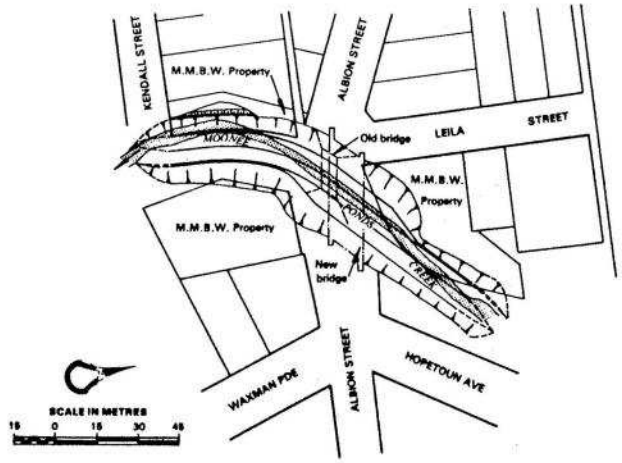
(b) **Improvements at Moreland Road (Five Mile Creek), Essendon.** In 1960/61 a section of Moonee Ponds Creek a short distance upstream of Moreland Road Bridge was realigned cutting off a sharp bend (Fig 5-15). The realignment was not carried out to alleviate flooding or to prevent erosion, but to facilitate the construction of a section of the Moonee Ponds Relieving Sewer. The invert of the new cut was paved with concrete, and pitchers were placed along the sides of the channel (Fig 5-15B and C; Plate 5-15). The old course of the creek was filled upstream of the junction with Five Mile Creek but the downstream section of the old course was left open to serve as an outlet for Five Mile Creek.

The original design capacity is estimated to have been 4 500 cusecs (127.4 cumecs - one-third of a ten-year flood). Post Jacana capacities and frequencies are given in Table 5-6.

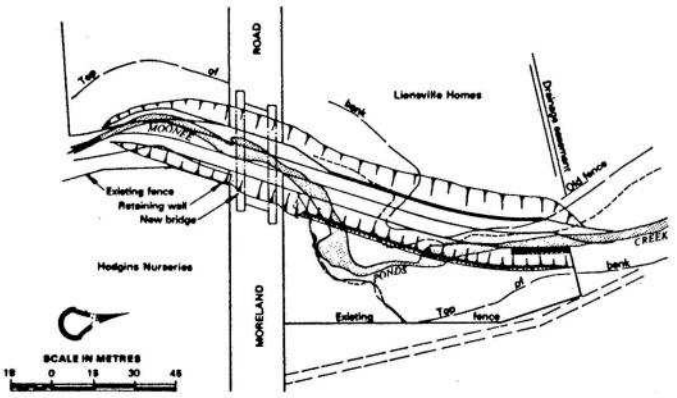
TABLE 5-6 IMPROVEMENTS AT MORELAND ROAD BRIDGE AND FIVE MILE CREEK JUNCTION : DISCHARGE CAPACITIES AND FREQUENCIES

	Estimated Discharges		Full Bank Flow				Flow with 0.5 m Freeboard				Flow at top of Lined Portion			
	Q * 100yr	Q 5 yr	Q	V m/s	Depth m	Approx Freq	Q	V m/s	Depth m	Approx Freq	Q	V m/s	Depth m	Approx Freq
Moreland Road Bridge														
	140	74	266	3.1	4.5	100	211	2.9	4.0	100				
No low flow section														
Five Mile Creek Junction														
	140	74	182	3.0	4.9	100	148	2.9	4.4	100	22.3	2.6	1.32	5

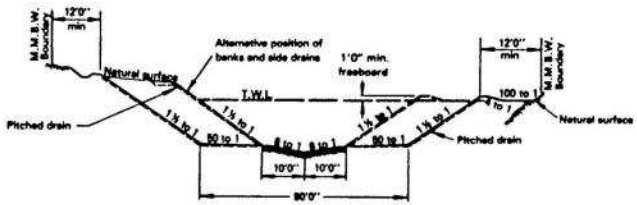
(* Q in cumecs)



A- ALBION STREET BRIDGE LOCALITY PLAN



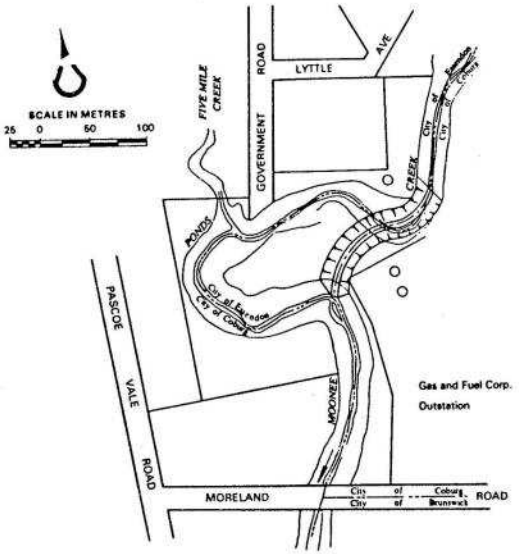
B- MORELAND ROAD BRIDGE LOCALITY PLAN



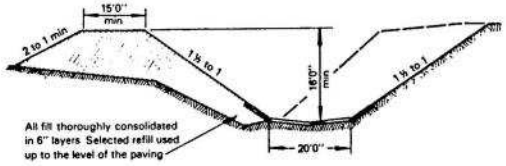
C- MORELAND ROAD BRIDGE TYPE CROSS SECTION

IMPROVEMENTS AT ALBION STREET BRIDGE AND MORELAND ROAD BRIDGE

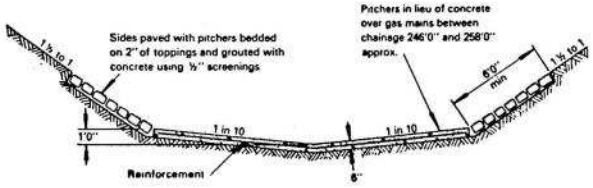
Figure 5-14



A - LOCALITY PLAN



B - TYPE CROSS SECTION



C - DETAIL OF INVERT

DEVIATION AT THE JUNCTION WITH FIVE MILE CREEK

Figure 5-15

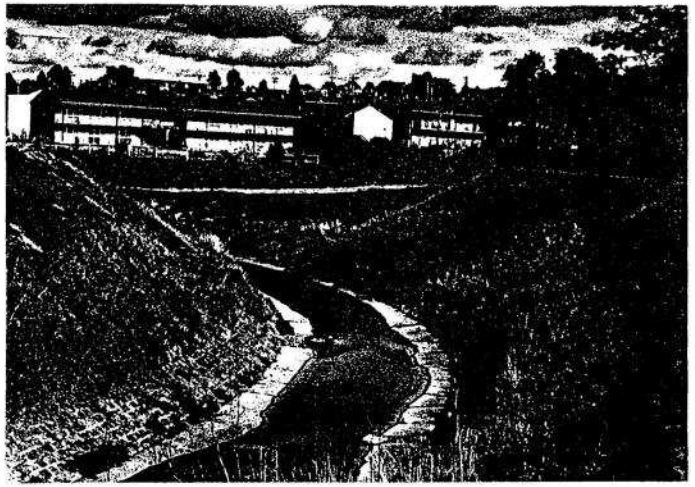


PLATE 5-15 The deviation at the junction with Five Mile Creek, mid 1980

numerous vegetable plants, and during the July 1963 flood the occupant of No 2 Somerset Street reported that the house had been flooded to a depth of three feet.

The Board of Works accepted that remedial measures were urgently required and decided to cut a new channel across the neck of the loop. Before work could commence, however, land had to be acquired. Work commenced in late 1965 and was completed in mid 1966. The alignment of the diversion can be seen in Figure 5-13A and Plate 5-13B, and a type section of the new channel is shown in Figure 5-13B. The land within the old meander loop has been developed for passive recreation (Plate 5-13C).

The original design discharge for the new channel is estimated to have been 5 500 cusecs (156 cumecs), which lies approximately half-way between one-third and two-thirds of a ten-year flow. The channel has not been modified since construction, and post Jacana discharge capacities and frequencies are given in Table 5-5 below.

TABLE 5-5 IMPROVEMENTS AT AVOCA CRESCENT : DISCHARGE CAPACITY AND FREQUENCY ESTIMATES

Estimated Discharges				Full Bank Flow				Flow with 0.5 m Freeboard				Flow at top of Lined Portion			
Q * 100yr	Q 5 yr	Q	V m/s	Depth m	Approx Freq	Q	V m/s	Depth m	Approx Freq	Q	V m/s	Depth m	Approx Freq
88	57	193	3.2	4.9	100	157	3.1	4.4	100	48.2	3.1	2.0	5

(* Q in cumecs)

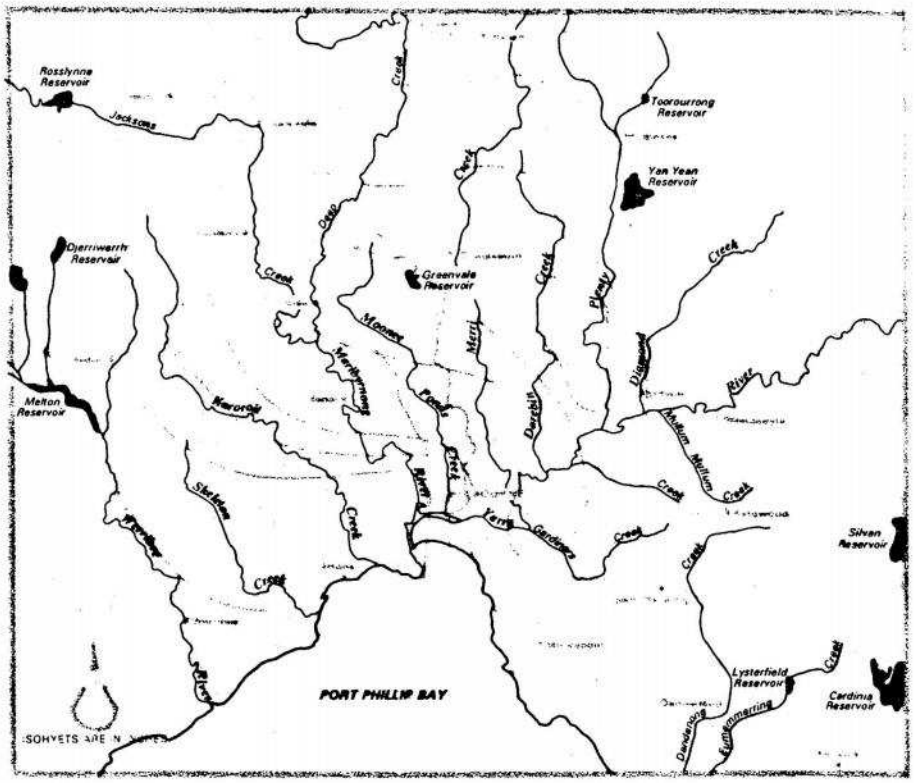
5.2 FLOODING

5.2.1 Introduction. As discussed in Section 4, flooding was a recurring problem prior to the Second World War in the low-lying parts of the Moonee Ponds Creek basin downstream of Ormond Road. As a result of particularly severe flooding in 1933 and 1934, a major drainage improvement scheme was implemented downstream of Flemington Road in 1936-37. The improvement works considerably alleviated the problem, but did not eliminate it; flooding occurred on a number of occasions between 1946 and 1963, and several remedial measures were undertaken. In addition, prior to the construction of the Jacana Retarding Basin in 1967, flooding was also a problem at some localities further upstream.

5.2.2 The Flood of February 1946. Steady rainfall started to fall over the northern suburbs of Melbourne at around 6.30 pm on 25 February 1946, and with the exception of a five-hour break in the middle of the night, continued falling until late in the afternoon of the following day. Five hundred and twenty-five points (134 mm) were recorded in twenty-five hours at Brunswick, and according to a Memo written by the Board of Works Engineer for Main Drains, the rainfall intensities reported from the northern suburbs were records for practically all durations from two hours upward. Isohyets for the period 24 to 27 February are shown in Figure 5-16.

Flows along Moonee Ponds Creek were the highest since 1933 and flooding occurred at a number of localities. A report on the flood for the area downstream of Ormond Road was prepared by the Melbourne City Engineer, the main points of which are summarised in Figure 5-17. Flood levels along the lower reaches of the creek were generally lower than during the Christmas day flood of 1933, except at Arden Street and immediately upstream of the Flemington Road Bridge. The floodwaters rose to the tops of the levee banks at a number of points along the 5 000 cusec channel, but only overtopped the banks at two localities : at Bent Street, and along the western levee between Arden Street and the Railway Gravitation Bridge. The levee bank was quickly built up at Bent Street and further flooding was prevented, but the floodwaters overtopped the western bank by six inches for a considerable distance below Arden Street. The Melbourne City Engineer estimated peak flow downstream of Flemington Road Bridge to be approximately 4 700 cusecs, but a Board of Works estimate placed it much higher; a value in the order of 6 000 cusecs was extrapolated from gauge readings taken upstream at Reynard Street. Tidal conditions in the Yarra are not thought to have contributed significantly to the flooding. The improvements to the outlet carried out by the Melbourne Harbor Trust in 1935 (see Plate 4-6) proved to be successful; the flood level at the southern end of Dudley Street was three feet four inches lower than the maximum level during the 1933 flood even though the tidal level in the Yarra was higher (3.67 ft compared with 2.09 ft).

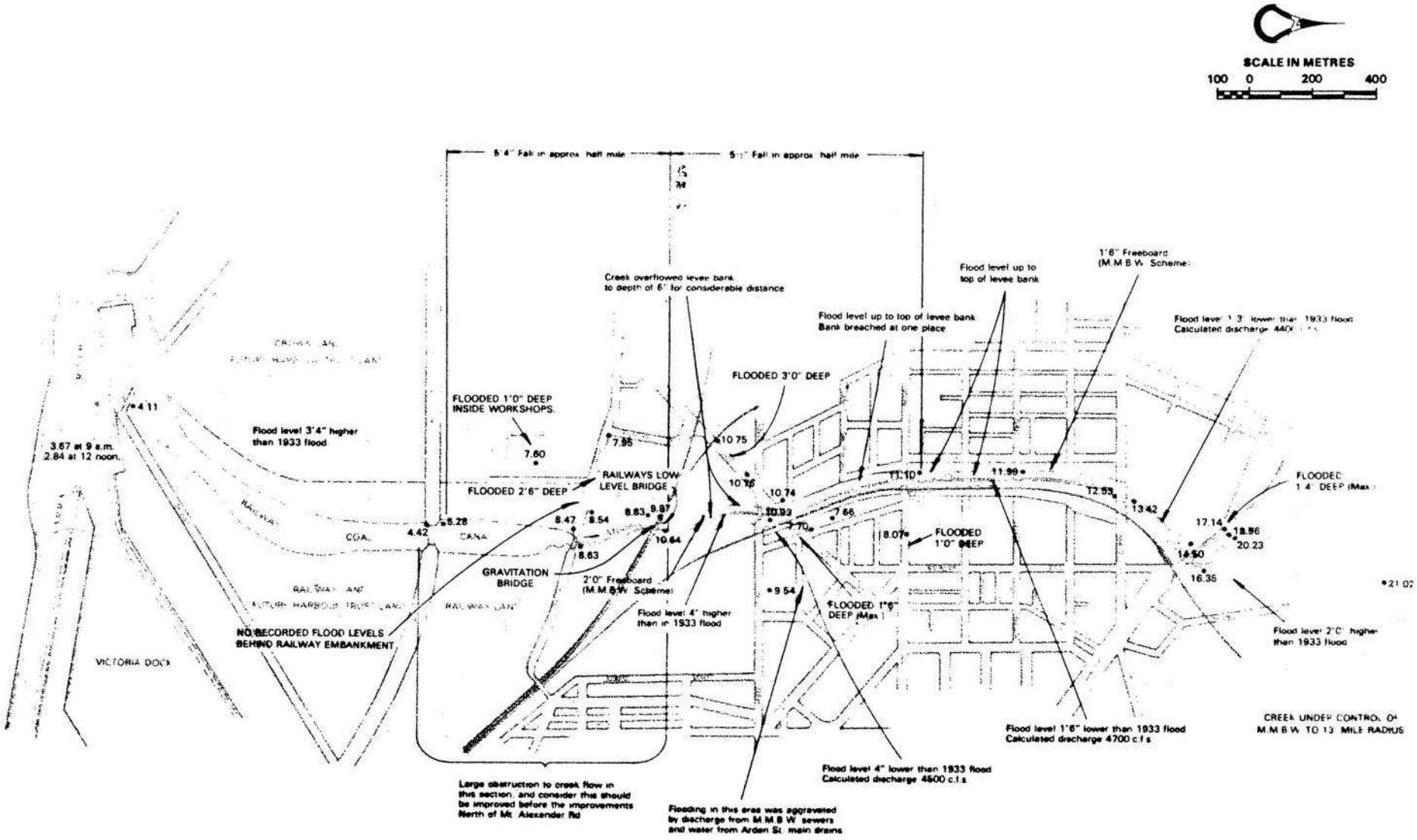
The areas flooded during February 1946 are shown in Figure 5-17. With only one exception, the Melbourne City Council's pumping stations below Flemington Road worked satisfactorily and prevented flooding by local stormwater runoff. In the Langford Street area, flooding occurred because the pumps at No 4 Pumping Station were unable to cope with overflows from MMBW sewers and stormwater drains. The relatively high flood levels between Arden Street and the Railway Gravitation Bridge were undoubtedly caused by the heading up of floodwaters at the Gravitation Bridge, and to a lesser extent at the low level Main Lines Bridge and at Dynon Road Bridge (Plate 5-16). Between the upstream side of the Macaulay Road Bridge and the upstream side of the Gravitation Bridge, the fall in water level was only five and a half inches, whereas between the upstream side of the Gravitation Bridge and the upstream side of the Melbourne-Footscray Road Bridge the fall was five feet four inches. There was at least a one-foot difference in water level between the upstream and downstream side of the Gravitation Bridge, and a ten-inch difference in level at the Dynon Road Bridge. At the Gravitation



48 HOUR DURATION

ISOHYETS FOR THE PERIOD 24 TO 27 FEBRUARY, 1946

Figure 5-16



DETAILS OF THE FEBRUARY 1946 FLOOD BETWEEN FLEMINGTON ROAD AND THE YARRA RIVER

Bridge flow was restricted by accumulated debris and by the piles and whalings (Plate 5-16B, C, D), even though some of the lower whalings had been removed in 1937. At Dynon Road Bridge the passage of floodwaters was hampered by siltation of the floodways under the outer arches of the bridge (Plate 5-16F). Flooding downstream of the Gravitation Bridge can probably be attributed to the inadequate capacity of the channel between the Gravitation Bridge and Dynon Road Bridge; this section was not improved when the 5 000 cusec channel was constructed.

The filling on the floodplain immediately upstream of Flemington Road Bridge constricted the floodway to such an extent that there was a five-foot nine-inch fall in water level during the flood between O'Dea's Service Station (just to the north of the bridge) and the southern side of the bridge (Plate 5-17A). Further upstream the extensive river flats were inundated, and the low point on Mt Alexander Road, which is located on the line of the old course of the creek, was flooded to a depth of one foot four inches (Plate 5-17C and D). As discussed in Section 4.5.2, the filling of the floodplain in the area between Flemington Road and Ormond Road Bridges commenced during the 1920s and 1930s. Theoretically the Board of Works had the power to prevent filling within 25 feet of the creek bank, but as Plate 5-17B indicates, filling had encroached almost to the bank edges at some points.

In reviewing the 1946 flood, the Melbourne City Engineer suggested that if the improvement works that had been proposed in the 1930s for the reach immediately upstream of Flemington Road Bridge had been carried out, the additional waters released would have overtopped the levee banks for considerable distances in the Bent Street and Stubb Street area. He considered that it was imperative that improvement works to this reach of the creek should not be contemplated until the channel capacity downstream of the Gravitation Bridge had been increased.

5.2.3 Flood Alleviation Proposals.

(a) **Improvement of the Channel below Dynon Road Bridge.** The Board of Works and the Melbourne City Engineer both agreed that the constriction of the channel downstream of Dynon Road was a contributory factor in the flooding of the low-lying land downstream of Flemington Road Bridge during February 1946. In March 1946 the Board's Water Supply Committee proposed that channel improvement works should be carried out at Dynon Road Bridge, and also for a distance of 500 feet downstream, although it was noted that legal responsibility for this section of the creek had never been resolved. The Water Supply Committee's recommendation was adopted by the Board on 2 April 1946 (Ref 4). It was estimated that the work would cost £1 400, and it is assumed that the work was subsequently carried out. It is also assumed that a proposal to dredge the channel between Macaulay Road and Dynon Road was executed. On hearing of the proposals for improvement works, the Melbourne City Council sought the Board's advice about the possibility of waiving or modifying restrictions to building activities on the low-lying areas adjoining the channel. The Board recommended that the restrictions should remain, pointing out that the improvement works would not completely eliminate the flood problem.

(b) **Proposed Improvements between Flemington Road and Ormond Road.** In July 1947, the Minister of Public Works authorised the Board of Works to convene a conference to be attended by all public authorities interested in the area adjacent to Moonee Ponds Creek between Flemington Road and Ormond Road to discuss a proposal to realign and reconstruct the creek, and to build a new road alongside it (Fig 5-18A). The conference was held the following month and was attended by representatives from the Town and Country Planning Board, the Country Roads Board, the MMBW, the City of Melbourne, the City of Brunswick, and the City of Essendon. The conference passed a motion supporting the proposal for the construction of a new road and for the realignment of the creek.

In December 1949, the Board of Works produced a plan for a 150-foot wide open channel floodway between Flemington and Ormond Roads (Fig 5-18B). It was proposed that the bed of the floodway would be between one and three feet below the level of the existing creek flats, and that the flats would be protected by levee banks. The design of the floodway allowed for an 11 ft wide beached centre channel. It was noted that for an additional £106 000 the beached centre channel could be replaced by twin 8 ft by 5 ft covered conduits.

The Board of Works gradually purchased the land that was required for the proposed improvement works. It acquired a number of parcels of land immediately upstream of Flemington Road Bridge during the late 1940s and the early 1950s, and together with the Cities of Melbourne, Brunswick, and Essendon acquired the unsightly floodplain land owned by the City of Melbourne Golf Club downstream from Ormond Road. The Board of Works obtained title to a 150-foot wide strip of land that was intended for use for drainage purposes, and the three municipalities obtained title to the remainder, which it was intended should be filled and developed for recreational purposes.

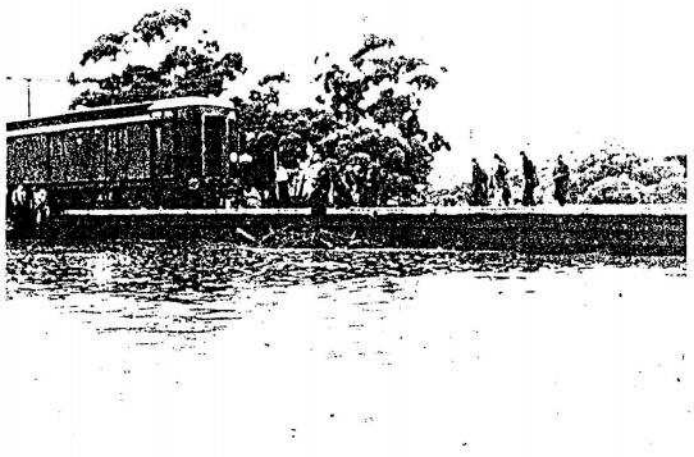
The proposed works were never carried out, presumably because of financial constraints. In December 1952 the Board of Works produced a slightly modified design for a 800-foot long section of the creek from Flemington Road Bridge to opposite Delhi Court. The ultimate design capacity for this section of the channel was 9 000 cusecs, which was considered to be two-thirds of the 10-year flood. The first stage design was for a nominal 5 000 cusec capacity at an estimated cost of £12 000. Due to financial restrictions, however, the project was shelved until 1962 (see Sub-section 5.2.5).

5.2.4 The October 1954 and September 1960 Floods. Flooding occurred along Moonee Ponds Creek in October 1954 and September 1960, refocusing public attention on the problem. On 25 October 1954, heavy rain fell over the City and several areas were flooded. One hundred and forty four points (36.6 mm) were recorded at Flemington, while at Essendon 173 points (43.9 mm) were recorded. The levee banks downstream of Flemington Road Bridge were not overtopped, but there was localised flooding along Stubbs Street, the pumping station being unable to cope with the heavy storm runoff. Between Flemington and Ormond Roads the creek flats were inundated, and the low point on Mt Alexander Road was flooded.

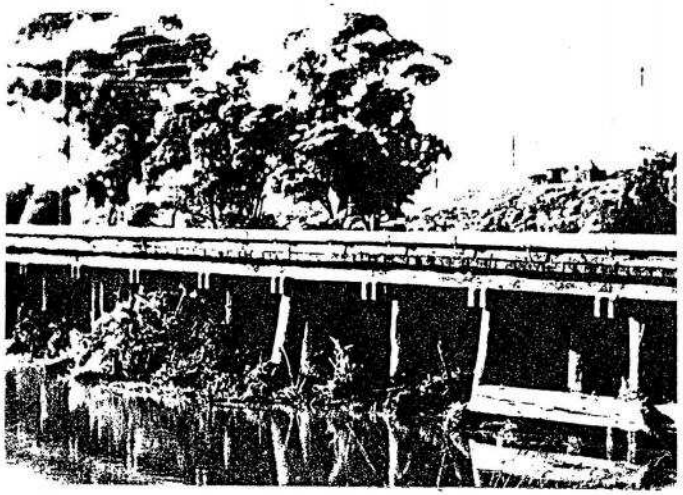
The flood of 17 September 1960 was far more severe. The water lapped the tops of the levee banks downstream of Flemington Road and overtopped the bank at one point. Upstream of Flemington Road Bridge water flowed across Mt Alexander Road flooding properties in the area to a depth of two feet six inches (Plate 5-18A), and then flowed through Debneys Paddock and across Racecourse Road flooding houses in Stubbs Street. Further upstream, the creek overtopped its banks at several points and inundated a number of allotments (Plate 5-18B).

Peak discharge along the lower reaches of Moonee Ponds Creek during the September 1960 flood was estimated to have been in the order of 6 000 cusecs, which was of comparable magnitude to the February 1946 flood. The 1946 flood occurred after a fall of some five inches (127 mm) of rain on a dry catchment, whereas the September 1960 flood occurred after a fall of less than two inches (50.8 mm) on an already wet catchment.[1] The Board of Works Executive Engineer postulated that if the amount of rainfall received in February 1946 had fallen on the prewetted and more extensively developed catchment in September 1960, the discharge would have been 10 per cent

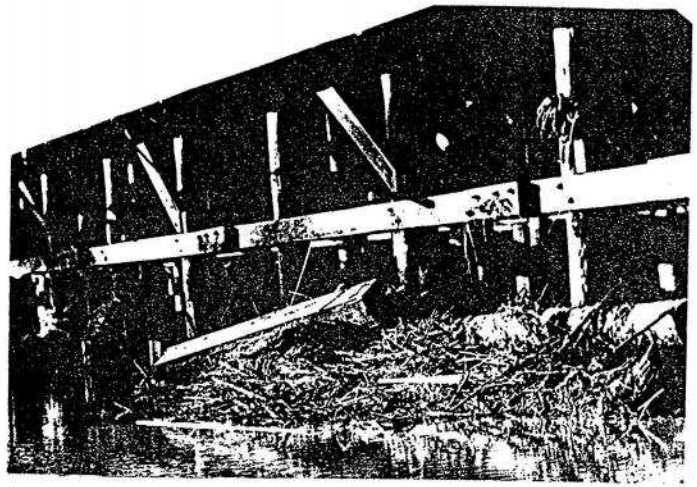
[1] The Board's gauge at Keilor (on the Maribyrnong River) recorded 187 points (47.5 mm) between 5.00 am and 1.00 pm on 17 September, with 114 points (29.0 mm) falling between 8.30 am and 12.30 pm.



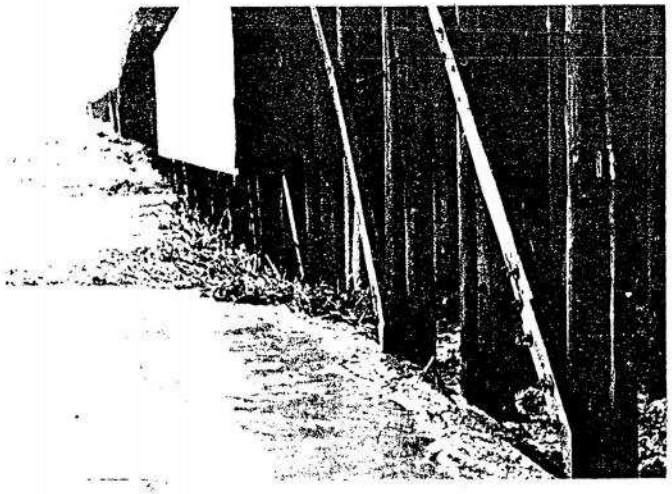
A The low level Main Lines Bridge



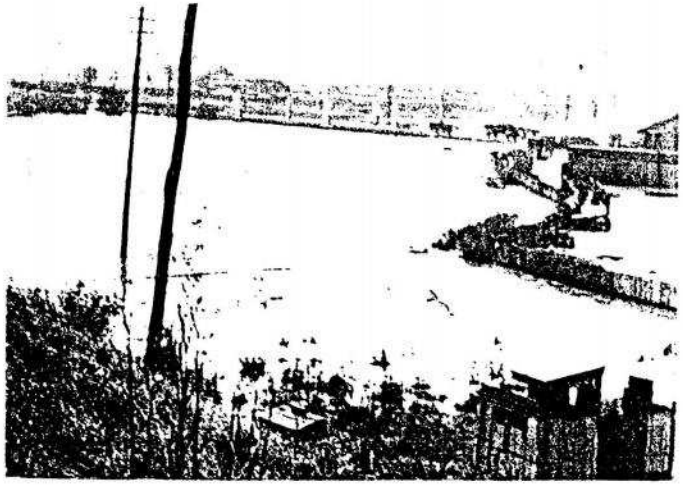
B Debris piled up against the Main Lines Bridge



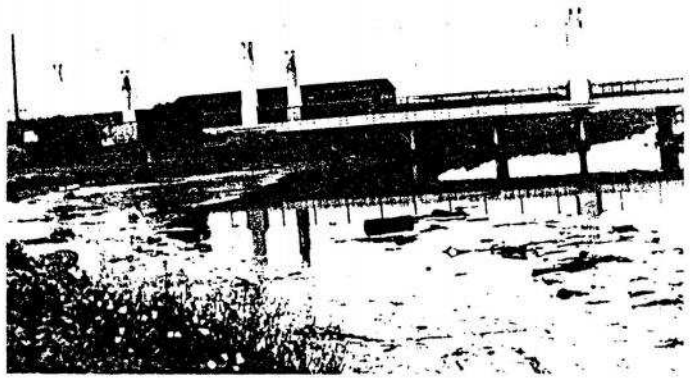
C Debris piled up against the Railways' Gravitation Bridge



D Head-up of water on the upstream side of the Railways' Gravitation Bridge



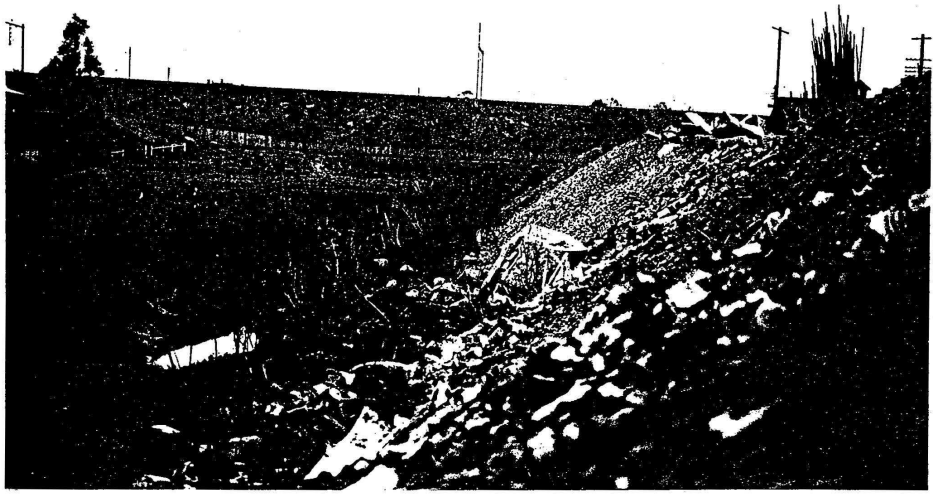
E Looking downstream towards Dynon Road Bridge



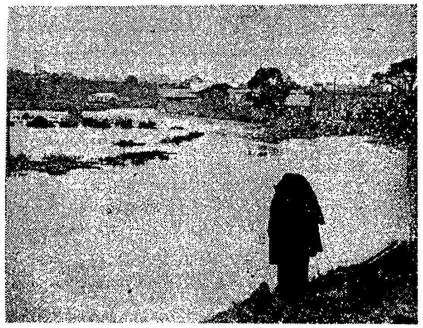
F View of Dynon Road Bridge showing the siltation under the eastern spans

PLATE 5-16 The February 1946 flood downstream of Flemington Road

A Floodwaters racing through the constricted channel above Flemington Road Bridge



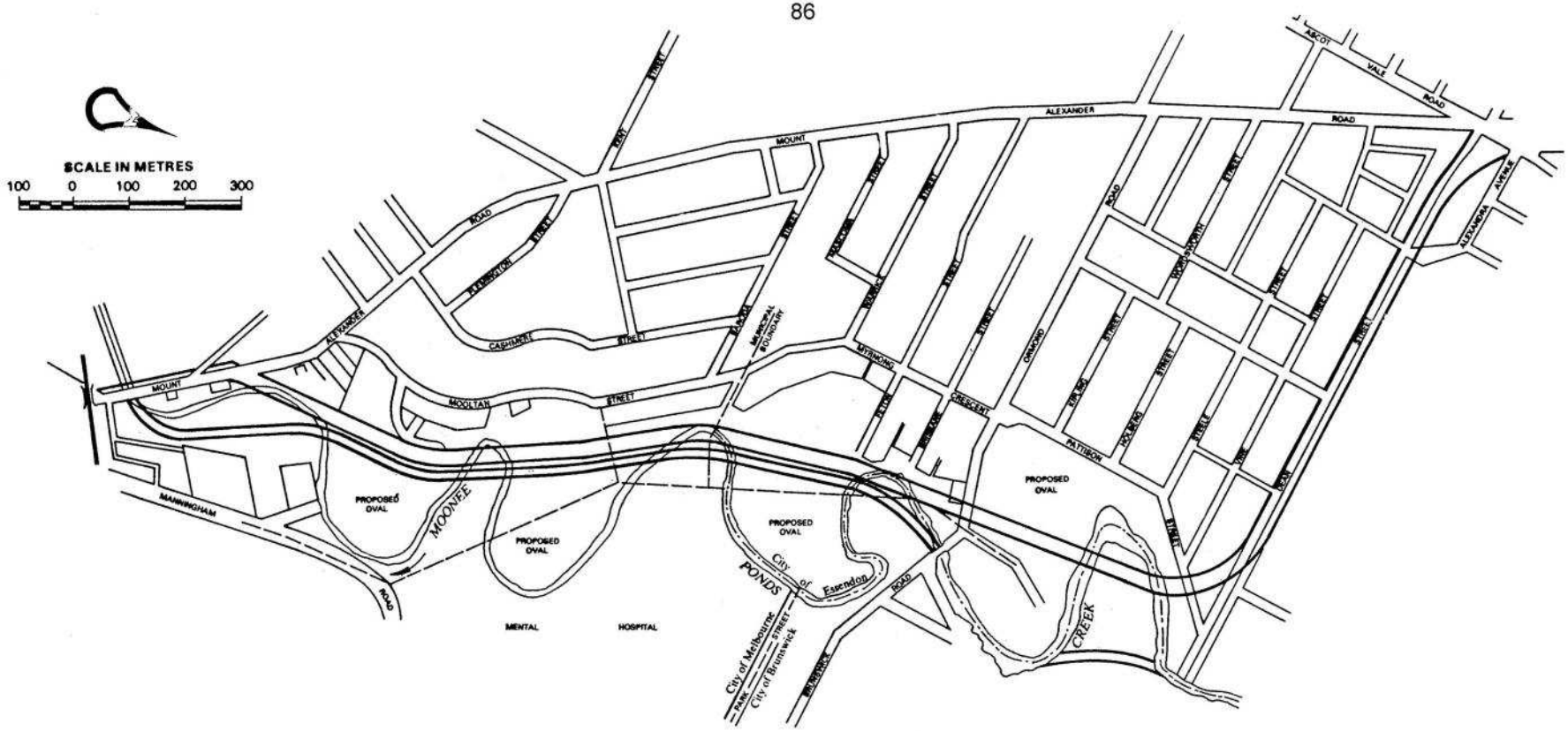
B Filling on the floodplain upstream of Flemington Road



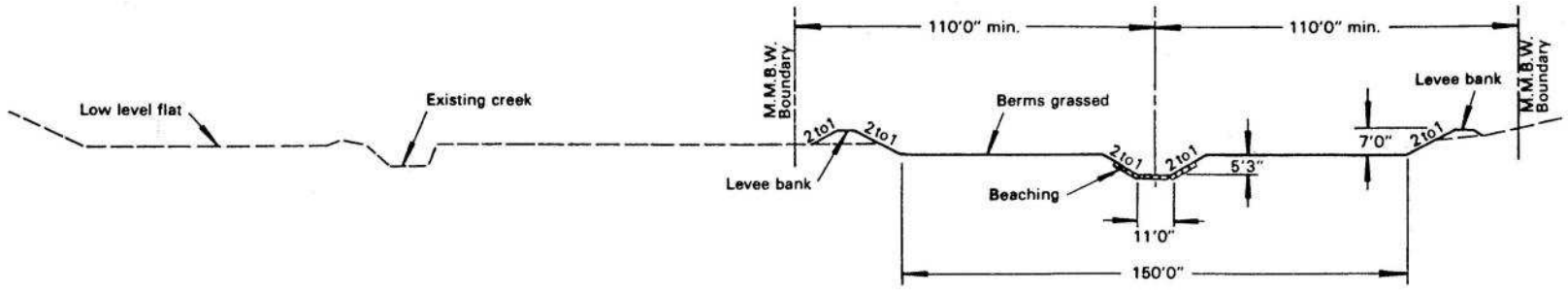
C Flooding of the flats upstream of Flemington Road
"Source: **The Argus** of 27 February 1946"

D Flooding on Mt Alexander Road
"Source: **The Argus** of 27 February 1946"

PLATE 5-17 The February 1946 Flood: Flooding immediately upstream of Flemington Road



A-LOCALITY PLAN



B-TYPE CROSS SECTION

PROPOSED CREEK REALIGNMENT BETWEEN FLEMINGTON ROAD AND ORMOND ROAD

Figure 5-18

higher, and severe flooding would have occurred along the lower reaches of the creek.

5.2.5 Remedial Measures. In his report on the September 1960 flood, the Board of Works Executive Engineer made a number of observations and recommendations with regard to possible remedial measures. He noted that by raising the levee banks below the Flemington Road Bridge by two to three feet a discharge of 7 000 cusecs could be accommodated for a cost of between £85 000 to £100 000. He also noted that any additional increase in capacity could only be achieved by widening and concrete-lining the channel, but pointed out that this would necessitate the raising of a number of bridges and require the acquisition of adjoining land which would add considerably to the cost of the project. To provide for the ultimate capacity of 13 000 cusecs that it was envisaged would be required in fifty to one hundred years time was, in the opinion of the Executive Engineer, *"impracticable if not impossible"*.

The Executive Engineer suggested that flows could be restricted to 7 000 cusecs by the construction of retarding basins within the catchment, and identified three potential sites : at Jacana in the central part of the basin, upstream of Westmeadows Township, and on Yuroke Creek (see Section 6).

The remedial measures that could be implemented along Moonee Ponds Creek were constrained by the limited funds available, and had to be considered along with proposals for improvement works along other Metropolitan watercourses. Bearing this in mind, the Board's Engineer-in-Chief made the following recommendations in order of priority :

(a) that improvement works should immediately be carried out near Flemington Road Bridge,

(b) that bank protection works should immediately be undertaken at selected sites upstream of Ormond Road [see Section 5.1.3],

(c) that the necessary land should be acquired at the three retarding basin sites, although it was considered that there was no urgency to acquire the land at the Westmeadows [Tullamarine] *and Yuroke Creek* [Broadmeadows] *sites,*

(d) that the Jacana Retarding Basin should be designed and constructed.

The Engineer-in-Chief recommended that the tidal section below Macaulay Road should not be dredged because previous experience indicated that such action was not justified for flood control purposes and was undesirable for health reasons.

In order to alleviate flooding on Mt Alexander Road, the creek was realigned immediately upstream of Flemington Road Bridge in early 1962 at a cost of approximately £30 000 (Plate 5-19; Fig 5-19A). The bed of the constructed channel was 80 ft wide and contained a 6 ft wide concrete-lined centre channel (Fig 5-19B).

The design discharge for the channel is calculated to have been 9 800 cusecs (278 cumecs), which is estimated to have been approximately two-thirds of a one in ten-year flow.

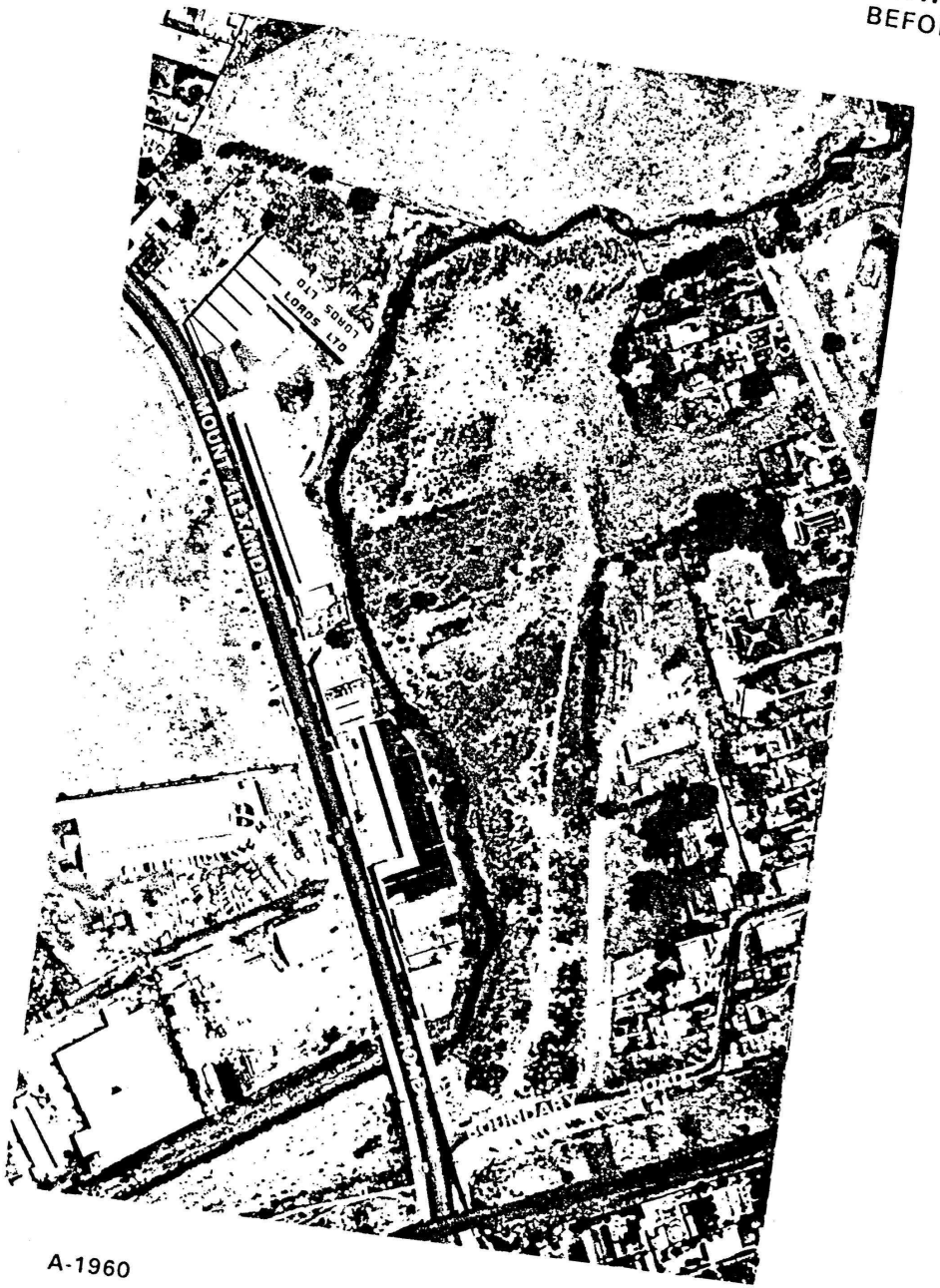
In order to prevent the sides of the centre channel from being undermined, a four-foot wide strip of concrete was laid along the berms on either side of the channel, while to prevent the banks of the main channel from being eroded, the bank toes were lined with bluestone pitchers (Fig 5-19B). It was assumed that the velocity of flow over the berms would be sufficient to prevent siltation, although it was appreciated that floodwaters would head up at Flemington Road Bridge because of the sharp bend in the channel at

A Floodwaters at the end of Kernan Avenue, Pascoe Vale. The men were attempting to rescue two stranded sheep

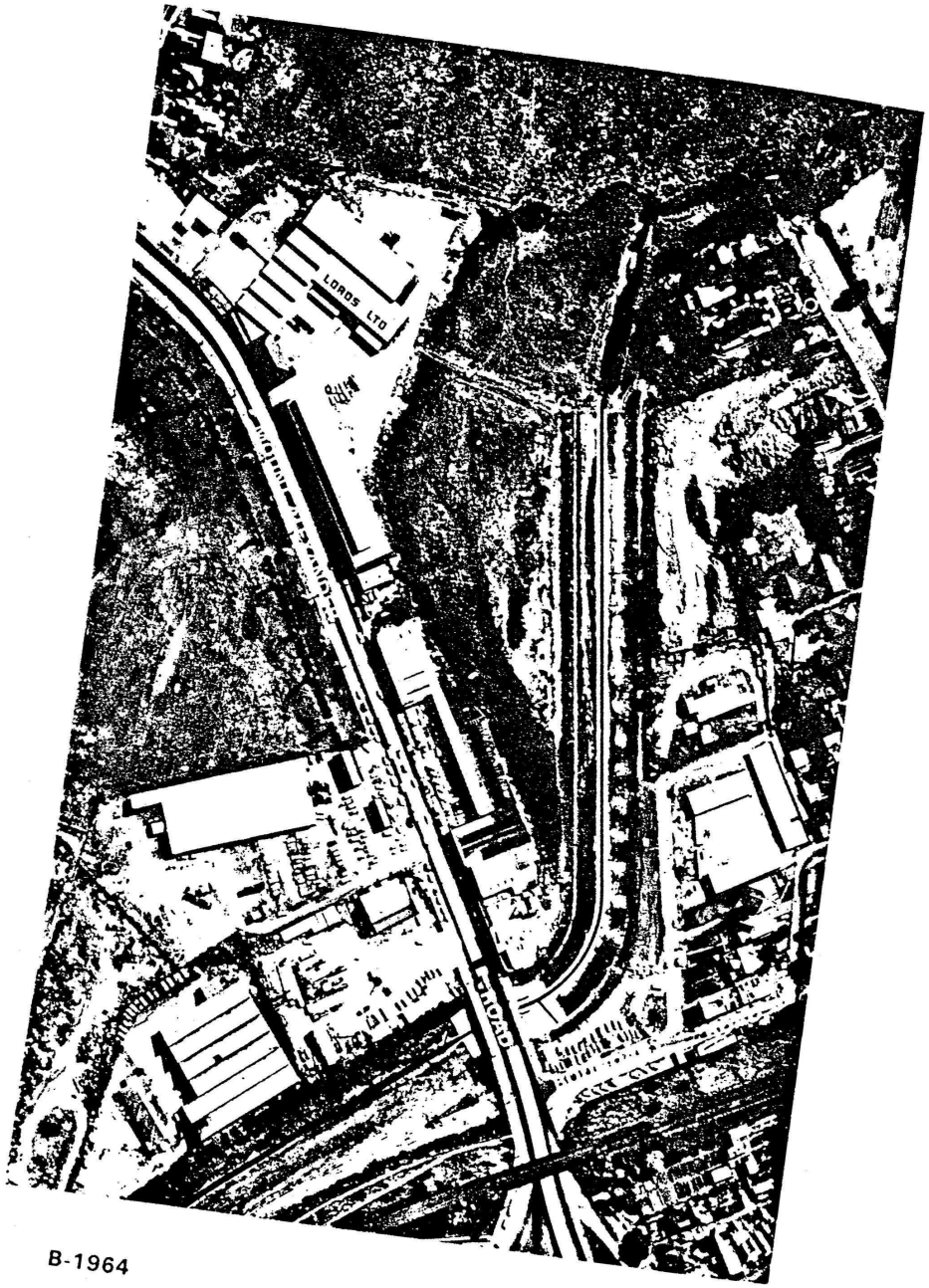
B Flooding on Mt Alexander Road

PLATE 5-18 The September 1960 flood
"Source: **The Age** of 19 September 1960"

BETWEEN MOUNT ALEXANDER ROAD AND DELHI COURT
BEFORE AND AFTER CONSTRUCTION

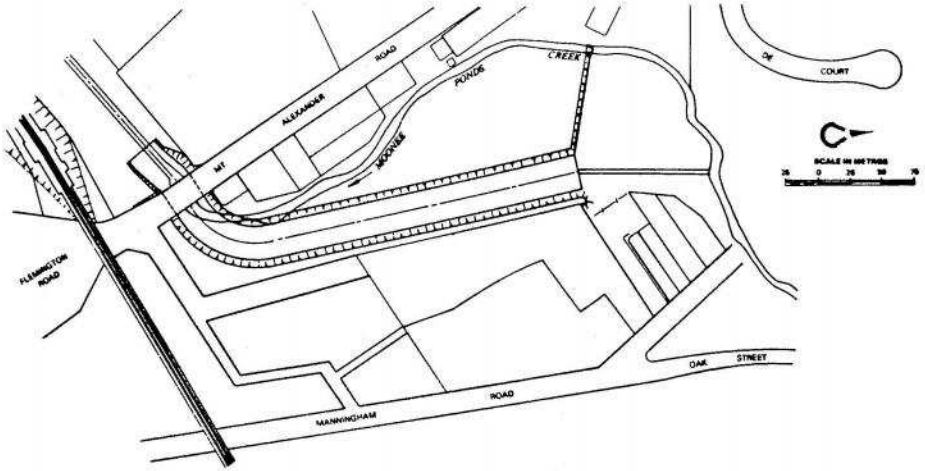


A-1960

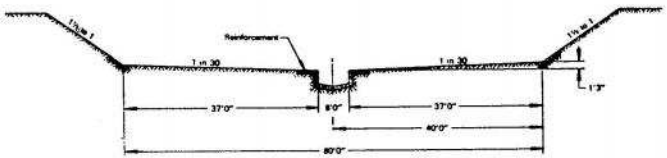


B-1964

METRES 50 25 0 50



A- LOCALITY PLAN



B- TYPE CROSS SECTION

IMPROVEMENTS BETWEEN FLEMINGTON ROAD AND DELHI COURT

Figure 5-19

this locality (Plate 5-19B). In order to minimise this problem and to prevent siltation from occurring on the inside of the bend under the bridge, timber training walls were constructed against the bridge piles to divert flows more evenly under the bridge (Plate 5-20).

Between the Flemington Road and Macaulay Road Bridges, accumulated deposits of silt were removed from the berms in order to restore the design capacity of the channel. It was hoped that a grass cover could be rapidly established on the leveled berms, and that once established the berms would look aesthetically pleasing and be relatively easy to maintain.

5.2.6 The 1963 Floods. Quite serious flooding occurred along parts of Moonee Ponds Creek on 28/29 January and 13 July 1963. On 28/29 January between five and six inches (127 and 152 mm) of rain fell over much of the basin. The levee banks were not overtopped, but some areas downstream of Flemington Road were flooded by stormwater runoff. Flooding was exacerbated along Stubbs Street by the failure of an old four-foot diameter underground brick drain in Parsons Street.

Rainfall was heaviest during the January storm over the central-eastern part of the Moonee Ponds Creek basin, and flooding occurred along the lower reaches of Westbreen Creek. Floodwaters overtopped the entry structure to the newly constructed underground section of the drain immediately upstream of Railway Parade, breached a protective levee, and flowed at high velocity towards Railway Parade. Several shops and a hotel were flooded at the intersection of Railway Parade and Gaffney Street, and damage was estimated to have been in excess of £3 000.

The July flood was generally more severe. Floodwaters just overtopped the levee banks downstream of Flemington Road at a number of points, and sand bags had to be used to stem the flow. Local residents complained that the banks had not been maintained, and had been worn down in a number of places (Ref 5).

According to a report by the Melbourne City Council the flood problem downstream of Flemington Road Bridge was aggravated by a number of factors :

- by Board of Works sewers back-flooding during times of peak rainfall, the problem being compounded by the fact that the Board had sealed some of the sewer manholes,
- by blockages in stormwater drains that discharged into the Moonee Ponds channel,
- by filling - the policy of requiring all new buildings to have floor levels above flood level resulted in reduced storage area and higher water levels in the streets.

A further problem was encountered during the July flood. At the height of the storm the No 2 pump at the Macaulay Pumping Station failed, and according to a local newspaper report (Ref 6) it took the SEC four and a half hours to repair the fault. As a result of the failure, water banked up in Bent, Hardiman and Chelmsford Streets flooding a number

PLATE 5-20 The timber training walls on the upstream side of Flemington Road Bridge

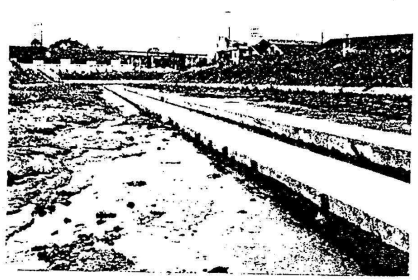
of houses (Plate 5-21). Some forty houses were inundated during the July flood, and a residents' action group, the Kensington-Macaulay Ratepayers' and Citizens' Advancement Association, was formed to press for damages for losses incurred (Ref 5).

There was considerable public pressure for flood alleviation works to be carried out. The Melbourne City Council installed three additional pumps, two at the Macaulay Road/Stubbs Street Station and one at the Macaulay Road/ Langford Street Station, and the Maintenance Branch of the Board of Works built up the low spots on the western levee bank between Macaulay Road and Arden Street, although it was noted that the low spots were a foot above the design flood level of the 5 000 cusec scheme. The Board did not respond to calls to raise the levee banks (see, for example, Ref 7), which would have been extremely costly, but maintained that the problem would be considerably alleviated when a retarding basin that was planned had been built at Jacana in the middle part of the basin.

The floods caused a very different problem along the improved section of the creek immediately upstream of Flemington Road Bridge. The new improvement works prevented extensive flooding during the 1963 floods (the flood level during the January flood was four feet lower than during the 1960 flood), but together with other floodflows eroded the edges of the lined centre channel (Plate 5-22). Frequent flushing flows of relatively high velocity had prevented grass from growing on the berms, with the result that they were progressively eroded. In addition, erosion also occurred at the entry to the new channel where the sudden drawdown of flood flows resulted in considerable turbulence. It was recommended that as it appeared unlikely that grass could be permanently established on the berms, it would be advisable to concrete-line them at an estimated cost of £20 000. It was subsequently noted, however, that a similar problem had occured on Elster Creek, and that there the eroded sections had been filled with rock over which silt had been deposited and a grass cover established. It was decided to treat the eroded section immediately upstream of Flemington Road in a similar manner. The work was completed in 1964 at a cost of £2 000.

In the meantime, the local councils were pressing for the creek to be completely realigned between Flemington Road and Ormond Road so they could fill and develop the land that they owned for recreational purposes. The Town Clerk of the City of Essendon informed the Board of Works on 22 July 1962 that at a council meeting held on 16 July 1962, the following resolution had been passed:

PLATE 5-21 Flooding at Bent Street, Kensington, July 1963
"Source: **The Age** of 15 July 1963"



A Eroded side of the concrete-lined centre channel

B The entry to the lined centre channel

C The view of the improved channel looking upstream from Flemington Road.
Note the swampy nature of the berms

PLATE 5-22 The improved section upstream of Flemington Road Bridge in mid 1963

That the Melbourne and Metropolitan Board of Works be advised that it is the Council's intention to fill the area of land on the Moonee Ponds Creek, south of Ormond Road Bridge, owned by the Essendon Council, and requests that the Board straighten the Creek to allow the Council to carry out the proposed work.

In January 1964, at a meeting held between representatives of the Board of Works and the City of Melbourne, the latter urged that the creek be realigned to enable the existing watercourse and the adjoining land owned by the council near Manningham Road to be filled and developed.

The question of the realignment of Moonee Ponds Creek between Flemington and Ormond Roads was finally resolved when the Tullamarine Freeway was constructed during the late 1960s. The Freeway was constructed on the land that had been acquired for the realignment of the creek, and a new channel for Moonee Ponds Creek was constructed immediately west of the Freeway. Details of the drainage works associated with the Tullamarine Freeway are given in Section 7.

5.3 WORK ON TRIBUTARIES

5.3.1 Introduction. During the war years and the immediate post-war years, relatively few houses were built within the Moonee Ponds Creek basin, but during the 1950s and early 1960s extensive residential development took place in parts of Essendon, Coburg and Broadmeadows. As reference to Figure 1-5 will show, the central part of the basin between Bell Street, Coburg and Camp Road, Broadmeadows, was developed between 1946 and 1960, and quite extensive areas in the Municipality of Broadmeadows have been developed since 1960. The existing drainage network was generally unable to cope with the increased volumes of runoff generated, or with the higher and more frequent flood flows that occurred, with the result that flooding and erosion became recurrent problems along many of the tributary watercourses. In addition, there were frequent complaints concerning the offensive nature of sullage waters that were discharged into surface drains and creeks, and about the poor state of many of the unmade streets. During wet weather some of these streets became little more than quagmires (Plate 5-23). It became obvious that drainage improvement works would have to be undertaken, and in most localities the problems were solved by undergrounding.

As drainage problems arose in an area, local residents and Progress Associations usually complained to their councils and MLAs, and to the Board of Works. A recurring request in letters received by the Board of Works was for the drainage to be undergrounded in order to eliminate flooding and erosion, to ensure access to properties, to eliminate the open steep-sided watercourses which were considered to be a hazard to children, and to remove the polluted waters which were considered to be a potential health hazard. Extracts from typical letters are quoted below :

From a local Progress Association concerning the Cardinal Road Drain :

Although drainage is necessary in the area we strongly condemn an open drain which has not been faced and will be scoured even deeper by the excess water during wet weather.

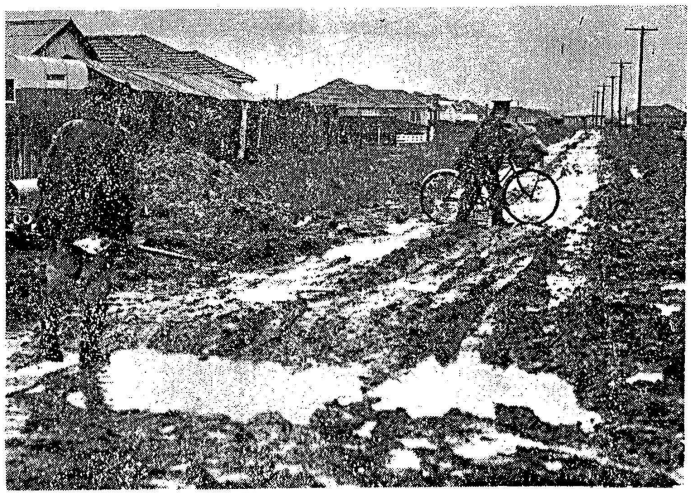


PLATE 5-23 An unmade road: James Street, Fawkner
"Source: **The Herald** of 17 September 1960"

We also note that no fence has been erected alongside the drain and that no crossing has been provided at Melbourne Avenue, Glenroy. As there are numerous children in the area we suggest that this matter receive your early attention. We would also appreciate your advice as to why the drain was not undergrounded by use of concrete pipes.

From the Town Clerk of the City of Broadmeadows concerning the Widford Road Drain :

I am directed by Council to request that action be taken to underground the open drain in Eleanor Street, Jacana, for its full length to the point where it discharges into Moonee Ponds Creek.

Council has received complaints from the School Committee regarding the foul state of this drain and Council's Health Inspector has reported that it is a harbourage for rats.

From a local MLA concerning the Chapman Avenue Main Drain :

At the request of the Oak Park Progress Association and a number of local residents, I write to direct your attention to the very urgent need for this drain to be placed underground. As you know the drain crosses the Oak Park district from north east to south west and collects effluent on the way. This has been aggravated by the erection of a large bakery, adjacent to the railway line at Devon Road and local residents are complaining very bitterly at the nuisance which this drain now causes.

Would you be kind enough to advise me whether there is any prospect of this drain being placed underground or an amount being placed on the estimates in the near future for this work.

Where deemed appropriate, and as funds permitted, the Board of Works agreed to underground sections of several watercourses. The undergrounding of drainage in residential areas was standard engineering practice at the time, and was seen as a permanent solution to many of the problems that had arisen. The location of drainage improvement works undertaken by the Board between 1941 and 1967 is shown in Figure 5-20. Descriptions of the various projects are given below, while detailed location plans and details of the works are summarised in Appendix C.

5.3.2 The Improvement Works

(a) **Royal Park Drain, Melbourne.** The only constructional work of any significance that was undertaken along the Royal Park Drain between 1941 and 1967 was the extension of the culvert under Popular Road (Fig 5-20; Appendix C). The culvert was extended on the downstream side to allow the road to be widened. The work was undertaken in mid 1958 and cost £319.

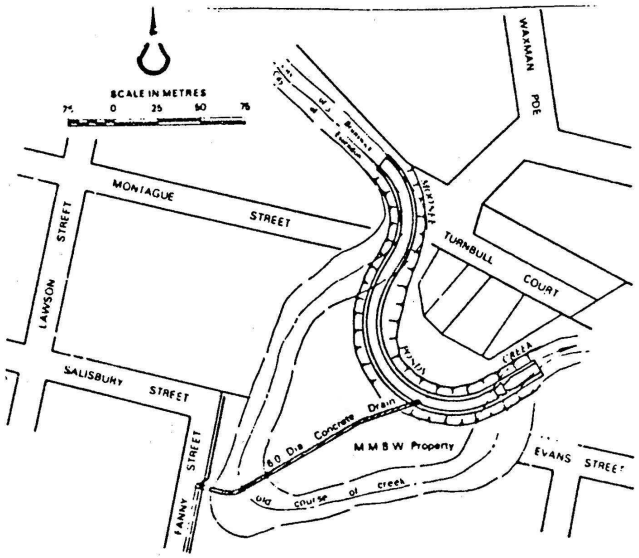
(b) **Bent Street Main Drain, Essendon.** The deviation of Moonee Ponds Creek at Waxman Parade in 1962 [see Section 5.3.1(d)] necessitated the extension of the Bent Street Main Drain (Figs 5-20 and 5-21). The extension, which consisted of a 200-foot length of 6-foot diameter concrete pipe, was connected to the existing 6-foot diameter brick drain along Fanny Street. Work on the extension was completed in August 1962 at a cost of £9 013.

(c) **Melville Main Drain, Coburg and Brunswick.** The middle reaches of Melville Creek were undergrounded between 1930 and 1940 (see Section 4-6 and Figure 4-12). As development proceeded within the catchment of Melville Creek, it became apparent that improvement works would be required along some of the upper and lower reaches.

In 1941, the Coburg Council drew the attention of the Board of Works to the occurrence of flooding in Soudan Street, immediately upstream of the existing undergrounded section of Melville Creek. The Board's Engineer of Main Drainage noted that upstream of Bell Street the drainage from an area of some 500 acres *"has to be carried by what are no more than slightly enlarged street channels"*, which he considered to be completely inadequate, and forecast that the situation would deteriorate further as development proceeded. The problem did become more acute, and in 1947-48 the Board of Works extended the existing underground drain from Bell Street northwards to Daphne Court (Fig 5-20; Appendix C). For a short distance along Cramer Street, a rectangular reinforced concrete drain was installed, but along the rest of the section concrete pipes of varying diameter were laid.

The only other work undertaken along the upper reaches of the Melville Main Drain between 1941 and 1967 was the construction in 1959 of an 80-foot section of pitched drain leading into the existing underground drain at Anketell Street (Fig 5-20). The pitched drain, and the improved entry pit that was constructed at the same time, were installed to alleviate localised flooding from stormwater runoff.

Between 1938 and 1946, the Board of Works received several complaints about erosion along the lower reaches of Melville Creek downstream of McLean Street Bridge. In 1926, the creek had been pitched under McLean Street and for a short distance upstream. At the same time a weir was constructed below McLean Street Bridge to reduce velocities and retard erosion (see Fig 4-14). However, the weir did not prevent severe erosion from taking place immediately downstream of it. In 1946, the Board's Sewerage Committee recommended that a culvert should be installed at McLean Street. The City of Brunswick requested that the proposed



LOCALITY PLAN

BENT STREET DRAIN: EXTENSION TO WAXMAN PARADE DEVIATION

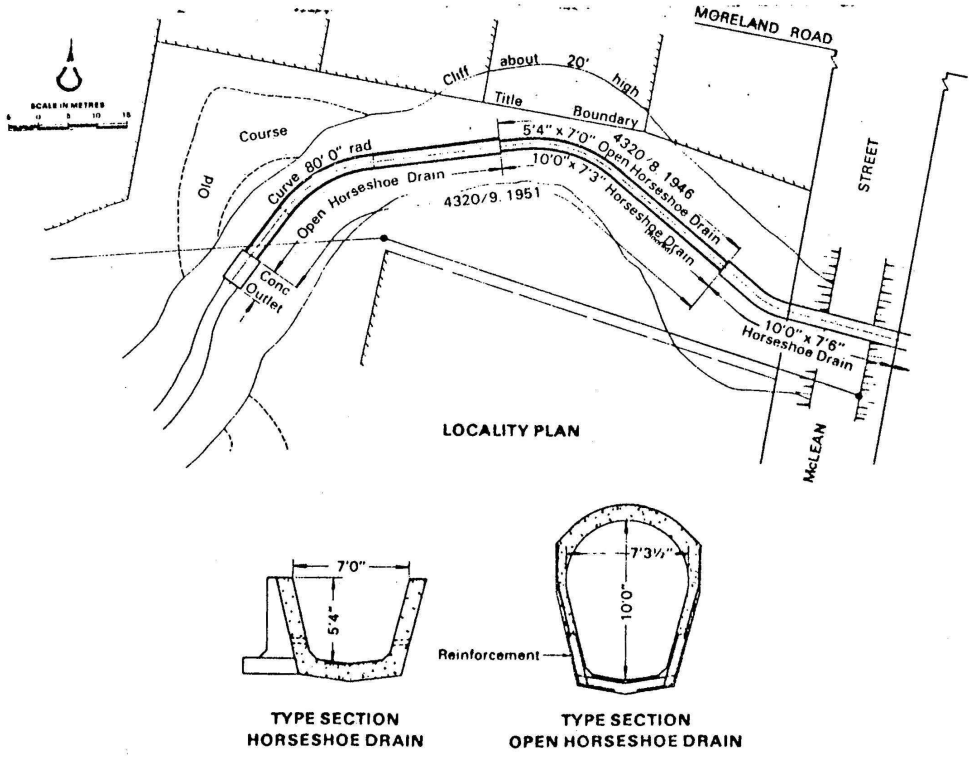
Figure 5-21

work should be extended downstream by fifty to sixty feet to protect a property that was being eroded. The Board agreed to the request, and recommended that the work should be extended 110 feet downstream from the culvert.

The work was undertaken in 1947 and cost £2 700. A 10 ft by 7 ft 6 in horseshoe drain was constructed under McLean Street, and an open horseshoe drain was built downstream of the bridge (Fig 5-22). The open section was designed so that it could be roofed at a later date if required. Immediately downstream of the culvert under McLean Street, the batters above the concrete were lined with pitchers.

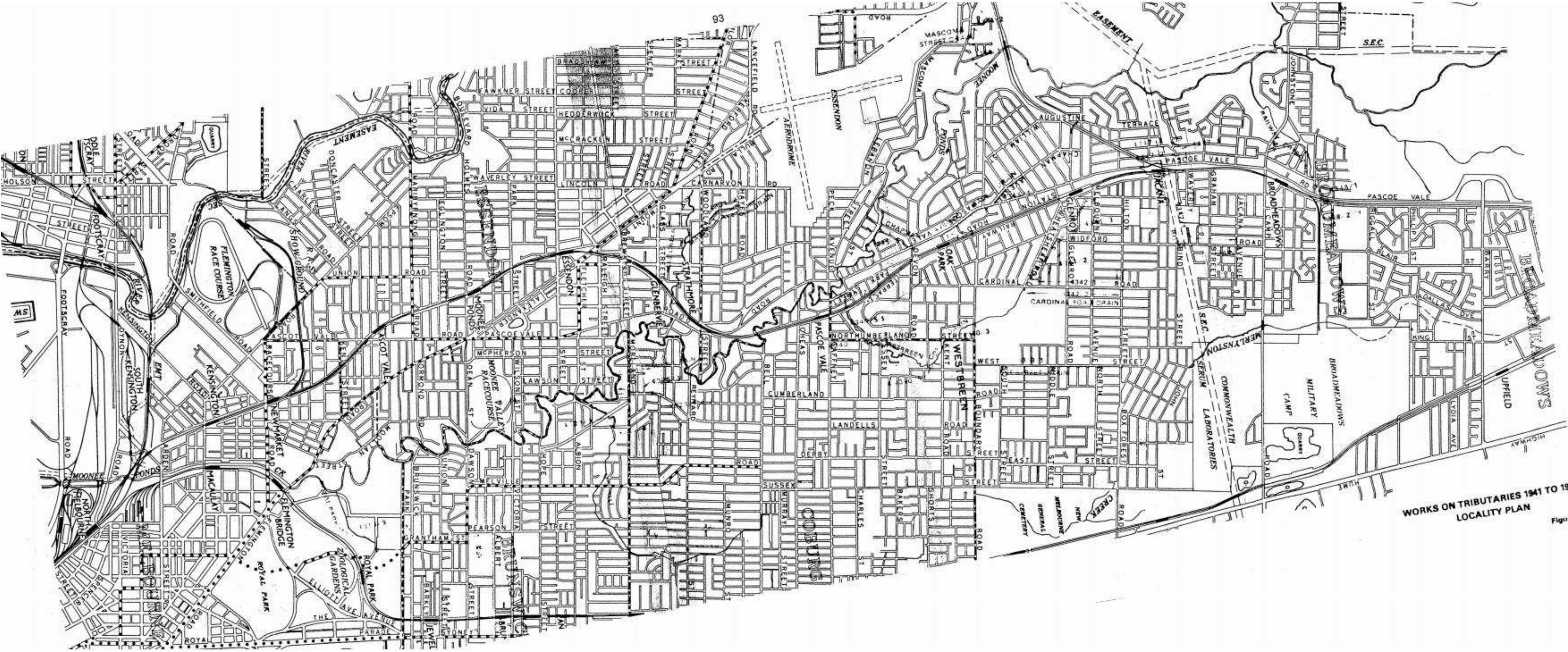
The works solved the erosion problem in the vicinity of the McLean Street Bridge, but erosion continued unabated further downstream. In 1950, the City of Brunswick offered to supply the labour if the Board was prepared to extend the improvement works downstream. The Board accepted the Council's offer, and the extension was undertaken in 1951 at a cost of £5 461. The existing open horseshoe drain was roofed, and an additional 190-foot long section of open horseshoe drain was constructed (Fig 5-22).

(d) **Coonans Road Drain, Brunswick and Coburg.** The section of the Coonans Road Drain that is located within the City of Brunswick was undergrounded in 1928, and the section within the City of Coburg between Moreland Road and Woodlands



MELVILLE MAIN DRAIN WORKS AT McLEAN STREET

Figure 5-22



WORKS ON TRIBUTARIES 1941 TO 19

LOCALITY PLAN

Figu

Avenue in 1946-47 (Figs 4-12 and 5-20). The latter project was financed by the Board of Works, but was undertaken by the City of Coburg.

As residential development proceeded to the north of Woodlands Road, drainage problems arose. Between Woodlands Road and Reynard Street, the watercourse was ill-defined, and floodwaters spread out over the valley floor. In late 1949, complaints were received from local residents concerning flooding and the foul state of the watercourse. Building construction, however, continued apace, and by 1951 the watercourse had further deteriorated, particularly in the Reynard Street and Winifred Road areas. The Board's Planning Engineer for Sewers and Main Drains visited the latter area and commented that *"The streets are not made, and the drain having filled up, water spreads over the area forming an insanitary quagmire, receiving drainage from an almost fully built on area of 150 acres upstream"*.

Remedial measures were clearly urgently needed, and in May 1952 the Board of Works excavated an open earth-lined channel from Reynard Street to the intersection of Parkstone Avenue and Coonans Road (Fig 5-20; Appendix C). However, the works did not prove to be successful. By January 1953, the channel was badly eroded; the gardens of some allotments were being undermined, access to several allotments had been blocked, and a number of gas and water mains had been uncovered. The Board decided that it would be desirable to underground this section of the drain, and work commenced on the project in May 1953.

(e) **Five Mile Creek and Magdala Avenue Main Drains, Essendon.** The Magdala Avenue Main Drain, from Cameron Road to its junction with Five Mile Creek, was undergrounded by the Board of Works in 1948 (Fig 5-20). The drain was undergrounded for the specific purpose of conveying runoff from Essendon Airport.

A pitched channel was constructed along much of the length of Five Mile Creek in pre World War Two years (see Plate 4-15). It was, however, of limited capacity, and as development proceeded within the catchment flooding and erosion became progressively more problematical, with the result that there were frequent complaints from local residents. A relatively short section of the creek was undergrounded immediately downstream of Napier Street in 1959 to enable a block of private land to be subdivided, but it was not until 1966-67 that the reaches upstream and further downstream of Napier Street were undergrounded. The flooding of several houses in Napier Street during July 1963 provided the impetus for these works. The section of the creek from below Napier Street to just west of the Essendon-Broadmeadows railway line was undergrounded in 1966, and the section between Napier Street and Woodlands Park in 1967 (Fig 5-20; Appendix C). At Woodlands Park, the new drain was connected to an existing underground drain that had been installed by the Board of Works in 1929 to alleviate drainage problems on Bulla Road and Woodlands Street.

(f) **Westbreen Creek and the Acacia Street, Cardinal Road and West Street Drains, Coburg and Broadmeadows.** The Westbreen Creek sub-basin was developed for residential purposes between 1946 and 1960. In the northern part of the basin an extensive area was developed by the Housing Commission of Victoria. A familiar sequence of events followed: as development proceeded, flooding and erosion became more problematical, and sullage waters rendered the watercourses foul-smelling and unsightly. There were numerous complaints, and between 1952 and 1967 the Board of Works constructed underground drains along parts of Westbreen Creek and some of its upper tributaries (the Acacia Street, West Street, and Cardinal Road Drains - Fig 5-20; Appendix C).

Drainage improvements were most urgently required in the upper parts of the basin where the watercourses were generally ill-defined. There was a complaint as early as 1940 from a resident on Glenroy Road concerning the *"foul and unhealthy"* condition of the creek, and in 1946 the Shire of Broadmeadows forwarded a complaint to the Board of Works from the Glenroy Progress Association about the state of one of the upper tributaries (the Acacia Street Drain). The situation was improved between Glenroy Road and Blenheim Street in 1948 when the Shire of Broadmeadows installed 27-inch pipes (supplied by the Board of Works) along the bed of the creek.

Housing construction, particularly by the Housing Commission, continued apace, and in 1953 a number of Glenroy ratepayers forwarded a petition to the Board of Works complaining about the state of the Acacia Street Drain. They complained that the stench from stagnant water in the drain was overpowering, that the pools were breeding grounds for mosquitoes, that the creek frequently flooded, and that the roads in the area turned into bogs when it rained. The ratepayers requested that the drain should be undergrounded, and were supported by the Shire of Broadmeadows. In late 1953, the Board agreed to underground the Acacia Street Drain from Cardinal Road to Glenroy Road (Fig 5-20), and decided to replace the 27-inch pipe upstream of Glenroy Road with a 36-inch diameter pipe.

Residential development in the upper parts of the basin also necessitated the construction of drains along Cardinal Road and West Street (Fig 5-20) to alleviate problems similar to those described for the Acacia Street Drain. An open earth drain was excavated along Cardinal Road in 1954, and a small pipe was laid along the invert to convey sullage waters. A number of timber drop structures, the downstream sides of which were protected with rock spalls, were built along the drain to prevent erosion, but proved to be unsuccessful. The Broadmeadows Council and local residents pressed for the drain to be undergrounded, and this was undertaken by the Board of Works in 1956-57. The West Street Drain was undergrounded in 1955 for virtually the whole of its length.
The undergrounding of the Acacia Street, Cardinal Road and West Street Drains transferred the drainage problems downstream to Westbreen Creek; sullage water was conveyed more rapidly to the creek, and flood flows became more frequent. In 1952, the Board of Works undergrounded the lower section of Westbreen Creek between Park Street and Railway Parade (Fig 5-20) to enable the Shire of Broadmeadows to construct roads and drains on the new Greengables Housing Estate. Between 1958 and 1967, other sections of Westbreen Creek were undergrounded for health reasons, and in order to prevent erosion and to alleviate flooding. In 1958-59, the section of the creek immediately south of the Northern Golf Club (Northumberland Road to Rhodes Parade) was undergrounded, the section immediately upstream of Railway Parade was undergrounded in 1962, and the sections between Pleasant Street and west of Northumberland Road were undergrounded in 1967 (Fig 5-20; Appendix C). In addition, a short section of the creek was straightened at Arndt Street in 1962-63 when the existing footbridge was replaced by a road and culvert.

(g) **Chapman Avenue Main Drain, Broadmeadows.** In April 1949, the Shire of Broadmeadows requested the Board of Works to underground the section of the Chapman Avenue Main Drain that ran along Pascoe Vale Road upstream of Victoria Street (Fig 5-20) because the existing open pitched drain was proving to be inadequate to convey runoff from the new residential subdivisions in the area. The Board of Works agreed to underground the section of the drain between Victoria and Prospect Streets, and added the project to its list of works in mid 1950. The work was eventually undertaken in early 1953.

In October 1955, residents living along Pascoe Vale Road requested the Board of Works to underground the Chapman Avenue Main Drain along Pascoe Vale Road

between Victoria Street and Winifred Street. Their request was supported by the Broadmeadows Council. The residents complained that the open drain was a menace to health, was rat infested, overflowed frequently in winter, and that as more houses were built the increased effluent load would make the drain even more unpleasant, particularly during the summer months. The Board agreed that this section of the drain needed to be improved, and undergrounded it in 1957-58.

The lower reaches of the Chapman Avenue Main Drain were undergrounded in 1963-64 (Fig 5-20). Erosion was the main problem along this steeply-graded section of the creek. The steeply sloping banks were being severely eroded at a number of sites, and fences were being undermined. The Board received complaints from a number of local residents and from the Oak Park Progress Association. The Board finally decided to underground this section of the drain because of the impending construction of the Moonee Ponds Creek Main Sewer. If the drain had not been undergrounded, the sewer crossing would have formed a four-foot high obstruction across the drain invert.

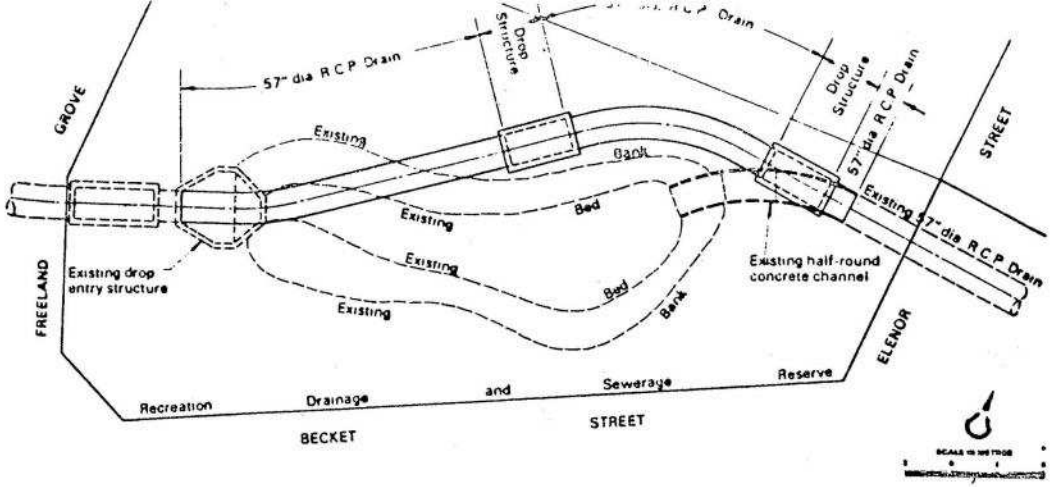
(h) **Mascoma Street Drain, Essendon.** Two sections of the Mascoma Street Drain were undergrounded between De Havilland Avenue and the Board's drainage limit in 1965-66 (Fig 5-20; Appendix C) at the time that residential subdivisions at Strathmore Heights were being developed. The City of Broadmeadows[1] was emphatic that the drain should be undergrounded. The council felt that an open drain would be a hazard to children, and would be aesthetically unacceptable. The underground drain was designed and constructed by the Board of Works, but was financed by the subdivider.

(i) **Widford Road Drain, Broadmeadows.** In 1955, the Board of Works undergrounded the section of the Widford Road Drain from Eleanor Street to Jacana Avenue (Fig 5-20) because it was felt that the existing watercourse would be unable to cope with runoff from the Housing Commission's proposed Broadmeadows Estate. The outlet was extended downstream along Eleanor Street in 1959 (Appendix C). In May 1961, the City of Broadmeadows requested that the undergrounding should be extended downstream to the junction with Moonee Ponds Creek because of the foul state of the watercourse, but no action was taken.

In August 1962 the Board of Works constructed a culvert and associated drop structure under Freeland Grove at cost to a subdivider (Fig 5-23). During the January 1963 storm, severe erosion occurred along the steeply sloping open section of the drain between Eleanor Street and the new culvert (Plate 5-24). Large rocks were scoured from the creek bed and deposited on the culvert grating, and a six- to eight-foot high embankment constructed by a subdivider was washed away. The Board agreed to underground this section of the drain at cost to a subdivider. The work was completed in August 1963.

(j) **Railway Crescent Drain, Broadmeadows.** In November 1958, the Housing Commission advised the Board of Works that it intended to proceed with the development of the Railway Crescent and King William Street areas, and requested that the Board should underground the drain along Railway Crescent. The Board agreed to the request, and undergrounded the drain along Railway Crescent between Dora Street and King William Street and under the Broadmeadows railway line and Pascoe Vale Road (Fig 5-20). Downstream of Pascoe Vale Road, a new open earth drain was excavated for a distance of 1 000 feet.

[1] The Strathmore Heights area was transferred to the City of Essendon on 19 May 1979 for council election purposes and on 1 October 1979 for all other purposes (see Victoria Government Gazette, No 82, p 2825).



WIDFORD ROAD DRAIN: IMPROVEMENTS AT FREELAND GROVE

Figure 5-23

A Looking upstream from Freeland Grove towards Eleanor Street

B Looking downstream towards the culvert under Freeland Grove

PLATE 5-24 Erosion along the Widford Road Drain in 1963

5.4 REFERENCES

1 Melbourne and Metropolitan Board of Works *Annual Reports* for the years 1947, 1952 and 1953.

2 Melbourne and Metropolitan Board of Works *Annual Report* for 1950.

3 Borrie, E F, 1947. *The future urban boundaries of Melbourne and the distribution of population therein.* MMBW; Melbourne.

4 Minutes of 1 366th Board Meeting of the MMBW, 2 April 1946.

5 *The Age,* 22 July 1963.

6 *The Northern Advertizer,* 18 July 1963.

7 *The Age,* 6 August 1963.