REPORT TO THE WESTERN AUSTRALIAN DEPARTMENT OF FISHERIES AND WILDLIFE

TYPHA AT LAKE FORRESTDALE

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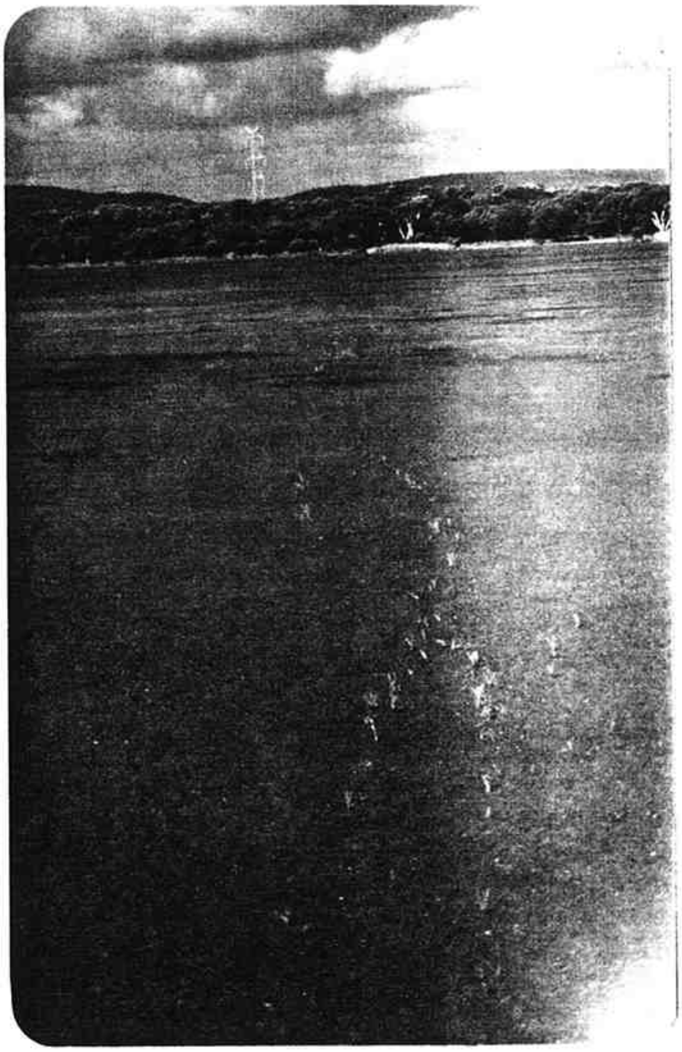


Photo 1 *Typha* seedlings growing in motorbike tracks, May 1984.

INTRODUCTION

(a) Forrestdale Lake

Forrestdale Lake is situated on the Swan Coastal Plain 22 km south of Perth and 7 km west of Armadale. To the north of the Lake is Armadale Road and to the west is Nicholson Road. The townsite of Forrestdale is situated on the north-eastern edge of the Lake, and the area is in the local authority of the Town of Armadale.

The Lake and some of the surrounding area is gazetted as a Nature Reserve and vested in the Department of Fisheries and Wildlife. The Lake is approximately 200 ha in size and is at an elevation of 25 m (A.H.D.). The water level of the Lake varies from dry to over 2 m. The Lakes water comes from rainfall and ground water inflow, there being little surface drainage in to it.

Forrestdale Lake is situated on three geological formations, Bassendean Sand, Muchea Limestone and Forrestdale Sandstone (Playford and Low 1972). The Bassendean Sands can be found along the shoreline and dunes around the Lake. These sands have been leached of calcium carbonate (Playford et al 1976). The lakebed has been described as "present day equivalent" of the Muchea Limestone ( ). describes the apperance of the Lakes' surface sediments as "a dark brownish grey organic rich mud for the first 5-10 cm, these then grade into a sticky, plastic, greyish white marl containing very little organic matter, or into sand". The third formation Forrestdale Sandstone, is present along the eastern margin of the Lake. The sandstone is a lithified sand, cemented by calcium carbonate which has precipitated out of the lakes water ( ).

Vegetation of the margins of the Lake are of four main groups; <u>Melaleuca</u>, <u>Typha</u>, <u>Baumia</u> and small reed species.

Forrestdale Lake is a very valuable wetland for waterbirds. This point being emphasized by the South-West Waterbird Project presently being under taken by the Royal Australasian Ornithologists Union for the Department. The December 1984 printout for the project (see Appendix 7) shows Forrestdale Lake to have the second highest number of waterbirds to be counted in any month on any wetland in the South-West, that being 23 000 birds. The Lakes importance is further emphasized in that it has the third highest number of species and fourth highest number of breeding species of all the wetlands surveyed to date during the project (RAOU unpublished data).

(b) Typha

Typha is a single genus of the family Typhaceae, having between 10 and 20 species across the world. In Australia the species have common names such as bulrush, cambungi and yangets; in other parts of the world names are used such as Cattails, reed mace, cattail-flag, flag tube, water torch and candlewick.

The principal species of the genus are; T. latifolia, T. angustifolia, T. domingensis, T. angustala, T. orientalis, and T. elephantina. Two of these species T. domingensis and T. orientalis, are native to Australia and a third T. latifolia has become naturalised in eastern Australia (Finlayson et al 1983). T. domingensis occurs through-out America, the West Indies, the Philippines, New Guinea and Australia. T. orientalis occurs in Japan, China, the Philippines, New Guinea,New Zealand and Australia. T. latifolia is widely distributed across the Artic to temperate regions of the nothern hemisphere (Morton 1975).

Across the world Typha causes problems in waterways, particularlyally in irrigation areas. Considerable research has been directed at increasing knowledge of the genus and developing management techniques. Most of this research effort has been on T. latifolia. In Australia, research is being undertaken on T. orientalis by the Irrigation Branch of the C.S.I.R.O. in Griffith, N.S.W. This work has been aimed at more effective control of Typha in irrigation areas and the species application to waste water treatment (Cary et al 1982).

Two species of Typha occur in the south-west of Western Australia, T. domingensis and T. orientalis. T. domingensis is native to the south-west, however there is some conjecture as to the status of T. orientalis. Several botanists suggest that this species was introduced around the time of European settlement in Western Australia (N. Marchant pers comm). Drummond (1842) wrote that Typha "is abundent in most of our lakes and rivers", and Moore (1884) wrote that Typha was "growing along fresh-water streams and the banks of pools". Several place names such as Yanchep and Lake Yangebup are derived from the abrigional name for Typha.

T. domingensis is now known at only a few locations on the Swan Costal Plain where as T. orientalis now occurs in most wetlands. T. orientalis appears to be an aggresive colonizer on wetlands with a muddy substrate, especially following disturbance such as by agriculture. Graphic examples of the rate growth of Typha stands are Herdsmans Lake and Benger Swamp, which were Melaleuca/Baumia/open-water wetlands before agricultural usage.

Typha plants produce a very large number of seeds. It has been estimated that seed production per inflorescence for *T. orientalis* is 336 000 (Prunster 1941), and estimates of its fertility vary from 67% (Prunster 1941) to 95% (Wilson 1977). Prunster (1941) estimates that a 1 m squared area of a mature *T. orientalis* stand can produce 6 000 000 fertile seeds. The seed is very light and pappus and may be transported many kilometres by wind (Finlayson et al 1983).

There appears to be little reference to the occurrence of *Typha* seedlings in the northern hemisphere. Gopal and Sharma (1983) state that "it is generally believed that *Typha* spp. reproduce only vegetatively and the seeds do not contribute to the multiplication and spread of the species". The scarcity of observations of seedlings of *T. latifolia* and *T. angustifolia* in the field has been attributed to autotoxic effects (McNaughton 1968), however this has been refuted by other workers (Sharma and Gopal 1978). In Australia, Prunster (1940) reported that he had not observed any *T. orientalis* seedlings in dense *Typha* stands and suggested that this could be due a lack of light. He did observe dense crops of seedlings in irrigation channels between November and April. Finlayson et al (1983) report *T. orientalis* seedlings can be found at any time of the year in the irrigation areas of N.S.W.

Considerable work has been carried out on the germination and early growth of *Typha*, most of it being on species that occur in the U.S.. Light intensity appears to be the major controlling factor of germination (Gopal and Sharma 1983). As such the turbity and cover from vegetation or dead leaves may reduce germination. Several authors have indicated that soil moisture and the water depth strongly influence the ability of *Typha* to establish and maintain itself (Penfound et al 1945; Bellrose and Brown 1941; Laing 1940; Giltz and Myser 1954). Bedish (1967) found that the seeds of a *T. latifolia/T. augustifolia* hybrid in the greenhouse required flooding for germination, however there was no difference in the percentage germination and growth rates between water depths of 2 cm and 15 cm. *T. latifolia* has been reported to germinate better under water than on moist filter paper (Morinaga 1926), and in up to 75 cm of water (Yeo 1964). Weller (1975) found that *T. latifolia* germination rates generally are inverse to water depth, with a maximum germination at 3 cm. He also found that seedlings 4-6 cm high can tolerate flooding to a depth of 50 cm. The optimum temperature for germination of *T. latifolia* is 30 C, and at temperatures less than 25 C both the percentage and rapidity of germination decreases rapidly (Sifton 1959).

Work in Australia on *T. orientalis*, showed that a dense crop of seedlings resulted from a pot submerged under 8 cm of water, a few seedlings under 30 cm and none under 60 cm (Prunster 1941). He also noted that seedlings did not occur in irrigation channals which had developed rushes (*Juncus* spp) and grasses (usually *Paspalum dilatatum*) at the waters edge.

Under favorable conditions *Typha* can spread quite rapidly by rhizomal growth. In a greenhouse experiment Yeo (1964) recorded a *T. latifolia* seedling growing rhizomes to a diameter of 3 m in a single season. The seedling produced 34 aerial shoots 45cm to 120 cm tall, 29 aerial shoots 10 cm to 45 cm tall, 35 aerial shoots 5 cm to 10 cm tall and 104 lateral buds.

HISTORICAL NOTES OF FORRESTDALE LAKE

Background information on Forrestdale Lake, particularlyularly prior to aerial photography, has been obtained from papers and news cuttings at History House, Armadale, and from Daphne Popham's book, First Stage South.

January 1885	First settlers at Forrestdale Lake. Alfred and William Skeet were granted a Special Occupation Licence for 100 acres adjoining Forrestdale Lake. They also had licences to cut and sell timber (Popham 1980).
1911	The drainage system at Forrestdale Lake was surveyed. Mont A. Taylor was contracted by the Jandakot Road Board to dig part of the inlet drain into the Lake. (History of Forrestdale, History House, Armadale)
1914	Severe drought. Rainfall said to be 18" (450mm) below average. (History of Forrestdale, History House)
1938 - 39	Drought (Popham 1980).
February 1939	Forrestdale Lake "cracked dry". Vehicles able to drive across the Lake bed (Skeet family photographs; Popham 1980).
Winter 1940	Forrestdale Lake in flood (Forrestdale History, History House; Popham 1980).
1958 - 1962	Two dry seasons occurred within this period of time (Popham 1980).
1958	Sailing Club opened at Forrestdale Lake by the Armadale Rotary Club.
1959	Sailing season abandoned due to lack of water.
1960	Sailing event held although the water level was low and weed was a problem.
1961 - 62	Sailing not possible.
1963	Meeting to be held, to re-open Sailing Club activities, on Friday 26 July 1963 due to good rains during the last year (Popham 1980; The West Australian, South Suburban Section 24 July 1963 pg.2).

Descriptions of the Lake prior to 1920;

1885	"...the rich swamplands were closely covered with huge paperbark trees, many thirty feet high, with a diameter of some three feet, the undergrowth beneath them dense with rough scrub and tanglewood creepers" (Popham 1980).

1902 Alfred Skeet disclosed that "he had seen the dust blow off its (Forrestdale Lake's) bed" to Lilian Dumsday who was "entranced" by the Lake. She had never seen it dry (Forrestdale History, History House).

1911 "When the weather was warm, their father would row them across the calm water to the sandy beaches where they picnicked and swam." (Forrestdale History, History House).

The above History of Forrestdale Lake gives some important background information to changes that have been occurring on this Lake over the last 80 years.

ESTABLISHMENT OF *TYPHA ORIENTALIS* ON FORRESTDALE LAKE

Aerial photography from the Department of Lands and Surveys was studied to ascertain when *Typha orientalis* became established on Forrestdale Lake. Vegetation maps have been drawn from these photographs to show the growth of *Typha* on the Lake over the last 20 years. The vegetation types mapped include, *Melaleuca* which makes the border of the Lake, *Baumea articulata*, *Typha orientalis* and a fourth group of the small reed species,grasses and herbacious plants. All aerial photography used for mapping were black and white with the exception of the 1984 map where the colour photography of 1983 was used as a base.

The earliest photography viewed was February 1948. No *Typha* was present on the Lake. Some small stands of *Typha* existed in the "South-west Swamp" just west of Forrestdale Lake. The west inlet drain into Forrestdale Lake goes through this swamp.

The dates of other aerial photography viewed which showed no evidence of *Typha* being present on the Lake were; July 1948, November 1953, May 1959, March 1961, October 1963 and April 1964. Figure 1 shows the vegetation on Forrestdale Lake in May 1959.

March 1967, one very small stand of *Typha* existed at the south end. No other stands of *Typha* could be detected.

May 1968, two small stands of *Typha* had established at the south end, one being the same as observed in 1967 only larger. The aerial photography shows Forrestdale Lake was full with water, it flooded into the *Melaleuca* on the west side. Due to this flooding only the taller reed species, *Baumea* and *Typha* were visible (see Figure 2).

June 1976, saw the next major growth of the *Typha* stands at the south end. *Baumea* and *Melaleuca* had become established in the open areas of the south-west corner. Some areas of the exposed shores were not covered by any vegetation and showed as "white" shores (see Figure 3).

August 1978, the *Typha* stand at the south end has continued to grow, *Typha* stands have begun to establish themselves at the north end. 'Small reed' species have established in large stands growing towards te centre of the Lake on the east side and to a lesser extent the north west side. This had not been observed in earlier aerial photography (see Figure 4).

June 1980, *Typha* has increased its distribution around the Lake indicating a comparitively high colonizing and growth rate over the last two years. *Typha* is now well established at the northern end although it does not appear to be very dense. The stand at the south end has continued to grow extending along the south- west shore. *Typha* stands have also been established on the west and east shores (see Figure 5).

Legend

Typha

B Baumea

Other Reeds, Grasses

Melaleuca

Drain

Scale

0 — 0·5 km

Figure 1 VEGETATION OF FORRESTDALE LAKE 1959

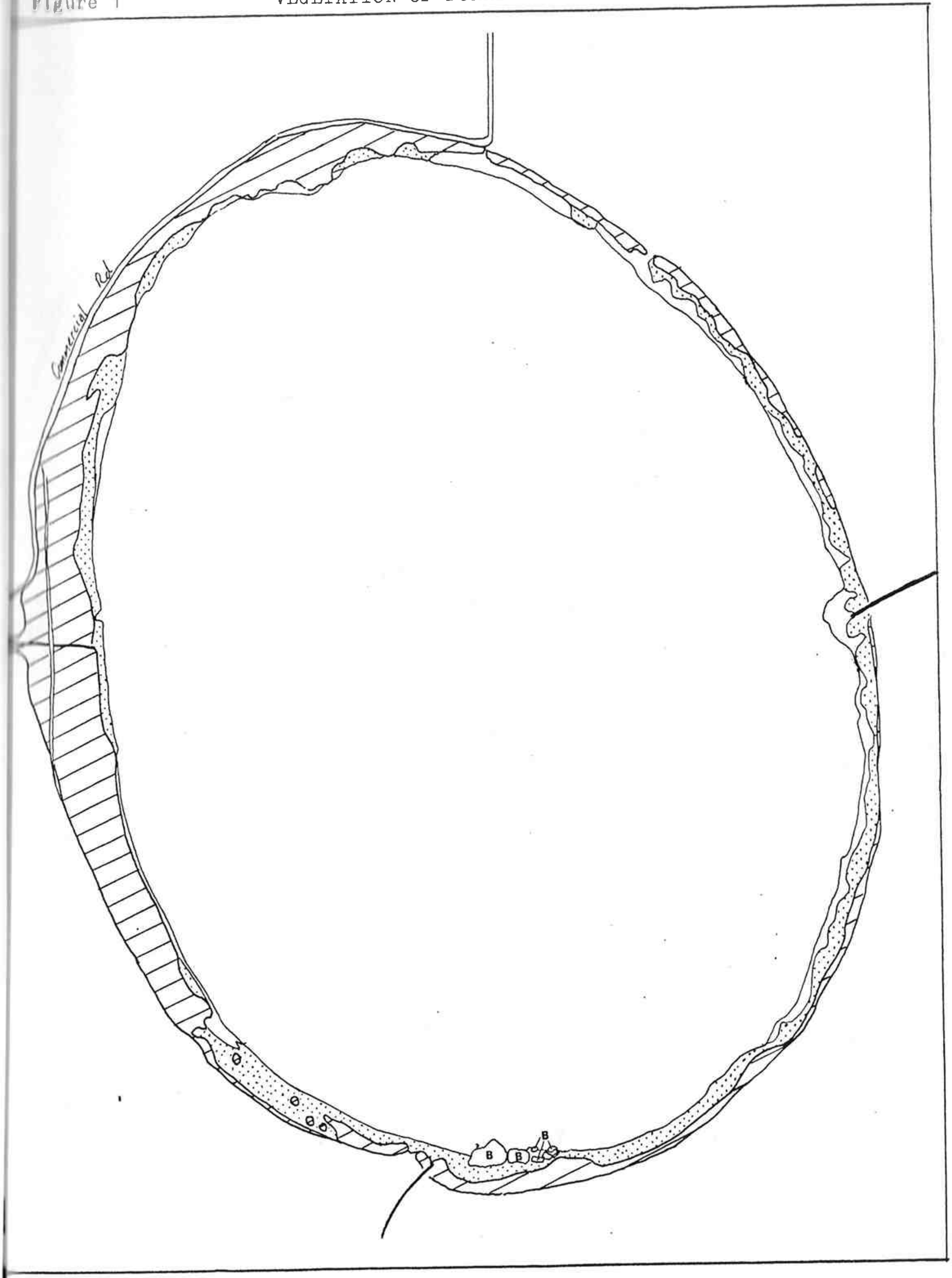


Figure 2 VEGETATION OF FORRESTDALE LAKE 1968

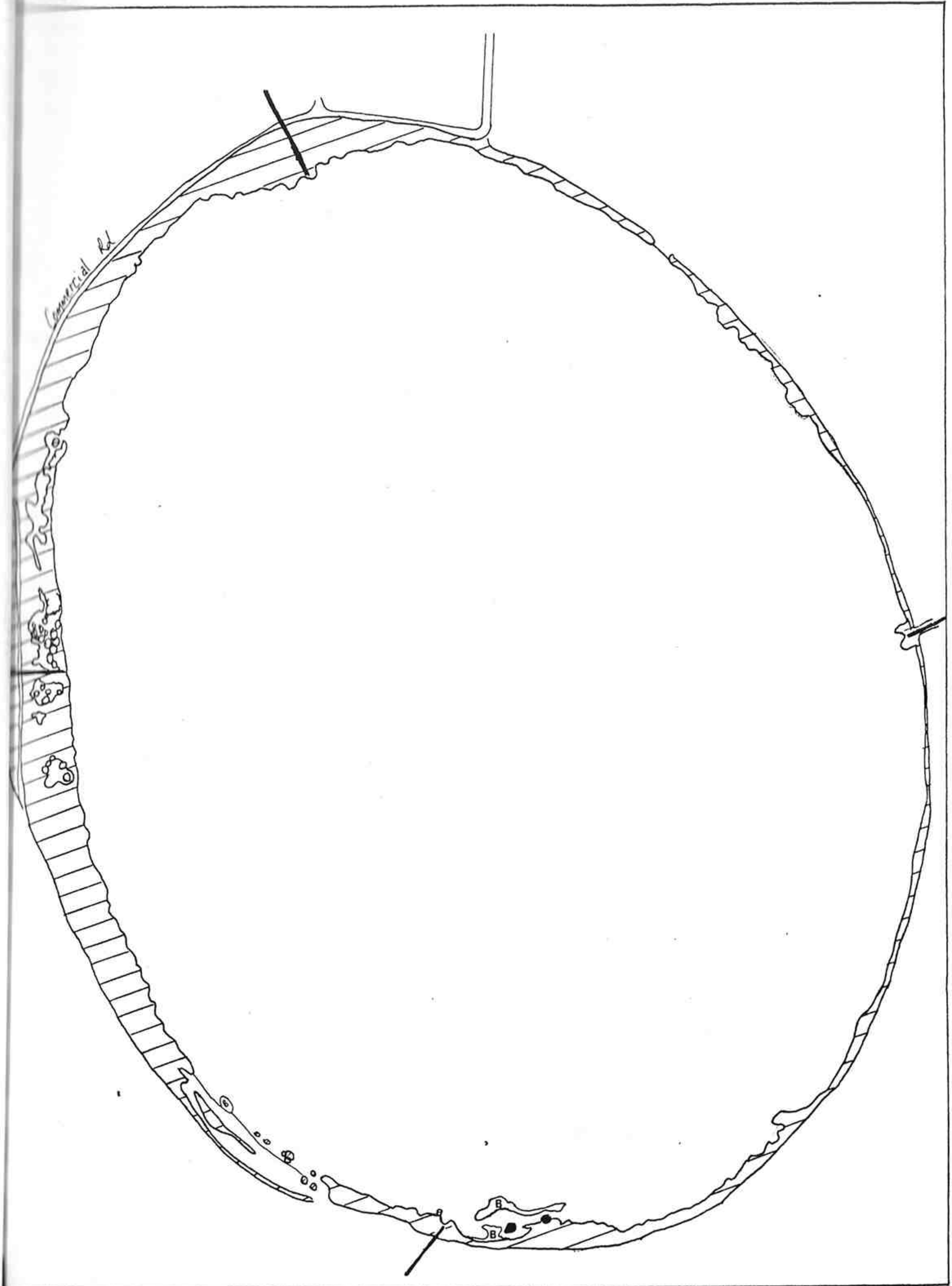


Figure 3 VEGETATION OF FORRESTDALE LAKE 1976

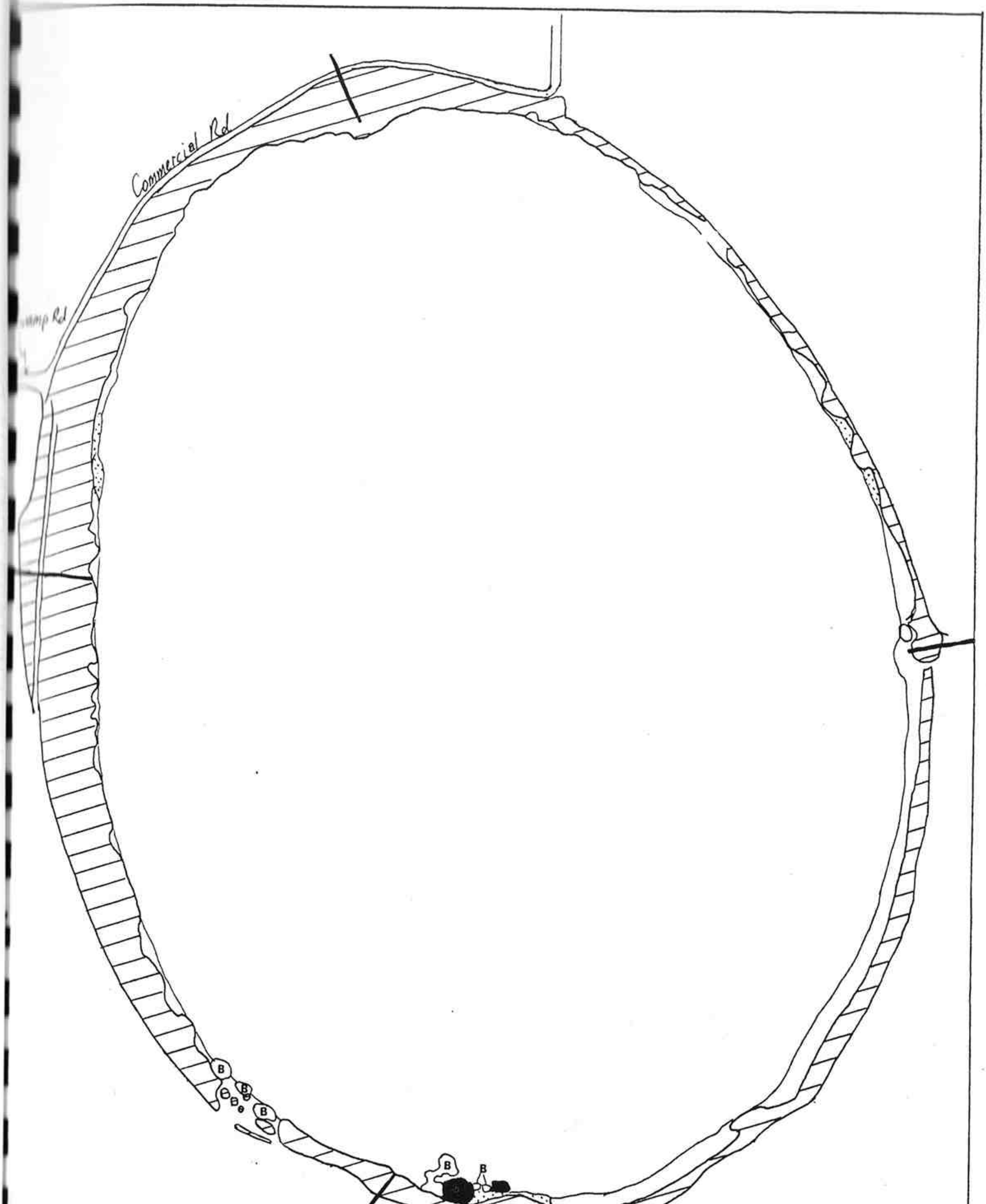


Figure 4 VEGETATION OF FORRESTDALE LAKE 1978

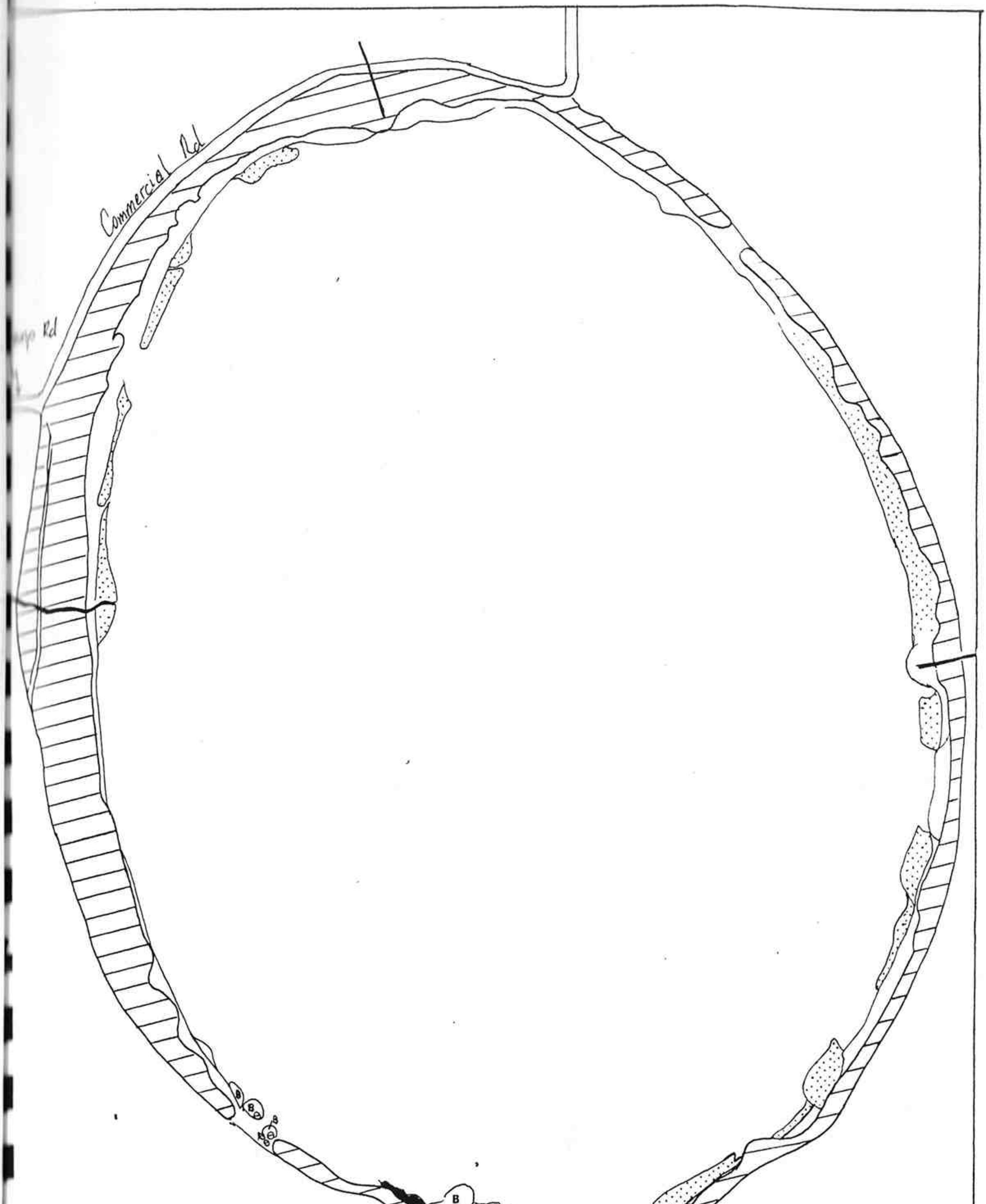


Figure 5 VEGETATION OF FORRESTDALE LAKE 1980

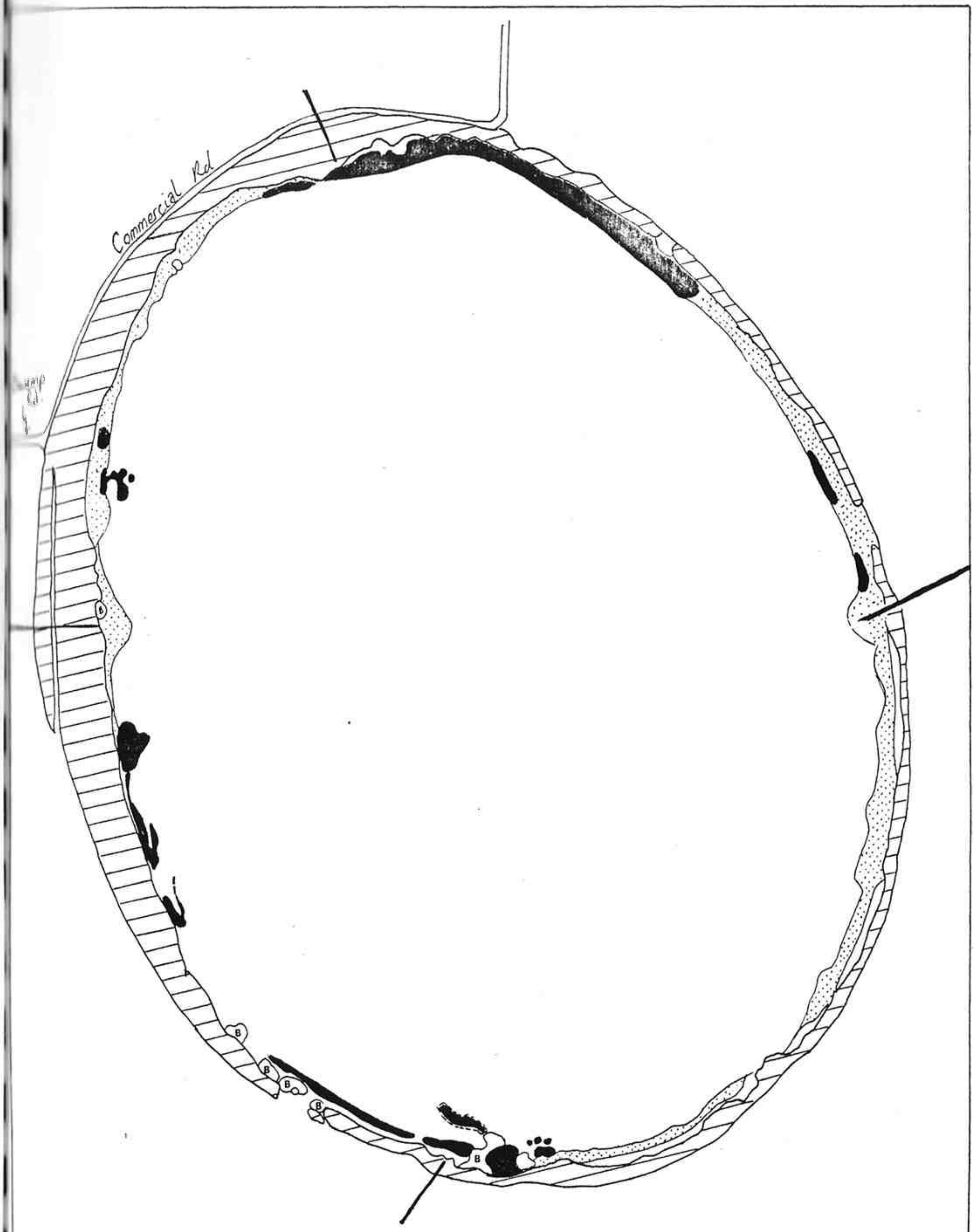


Figure 6 VEGETATION OF FORRESTDALE LAKE 1982

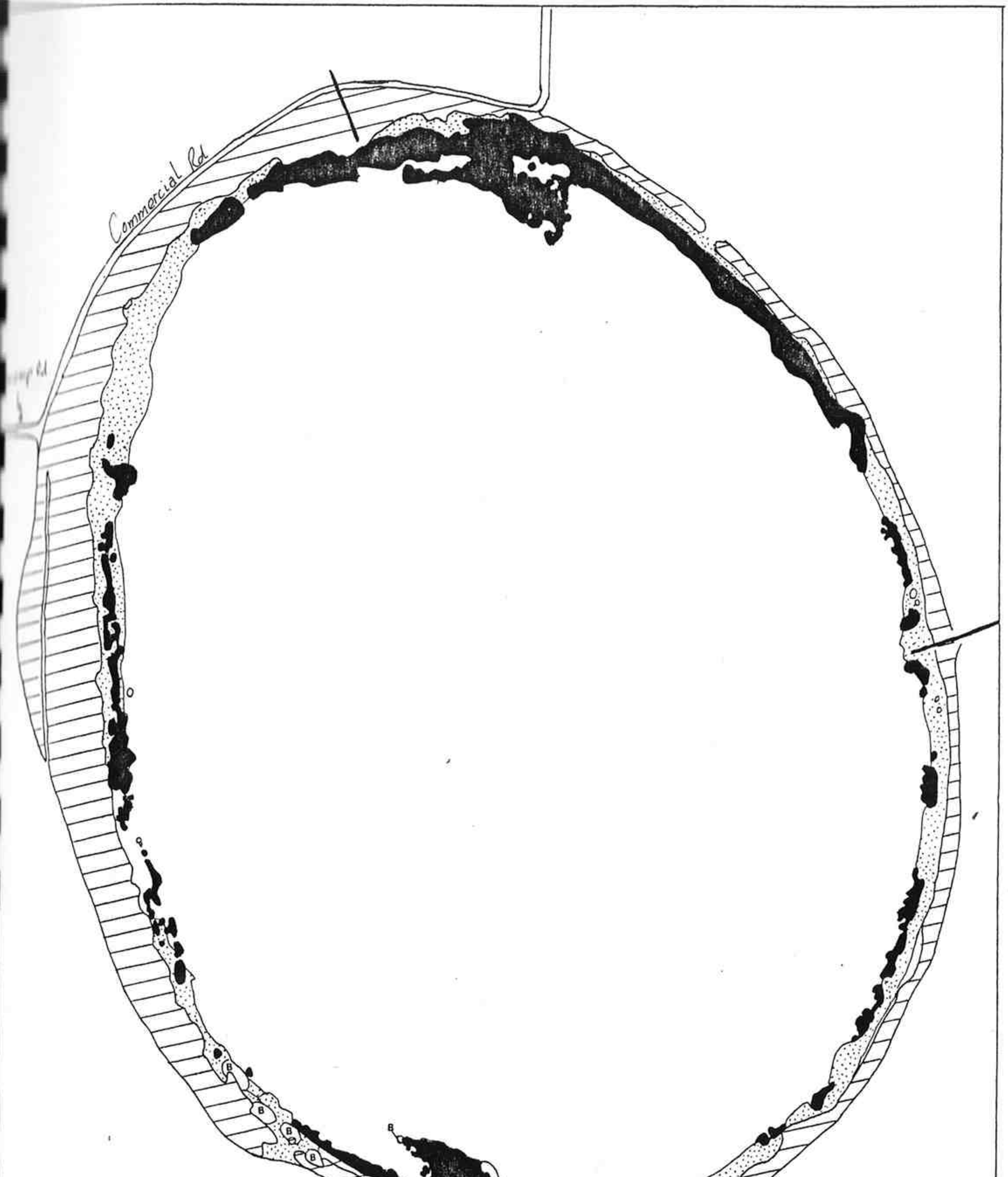
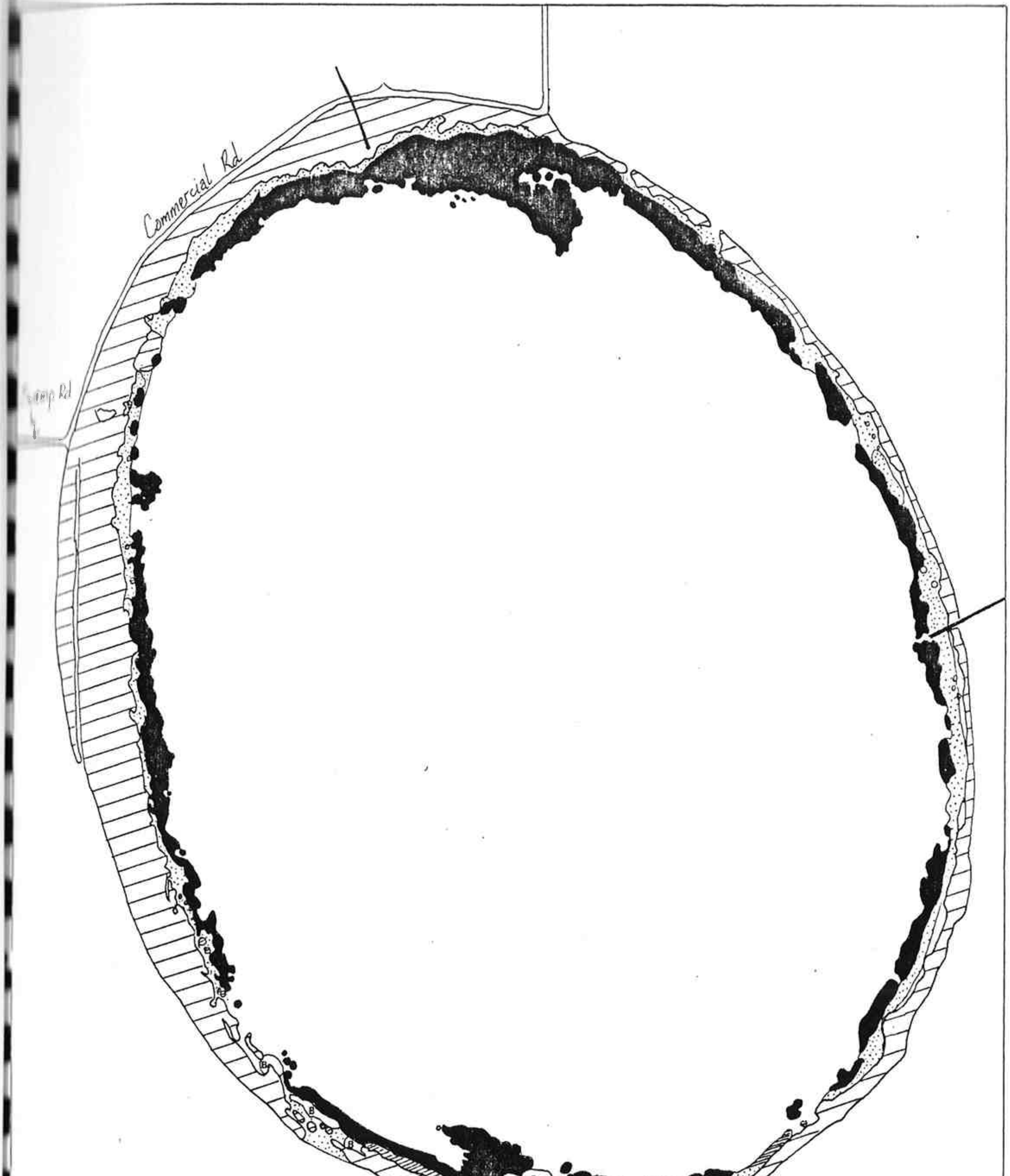


Figure 7 VEGETATION OF FORRESTDALE LAKE 1984



August 1982, the vigorous growth of *Typha* has continued. At the northern and southern ends the *Typha* is growing in towards the centre of the Lake as well as along the edges. The south-west side, unlike the west side, shows smaller isolated stands of *Typha* rather than a continuous stand. The *Baumea* at the south end has extended its stand (see Figure 6).

February 1984, the stands of *Typha* have continued to advance. The stands have become deeper, moving in towards the centre of the Lake. Stands which were isolated in 1982 are now joined to other stands. The *Baumea* stand at the south end has retracted (see Figure 7).

In summary; prior to 1964 there was no *Typha* present on Forrestdale Lake. During the years 1965 to 1967 the first *Typha* plants became established . In 1967 the *Typha* stand was just visible on aerial photography. The growth of *Typha* on the Lake was comparitively slow until the end of 1978. The following four years saw a rapid increase in the rate of growth of stands and the establishment of new stands by seedlings. Although the growth of the *Typha* stands may have appeared to have slowed down during 1983 and 1984 the continued growth is significant. The growth of *Typha* during 1979 to 1982 consisted of a large amount of seedling and rhizomal growth. In contrast, during 1982 to 1984 the expansion of *Typha* stands was mainly a result of rhizomal growth.

The appearance of *Typha* on the South-west Swamp along side Forrestdale Lake as early as the 1950's indicates that there has been a source of *Typha* seed to colonize Forrestdale Lake for many years before *Typha* occurred on this Lake.

During the 1950's the South-west Swamp was grazed on by pigs and cattle which fed on the *Typha*, often killing small stands. These grazing animals were later removed where by the *Typha* stands could grow unchecked. During one season approximately eight years ago (prior to 1977),open areas of this swamp became covered in *Typha* seedlings. These seedlings survived to cover the whole swamp in *Typha*. Today the swamp is still over grown by *Typha* (Mr and Mrs F.W. James and David James, Forrestdale Lake, pers comm).

During the years before *Typha* became established on Forrestdale Lake the reed species consisted mainly of a fine reed species growing about one metre high (probably *Juncus* species) and a few small patches of *Baumea articulata*(Mr and Mrs' F.W. James and David James pers. comm.; Skeet family photographs, History House). A fine reed species still grows on Forrestdale Lake but not over extensive areas. *Baumea articulata* often grows in a thin belt along the *Melaleuca* stands edge but not in dense enough stands to pick up with aerial photography. Another species of reed, *Scirpus* predominates on the Lakes edge where *Typha* is absent. This species shows vigorous growth as the Lake dries up in the summer months.

ASPECTS OF THE HYDROLOGY OF FORRESTDALE LAKE

Three aspects of the Lakes hydrology were examined; rainfall, ground water levels, ground water abstraction and the Lakes water level.

(a) Rainfall

The rainfall data was supplied by the Bureau of Meteorology from the Armadale Station, the closest station to Forrestdale Lake. The mean annual rainfall over the last 80 years has been 877 mm. Figure 8 shows the annual rainfall at Armadale from 1922 to 1984.

Over the last 10 years the annual rainfall has consistantly been below the mean. The years 1955 to 1962 (a total of six years) is the only other time period within the 62 years shown with more than 4 years below average rainfall. This time period corresponds with the founding of the Sailing Club at Forrestdale Lake and explains why they eventually had to disband as a result of lack of water in the Lake. A high annual rainfall occurred in 1963 which shows the Lake in the aerial photographs to have flooded all the paperbarks along the margin of the Lake. The only other year in which this was observed on aerial photography was in 1974. This is not suprising as it correlates with the two highest rainfall years in any of the years looked at with aerial photography.

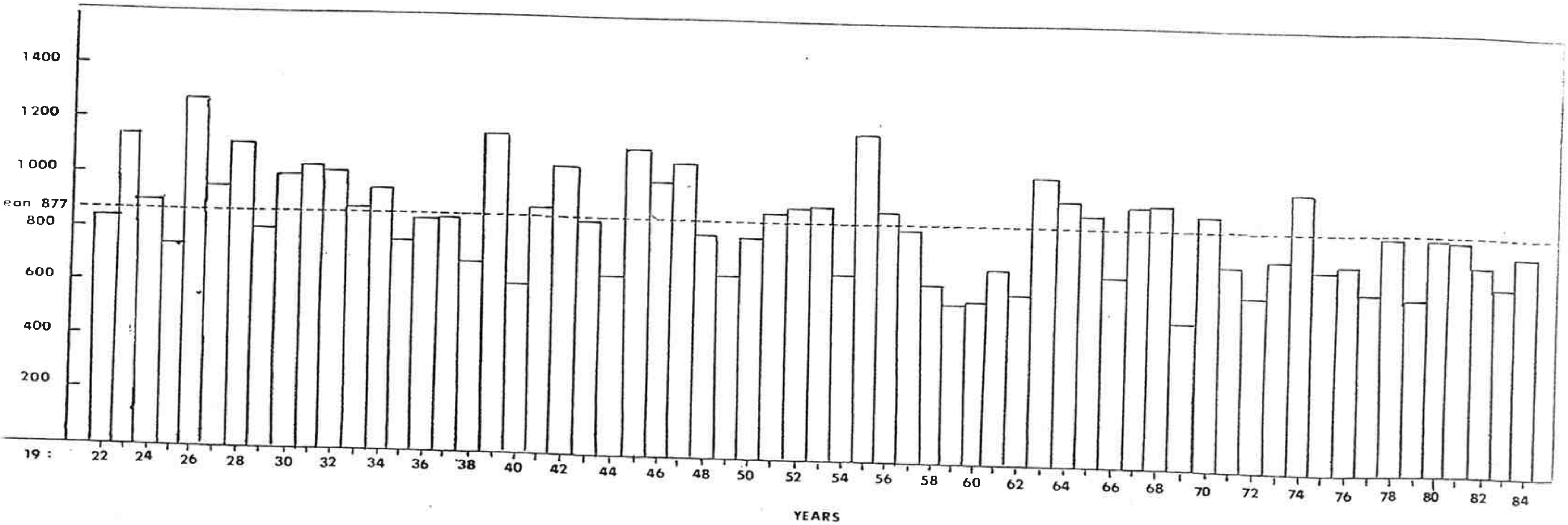
Periods of drought, or low water levels at Forrestdale Lake appear to correspond with three or more years of below mean annual rainfall. This has been the situation over the last 10 years, in the late 1950's and also in the 1930's. Four years of below average rainfall occurred up to early 1939 when Forrestdale Lake dried out. Following this drought a very high rainfall occurred in the winter of 1939 which caused some flooding. During other years the rainfall has fluctuated dramatically. Such fluctuations, particularlyularly the high ones, could be very important in maintaining a high water level at Forrestdale Lake. A high water level would reduce the Lake's tendency to dry out as a result of evaporation. Droughts occurred in the district during 1914 and prior to 1902 (see History of Forrestdale Section).

In conclusion the drying out of the Lake has been an intrinsic part of its cycle for the last 100 years although the frequencey in which it is drying out has greatly increased in recent years. This increased frequency of drying out corresponds to the longest period of below rainfall on record.

(b) Ground Water Levels

The ground water level is measured by the Metropolitan Water Authority at a well north of Forrestdale Lake (see Appendix 2). All available ground water readings available from this well are presented in Figure 9.

Figure 8. ANNUAL RAINFALL FROM ARMADALE STATION 1922 to 1984



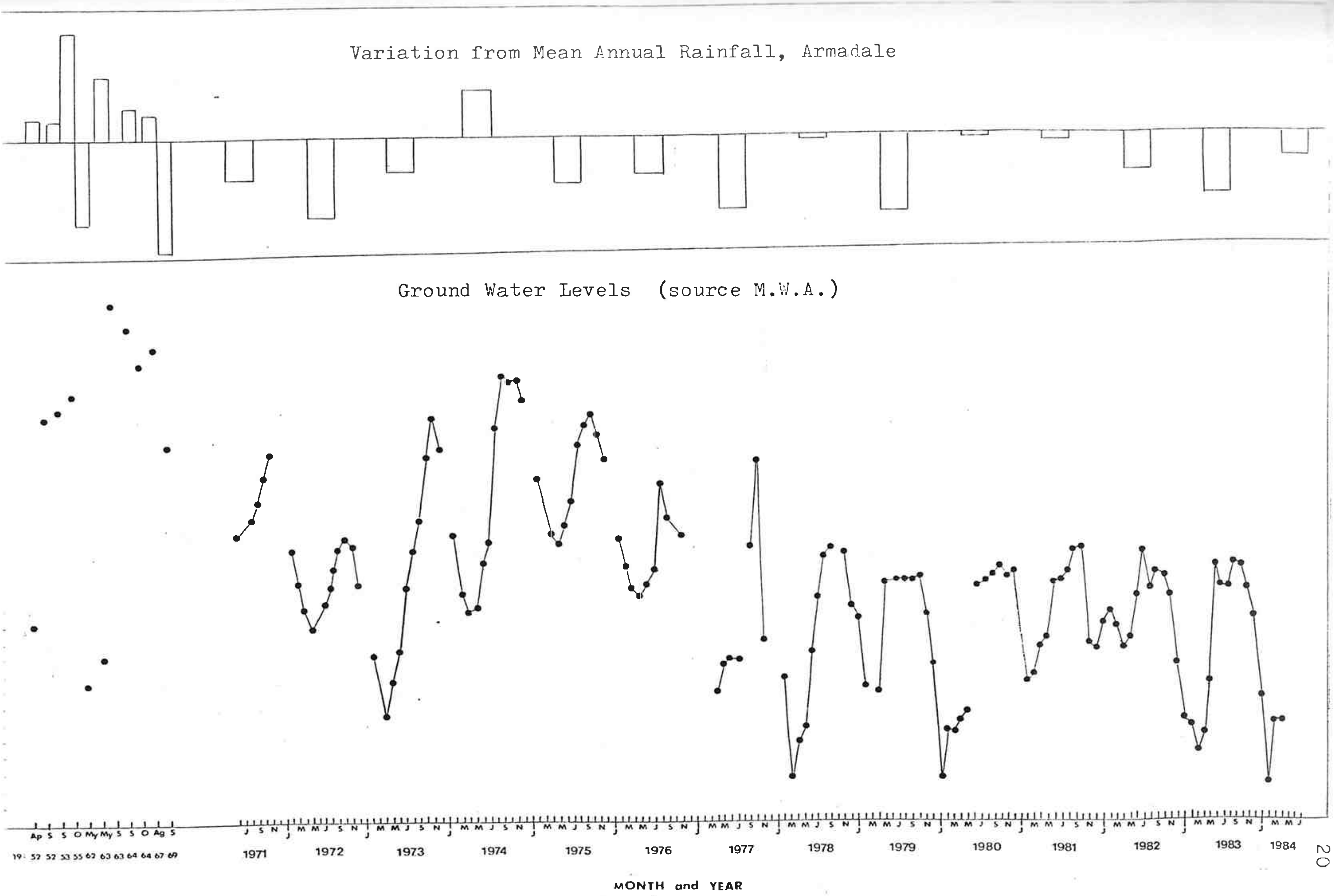
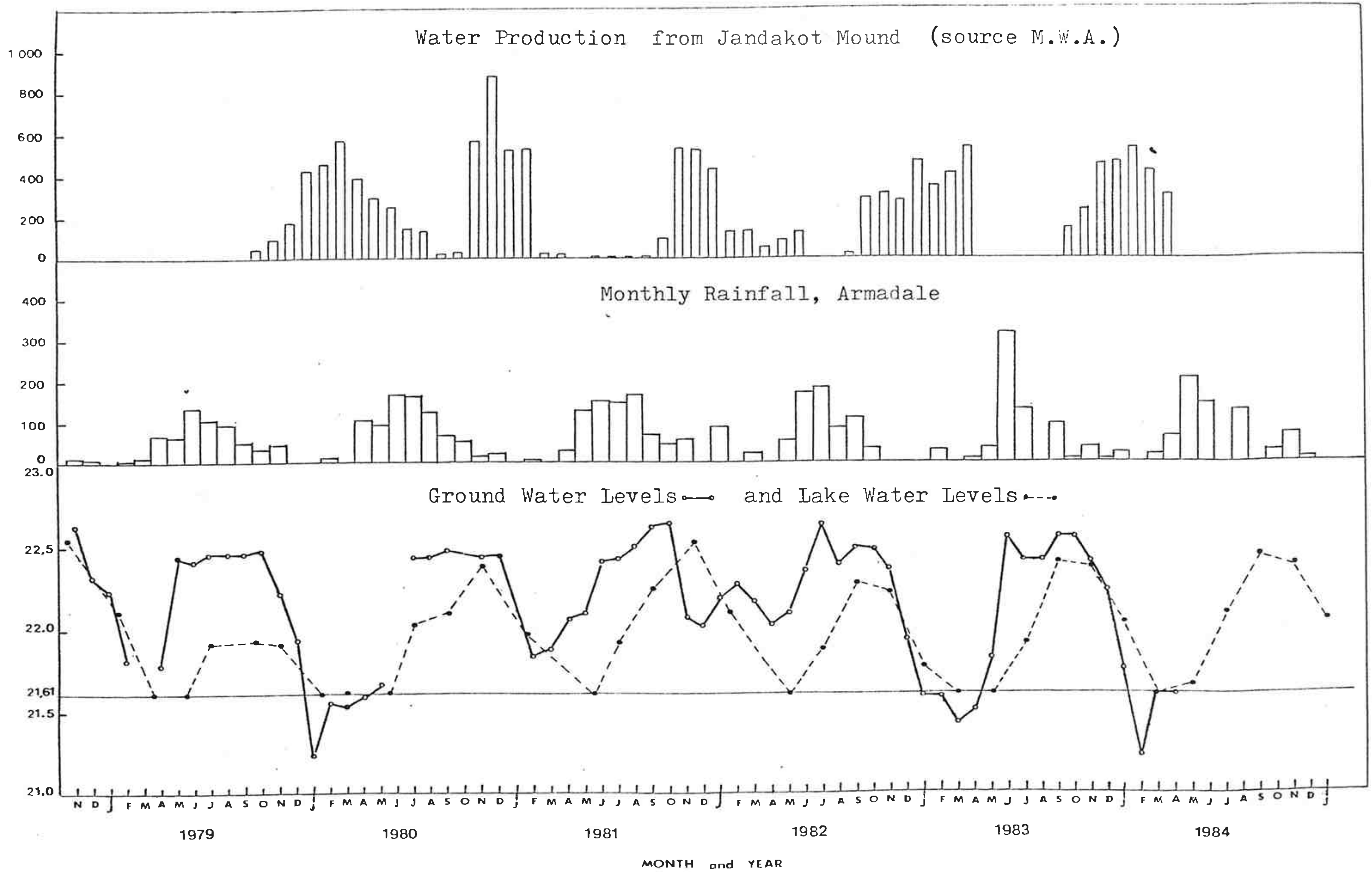

Variation from Mean Annual Rainfall, Armadale
Ground Water Levels (source M.W.A.)
Ap S S O My My S S O Ag S
19: 52 52 53 55 62 63 63 64 64 67 69
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
MONTH and YEAR

Figure 10. CHANGES IN ASPECTS OF THE HYDROLOGY OF FORRESTDALE LAKE



The first eleven points on the graph show only the occassional readings taken in the 1950's and 1960's. The following years show that ground water attained a relatively high level, given that the points may not be the actual maximums for the year; September 1952 and 1953, October 1955, September 1963, September and October 1964, and August 1967. All these high water table levels correspond to years with above mean annual rainfall.

The highest rainfall over the past 10 years was in 1974. The ground water shows a steady decline in levels since 1974 to stabilize at approximately the 1979 level. The highest level recorded was in September 1963 and the lowest was in January 1984. The ground water levels are very closely related to the rainfall in the region although other factors such as ground water abstraction, clearing of land and drainage of wetlands can effect this correlation (M.W.A. 1984). In recent years the lower rainfall and ground water levels have meant that there has been a decrease in the input of water into Forrestdale Lake.

(c) Abstraction of Ground Water

Forrestdale Lake lies on the east side of the Jandakot mound and its Public Water Supply Area and Underground Water Pollution Control Area boundary. The Metropolitan Water Authority commenced production from this mound in October 1979. The water is drawn through 15 wells from the unconfined aquifer, the location of these wells are shown in Appendix 3.

The total planned production from the unconfined aquifer is 5.5 x 10 m per annum (M.W.A. 1984). The monthly abstraction of ground water from the unconfined aquifer by the MWA is shown in Figure 10.

Abstraction has also occurred from the shallow artesian aquifer since 1979. "Hydrological studies have shown that an impermeable layer exists between the unconfined aquifer and the underlying shallow artesian aquifer in this area and that the abstraction from the artesian aquifer does not have any significant effect on the water table" (M.W.A. 1984).

Abstraction from the unconfined aquifer has increased by 10% during 1982-83 compared to 1981-82. This increase was due to increased demands in the summer and autumn of 1983 (M.W.A. 1984). Private pumping contributes considerably to the total amount of ground water abstracted. Figures from the M.W.A. report 1984 are given below. The MWA manages the use of the ground water in this area, each well having to be licensed and the MWA able to review management guidelines for ground water allocations.

Shallow Unconfined Aquifer
106m yr

Water Year (Oct. - Sept.)	MWA pumping	Estimated Private Pumping	Estimated Total
1979 - 80	3.065	5.300	8.365
1980 - 81	2.384	5.440	8.274
1981 - 82	2.243	5.720	7.963
1982 - 83	2.552	6.700	9,252

The MWA abstracts approximately 33% of the total ground water abstracted each year. The estimated private pumping has increased with the allocation of an additional 0.5 x 10 m yr to new licensed wells. There has also been an increase in pumpage from existing bores (M.W.A. 1984).

The MWA has calculated the change in water table to be a drop of 0.3 m or less during the period of below average rainfall and this is less than the change predicted in the MWA's submission to the EPA prior to the Jandakot mound scheme commencing. "...it is considered that the effect of pumping has been significantly reduced by the presence of partially confining clay layers in the area" (M.W.A. 1984).

(d) The Water Level of Forrestdale Lake

Water levels for Forrestdale Lake have been recorded by the Department of Fisheries and Wildlife since November 1978. These measurements are graphed with the ground water levels, rainfall and ground water abstraction in Figure 10. The lowest point in Forrestdale Lake is 21.61 m above the Australian Height Datum (A.H.D.) (see Appendix 1). It is at this point that the Lake has been graphed as dry and the ground water graphed on the same scale. The relative levels are only approximate.

Forrestdale Lake shows a delayed response to rises in the water table but has a much closer response to any falls in the water table. The difference in the Lake's peak water level and the ground water level peak is difficult to explain unless the water table at the point of this well is slightly confined from Forrestdale Lake due to such factors as clay layers. During December 1982 to April 1983 the ground water level at the well was 0.6 m higher than the bottom of the Lake at 21.6 m. This would be expected to maintain the Lake's water level, but the Lake dried out in May. This also occurred in the 1980-81 season. Evaporation could be the cause of the Lake drying out especially if the maximum water level in the previous winter was not high.

Since 1979 the Lake has dried out every year. This does not appear to have been the case in the early 1900's, where the drying out of the Lake was an unusual occurrence. We estimate that Forrestdale Lake began to dry out each year by the mid 1970's. Evidence indicates that the water levels obtained in the Lake prior to 1979 were often much higher than those obtained over the last 5 years, when the lake has only exceeded one metre in depth during the 1981-82 season.

The aspects of Forrestdale Lakes hydrology examined, indicate that the Lakes water level is determined by long term trends in rainfall. Ground water abstraction will be having an effect on the water level of the Lake, but the influence of the rainfall is of greater significance.

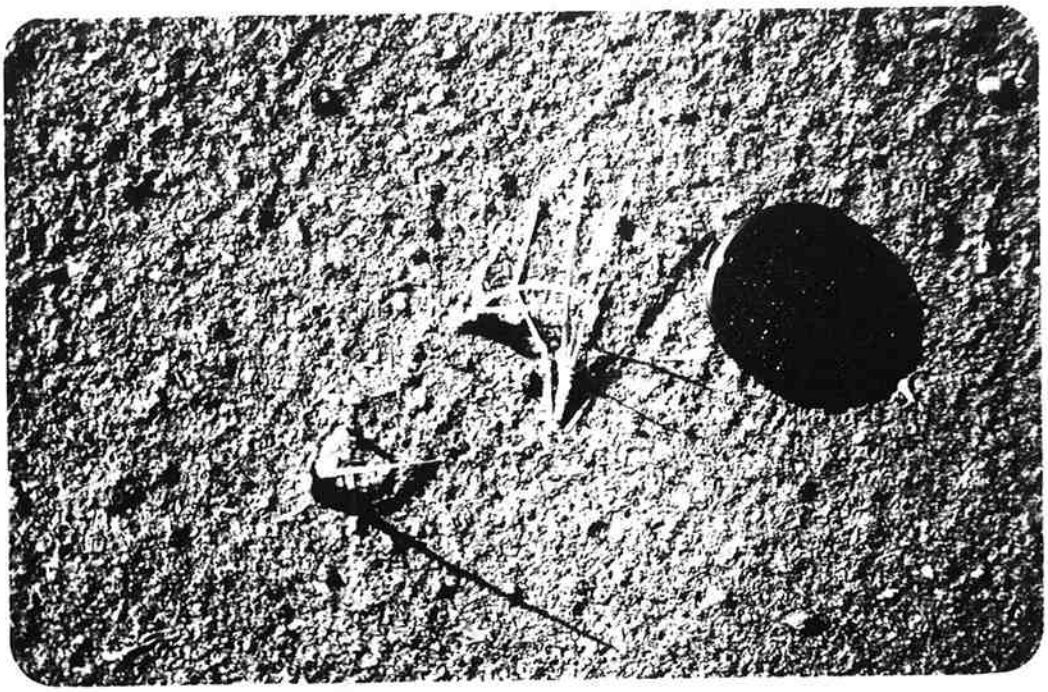


Photo 2 *Typha* seedlings.

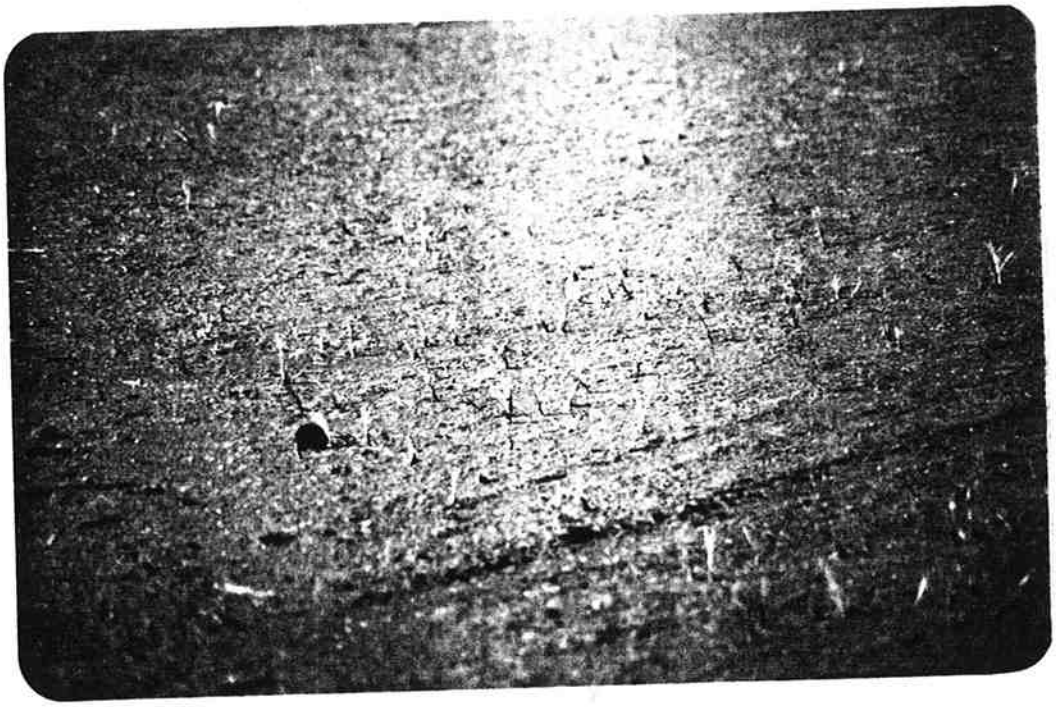


Photo 3 An area of *Typha* seedlings.

CONTROL OF *TYPHA* STANDS

The key to containing any species is to limit its spread. For *Typha* this means limiting rhizomal growth from established stands and eliminating seedlings. The rate of spread of *T. orientalis* from rhizomal growth is up to 2 m a year (pers. obs.). In contrast, seedlings have the potential to germinate and grow across the complete bed of a wetland in one season.

There are two basic ways to control a pest species, one is to remove individuals as they arise and the other is to alter the environmental conditions so they are unsuitable for the pest species.

The fundamental tool in wetland management is the alteration of water levels. If the minimum water level in a wetland throughout the year is greater than 50 cm, then the indications are that this will prevent the establishment of seedlings. To stop rhizomal growth the water must be considerably deeper, probably in excess of 150 cm. Increasing the depth of water can be achieved by holding more water in the wetland or by dredging the bottom. The dredging of the Floreat Waters area of Herdsmans Lake is an example of how it stops the rhizomal growth of *Typha*. In most wetlands in the South-West it would be far too expensive to increase water levels, even if the water was available and it was considered in the best interests of the wildlife.

There are other options for altering the environmental conditions;

(a) Change the wetlands substrate by topping it with a layer of sand. This suggestion it based on our observation that *Typha* does not grow on sandy substrates. It would however be very expensive and most probably have a large effect on the wetlands aquatic flora and invertebrate fauna.

(b) Promote the establishment of other plants in the areas of shallow water. This might not have much effect on rhizomal growth by *Typha*, but it should lessen the amount of area suitable for seedlings.

Grazing by cattle and pigs could be used to contain *Typha* stands but the stocking rate would have to be high. We consider that this would not be compatable with the nature conservation values of most wetland Reserves.

The major methods that can be used on established *Typha* plants are either chemical or mechanical. One of the dificulties with management work on established *Typha* plants is that the plant is at its most vulnerable stage while the wetland is still flooded.

Chemical Control

The Western Australian Department of Agriculture recommend the use of chemical sprays for the control of large stands of Typha. The recommendation is to use a spray called "Roundup" at the rate of 8 l/ha. Roundup has no residual as it breaks down on contact with the soil. The active ingredient is glycophosphate. The time of application should be when the total non-structural carbohydrates are at their lowest level, and this relates to when the floral head is green (Linde et al 1976). In the South-West this is usually in December (pers. obs.). Roundup costs approximately $20/l and should be diluted 1:100 for application by hand. As such the cost of the chemical/ha would be approximately $160.

The Wanneroo Reserve Management Team has had experience in working in Typha stands at Thompsons Lake Nature Reserve. Their comments on the practicalities of this type of work would be valuable if the Department considered following this course of management.

Mechanical Control

(a) Cutting Typha under the water

This method has been found to be the most simple and inexpensive procedure in the U.S. (Weller 1975). In the U.S. the cutting is done during the period when wetlands are frozen, so the procedure would have to be modified to suit the South-West conditions. Controlling Typha stands by cutting them under the water is based ot the theory that oxygen diffusion to the rhizomes will be prevented and this will result in anerobic respiration which will kill the tissue (Sale and Wetzel 1982). This method can achieve up to 98% control in the first year (Wilson 1977).

Cutting by hand is considered only applicable to small areas of Typha (Wilson 1977; Rutherford 1978). Machines have been developed in Europe and the U.S. (Robson 1974), which make this method a viable alternative. The machines are similar to weed-cutting boats. Based on these is a reciprocating cutter bar used on farms for mowing. The cutter bar is lowered to 150-300 mm below the water and driven by a moter on the boat. The boats are usually propelled by a paddle wheel to avoid fouling by weed. To our knowledge only one machine of this type has been used in Australia, by the Tasmanian Department of Agriculture.

(b) Cultivation

There are several different levels of intensity of cultivation that can be used and the choise will depend on local conditions. All are dependent on the wetland drying out sufficiently to enable a machine to work on it. Trials using cultivation to manage Typha are at present being conducted at Benger Swamp for the Department. No references to this method could be found in the literature. We would suggest that the wetland cycle in the South-West with its autumn drying out, is probably different to that in most wetlands with Typha in other parts of the world.

MANAGEMENT WORK ON TYPHA SEEDLINGS AT FORRESTDALE LAKE

On the February 24 visit to the Lake a large area of seedlings 2-4 cm high were found at the south end. In an area of 1 m squared over 100 seedlings were counted. In mid April the area over which seedlings had germinated was mapped and found to be approximately 14 ha. It was noted that many of the seedlings had turned a yellow colour and were presumably dying. In the area that had 100 seedlings/square metre there were now only 20 seedlings with green leaves.

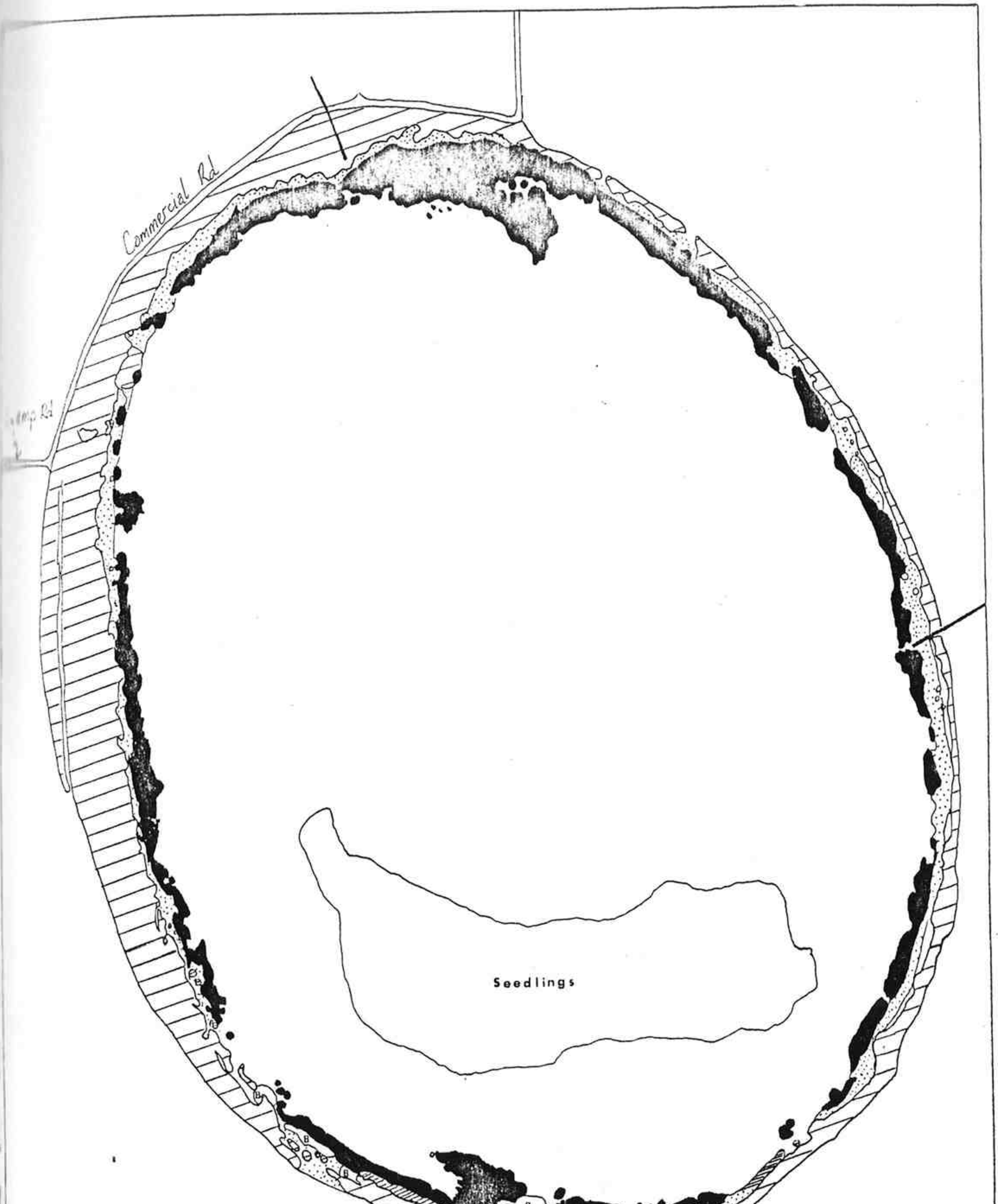
At the onset of the project it was invisaged that the seedlings would be managed by light cultivation of the lake bed. This was to be done by the Wanneroo Reserve Management Team using the Departments tractor and cultivator. As the time passed into autumn it became obvious that a tractor could not be used on the Lake because the ground was quite "spongy" and the water table was only 50 cm below the surface. Observations of the distribution of seedlings indicated that germination was considerabily higher in wheel tracks (see Photo 1). As such it was considered desirable not to use any vehicle that left wheel indentations on the lake bed. This severly limited management options. The use of a Honda Trike which is light and has ballon tyres was opted for (see Photo 4).

It had been noted while mapping the seedlings that plants could be pulled from the ground very easily. Dragging a shovel along the ground and applying light pressure was effective at pulling out most seedlings. We decided to use a drag to pull out the seedlings. A heavy drag made of two lengths of railway iron was tried first. This was too heavy for the Trike. Next a length of heavy chain was used, but this missed too many seedlings. As a last resort on that day the tailgate of the trailer was tried and proved to be quite successful. The next day a sheet of weldmesh (2 m by 1 M), was tried and with the addition of a few wieghts, found to be the most efficient drag (see Photo 5).

The area of seedlings was worked in an eastern and western block with a small non-treated plot between the two blocks. The "control" plot was approximately 20 m by 40 m (see Photo 7). The two blocks were worked by driving in circles around the block towards the center (see Photo 6). It took 9 hours to drag the complete area as the Trike could only work in second gear.

Some difficulty was experienced because of water. There was considerable urgency to complete the management work in early May as heavy rainfall caused the water table on the Lake to rise approximately 60 cm in two days. By the time the work was completed there were large pools of water in the Lake. The rain and surface water made working conditions very uncomfortable and caused problems with the Trikes' eletrical system. At "high" speeds the drag tended to aqua-plane which reduced its effectiveness at removing seedlings.

Figure 11. Distribution of Seedlings, 1984



The mean number of seedlings/square metre in the control plot was 7.5 with a standard deviation of 7.19 calculated from eight samples. The numder of seedlings still erect after management was 0.33 with a standard deviation of 0.64 from twenty-three random samples. This illistrates the effectiveness of the management technique.

When the Lake was inspected in late May the seedling area was flooded with 15 cm of water. The seedlings in the control plot were completely under water and their leaves were turning yellow. Only a few seedlings could be found in the worked area, and these too were yellow in colour. We believe all the seedlings were killed by the sudden flooding.

Photo 4 The motorbike used in the management work. Note the mature <u>Typha</u> stand in the right of the photo.

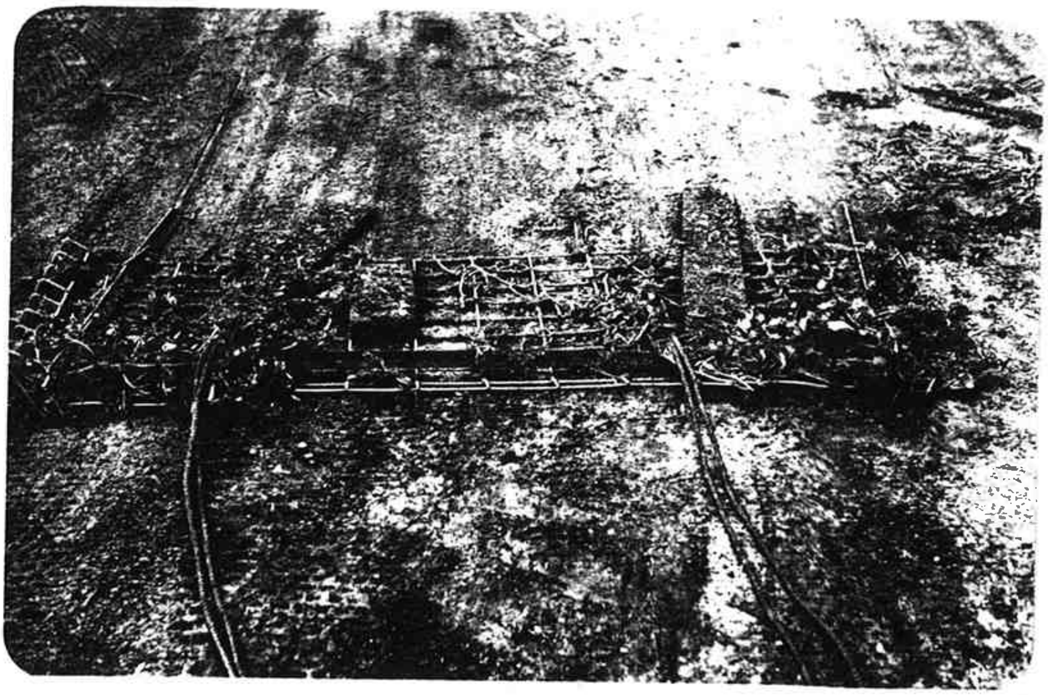


Photo 5 The drag used for the management work.

Photo 6 View east across the area after the management work.

Photo 7 View north along the edge of the control plot.

RECOMMENDATIONS

In making recommendations about the long term management of *Typha* it must be recognised that the establishment of the species at Forrestdale Lake has many desirable aspects for nature conservation at the Reserve. The major value of the *Typha* has been to the waterbirds. The Lake is now able to support larger populations of species which inhabit reed beds such as, Clamorous Reed Warbler, Purple Swamphen, Buff-banded Rail, Little Bittern, and the three species of crake. In addition many of the waterfowl species use the stands for nesting, particularly Hardheads (R.Jaensch pers comm).

The major conservation values of the Lake are a result of it being a shallow, open water wetland with a mud substrate. A diversity of fringing vegetation is also important. The continuing advance of *Typha* across the wetland will detract from the above conservation values. As such we recommend that it is desirable that the *Typha* stands be contained. The most important aspect of *Typha* control is preventing the establishment of *Typha* seedlings.

A substantial case could be put for having *Typha* stands in the centre of the Lake for waterbird usage. These could be formed by allowing certain areas of seedlings to become established. Management of seedlings is much easier than the control of mature stands. We would suggest that the Department should develop viable methods for controlling mature stands before any serious consideration is given to allowing areas of seedlings to establish in the centre of the Lake.

The indication from the death of the seedlings in the control plot is that the plant were not tall enough to survive flooding in 1984. At other wetlands (ie. Benger Swamp, Herdsman Lake) the rate of growth of seedlings is generally much greater than that at Forrestdale Lake in 1984. This could be due to the conditions at the Lake in 1984 or the Lake many generally be poor for seedling growth. If this is the case then the seedling problems may not be as serious as they potentially could be. Monitoring of seedling growth over each summer will be very important.

Recommendation 1. Seedling growth be monitered in February and March each year at Forrestdale Lake.

Recommendation 2. Appropriate management techniques be implemented to prevent the establishment of *Typha* seedlings.

There are two strong cases for managing the *Typha* stands in small blocks and separating these from the main *Melaleuca* stands. Firstly the increased habitat diversity will benefit the waterbirds. Gaps in the *Typha* stands around the edge of the Lake are used as roosting areas by the waterfowl and as shallow feeding areas by waders and birds inhabiting the reed beds. The second case relates to the fire hazard of *Typha* stands in autumn. At this time of the year the *Typha* stands have died back and are very inflamable. Typha stands can carry intense fires, these having little detrimental effects on the stands as they reshoot in winter. However fires are damaging to Melaleuca stands (pers obs). Where Typha grows into Melaleuca stands there is a far greater probability that fires will penetrate the Melaleuca stands. Fires will be easier to contain on the Reserve if the Typha stands are managed in small blocks separated from the main Melaleuca stands. There is considerable local concern about the fire hazard caused by the presence of Typha on Forrestdale Lake Reserve.

Recommendation 3. The fringing Typha stands should be managed to keep them in small blocks and it would be desirable to have them separated from the main Melaleuca stands bordering the Lake.

Our literature research of management work in containing the fronts of Typha stands has indicated that cutting stands under water is the most desireable control method. This method has not been tried in Western Australia on a viable scale for wetland management. We recommend that the Department look into the use of a cutting machine operated from a boat.

Recommendation 4. That an evaluation be made of the application of a cutting machine operated from a boat for the control of mature Typha stands.

During the course of this project, some local residents have suggested to us that there is a "connection between the increase in Typha at the Lake and increase in midge (Chironomidae) numbers". We have found their arguments lacking in substance but have no evidence to dispute their claims. If a project is undertaken to study the midges at the Lake then we would recommend that some attention be given to the relationship between Typha and the midge populations.

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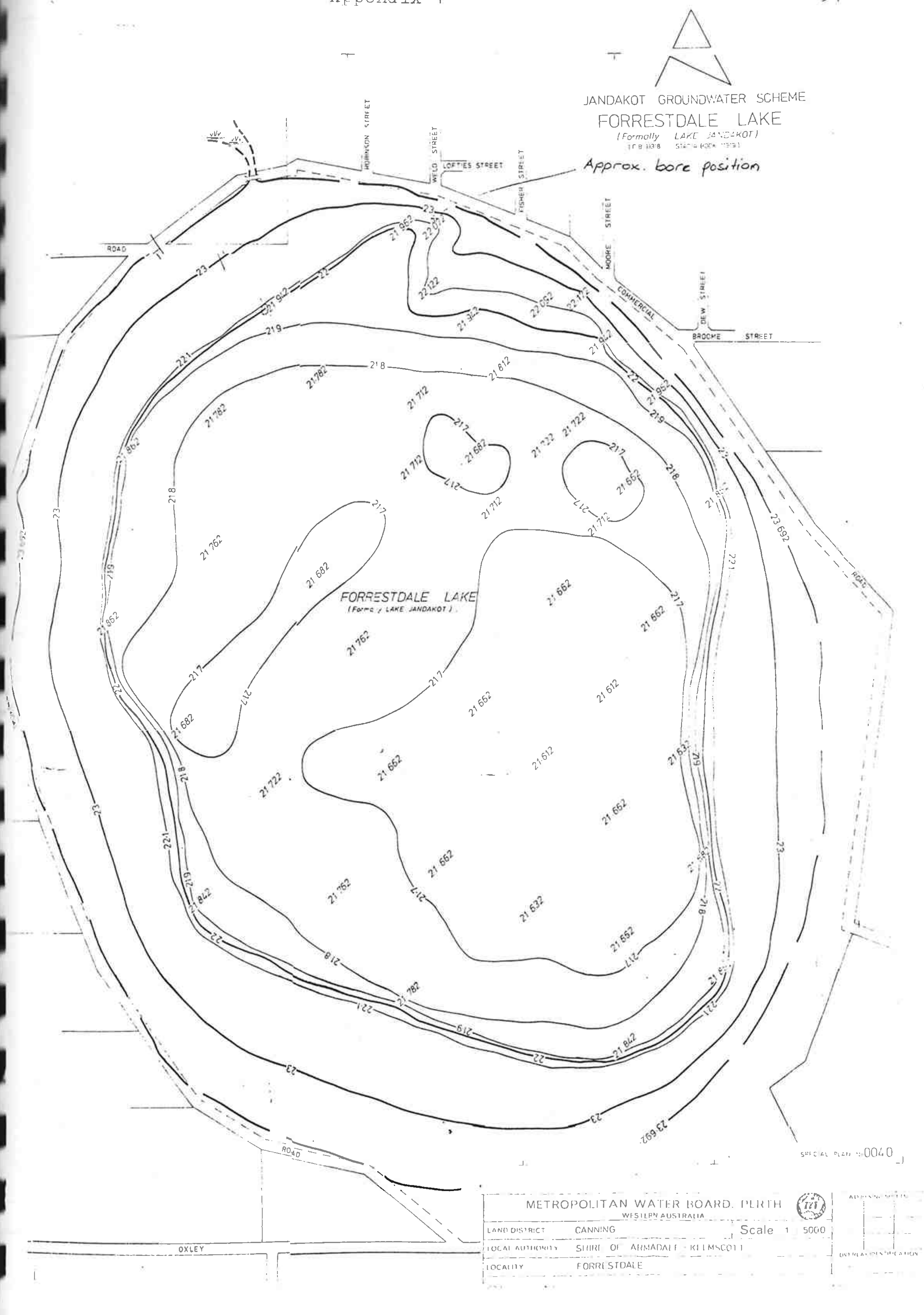

JANDAKOT GROUNDWATER SCHEME
FORRESTDALE LAKE
(Formally LAKE JANDAKOT)
Approx. bore position
ROBINSON STREET
WELD STREET
LOFTIES STREET
FISHER STREET
MOORE STREET
COMMERCIAL
DEW STREET
BROOME STREET
ROAD
OXLEY
FORRESTDALE LAKE
(Formerly LAKE JANDAKOT)
METROPOLITAN WATER BOARD, PERTH
WESTERN AUSTRALIA
LAND DISTRICT CANNING
LOCAL AUTHORITY SHIRE OF ARMADALE - KELMSCOTT
LOCALITY FORRESTDALE
Scale 1 : 5000

R.VITTIGLIA. MAY 82.

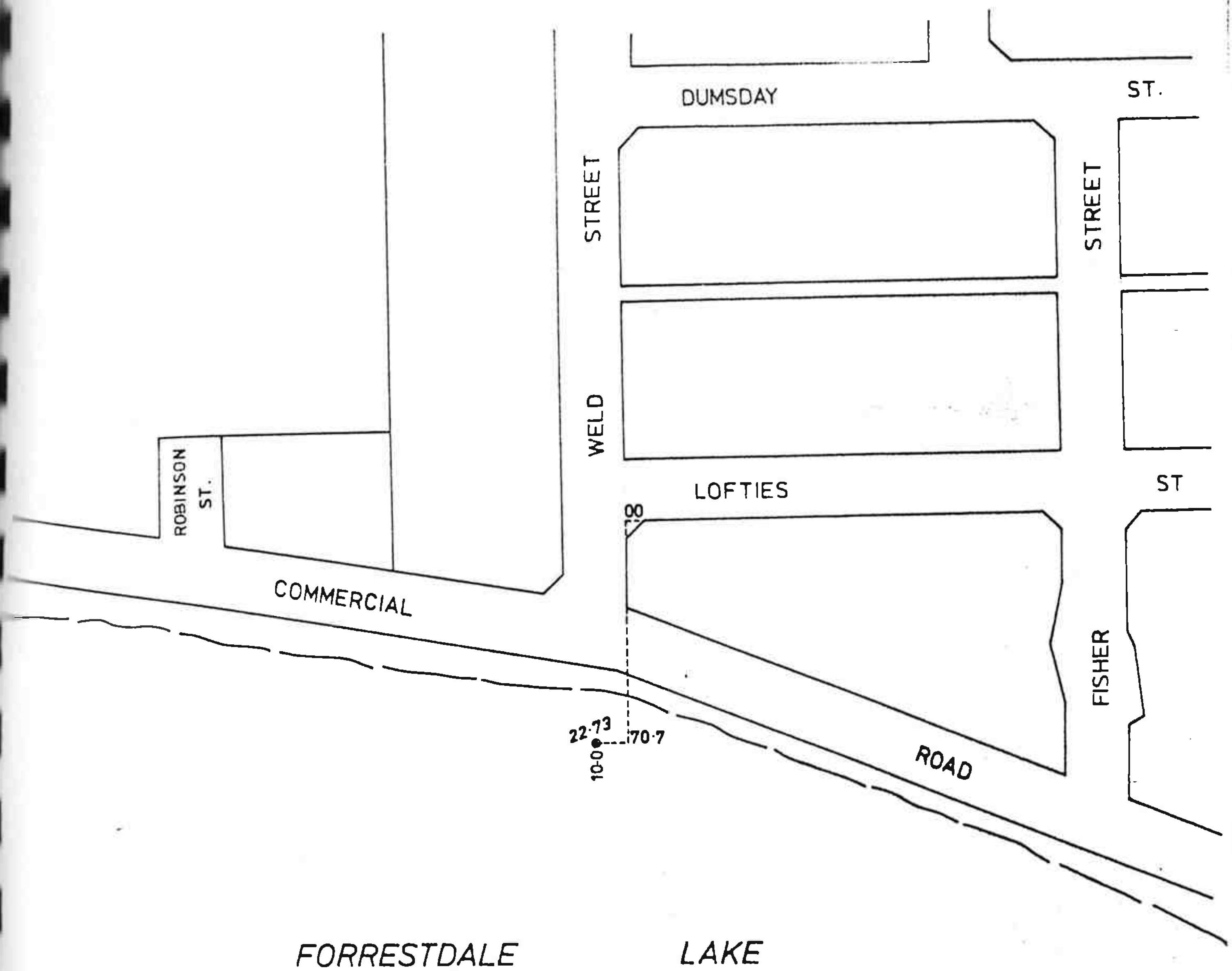
FREMANTLE SE

SURFACE WATER

SCALE 1:2000

LOCATION OF WELL No. 602

F B
L B. 11909 / 523
VERTICAL DATUM - A.H.D.
FILE



Access Sketch

Legend

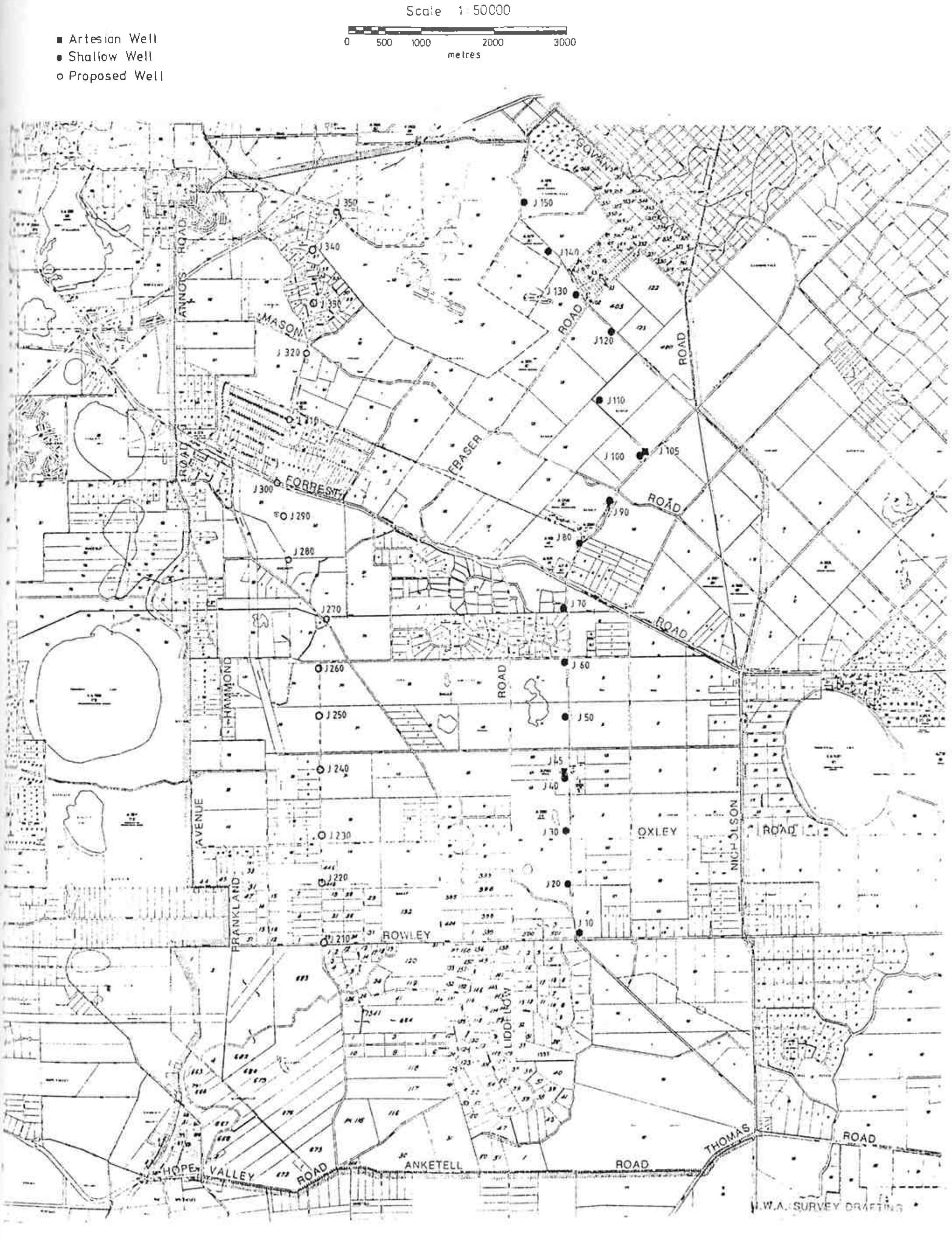
Peg
BSM
Bore
Gate
Bridge
Fence
Sealed Road
Limestone
Sand Track

M.W.B. SURVEY DRAFTING

WELL NAME	I.D. No.	TYPE	mN AMG	mE	REL	REMARKS
602	PER18031O1S	OBS	6 442 241 · 0	399 615 · 0	96	P 947

Appendix 3

JANDAKOT UNDERGROUND WATER POLLUTION CONTROL AREA AND PUBLIC WATER SUPPLY AREA SHOWING PRODUCTION WELLS



M E T R O P O L I T A N   W A T E R   B O A R D

RUN ON 31-DEC-81 (PROG WELLPRT)

G R O U N D   W A T E R   I N F O R M A T I O N   S Y S T E M

PAGE 2

WELL NO. 602 LAKE FORRESTDALE

SURFACE WATER

I.D. NO. PER1802101GWR S

AQUIFER = UNCONFINED
WELL TYPE =OBSERVATION (0)
X COORD. = 399300
Y COORD. = 6441300
RELIABILITY= 75

DATE
MAX. R.L. = 24.164 12-09-63 ~~R.L. OF WELL = 0.000 METRES~~
MIN. R.L. = 21.247 10-01-60

R.L. OF WATER	DATE	LEVEL BOOK	COMMENTS
22.217	28- 4-52		
23.457	25- 9-52		
23.491	8- 9-53		
23.592	7-10-55		
21.851	14- 5-62		
22.031	6- 5-63		
24.164	12- 9-63		
23.988	30- 9-64		
23.768	1-10-64		
23.884	24- 8-67		
23.284	15- 9-69		
22.732	30- 6-71		
22.826	3- 8-71		
22.918	2- 9-71		
23.101	4-10-71		
23.232	3-11-71		
22.653	3- 2-72		
22.442	2- 3-72		
22.284	6- 4-72		
(22.226	26- 4-72)		
22.183	31- 5-72		
22.321	4- 7-72		
22.421	1- 8-72		
22.656	30- 8-72		
22.723	2-10-72		
22.680	31-10-72		
22.445	4-12-72		
22.040	5- 2-73		
21.650	4- 4-73		
21.863	8- 5-73		
22.046	5- 6-73		
22.430	27- 6-73		
22.416	31- 7-73		
22.836	4- 9-73		
23.204	5-10-73		
23.454	2-11-73		
23.044	3-12-73		
22.553	13- 2-74		
22.391	13- 3-74		
22.283	9- 4-74		
22.309	3- 5-74		
22.583	7- 6-74		
22.705	11- 7-74		
23.384	14- 8-74		
23.707	16- 9-74		
23.677	11-10-74		
23.677	15-11-74		
23.552	16-12-74		
23.087	6- 2-75		
22.927	13- 3-75		
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22.793	12- 6-75		
22.939	8- 7-75		
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22.427	8- 6-79		
22.457	20- 7-79		
22.475	8- 8-79		
22.457	10- 9-79		
22.469	11-10-79		
22.227	9-11-79		
21.947	12-12-79		
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21.557	10- 2-80		
21.537	14- 3-80		
21.607	28- 4-80		
21.667	12- 5-80		
22.430	16- 7-80		
22.440	12- 8-80		
22.480	10- 9-80		
22.530	10-10-80		
22.470	6-11-80		
22.490	10-12-80		
22.120	5- 1-81		
21.840	17- 2-81		
21.880	11- 3-81		
22.070	7- 4-81		
22.100	15- 5-81		
22.420	10- 6-81		
22.430	10- 7-81		
22.500	11- 8-81		
22.620	10- 9-81		
22.640	15-10-81		
22.080	9-11-81		

1970 930
71 752
72 657
74 1026
75 737
76 755

NOTE: DAYS OF RECORD IN EACH MONTH ARE VARIABLE BETWEEN 25 TO 35 DAYS

JANDAKOT UNCONFINED GROUNDWATER SCHEME

ANNUAL AND MONTHLY WELLFIELD STATISTICS

PRODUCTION IN 1000 CUBIC METRES

DATE 13-NOV-80

1979/80 YEAR

WELL NO	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANNUAL TOTAL
J 10	12.3	40.5	32.5	25.6	41.4	26.5	17.3	0.0	0.0	0.0	0.0	0.0	196.1
J 20	15.8	40.5	40.3	46.6	23.1	27.8	13.1	31.1	7.4	0.0	0.0	0.0	245.6
J 30	11.8	1.4	37.7	60.0	40.9	57.6	19.7	32.6	.5	0.0	0.0	0.0	262.2
J 40	0.0	0.0	31.8	65.7	47.4	61.0	20.5	2.8	24.9	8.0	67.3	8.9	338.2
J 50	3.7	31.7	32.3	45.8	34.3	44.4	31.5	3.4	31.5	15.3	0.0	0.0	273.9
SUBTOT	43.5	114.2	174.6	243.7	187.2	217.4	102.0	69.9	64.3	23.3	67.3	8.9	1316.1
J 60	0.0	0.0	0.0	0.0	11.4	8.3	.0	.1	10.9	10.1	0.0	0.0	40.9
J 70	0.0	0.0	.6	43.9	35.2	41.7	42.9	38.5	22.2	0.0	0.0	0.0	225.0
J 80	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
J 90	0.0	0.0	0.0	65.1	57.7	43.2	19.9	33.0	18.1	14.5	0.0	0.0	251.4
J100	0.0	0.0	0.0	0.0	0.0	0.0	58.1	27.3	12.3	0.0	0.0	0.0	97.7
SUBTOT	0.0	0.0	.6	109.0	104.3	93.1	121.0	98.9	63.5	24.7	0.0	0.0	614.9
J110	0.0	0.0	0.0	0.0	24.9	33.1	12.6	8.4	13.2	0.0	0.0	0.0	92.3
J120	0.0	0.0	0.0	43.3	43.6	58.0	31.5	34.5	20.3	0.0	0.0	0.0	231.1
J130	0.0	0.0	0.0	27.7	59.4	53.2	30.4	11.9	36.7	18.8	0.0	0.0	238.1
J140	0.0	0.0	0.0	6.6	24.6	65.8	51.6	34.6	27.0	17.9	0.0	0.0	228.3
J150	0.0	0.0	0.0	0.0	23.4	45.7	42.9	44.9	29.5	72.2	76.5	9.5	344.5
SUBTOT	0.0	0.0	0.0	77.5	175.9	255.8	169.0	134.4	126.8	108.9	76.5	9.5	1134.3
TOTAL	43.5	114.2	175.2	430.2	467.4	566.3	392.0	303.2	254.5	156.8	143.8	18.3	3065.3

4

2188.8

7

876.6

5

NOTE: DAYS OF RECORD IN EACH MONTH ARE VARIABLE BETWEEN 28 TO 35 DAYS

ANNUAL AND MONTHLY WELLFIELD STATISTICS

PRODUCTION IN 1000 CUBIC METRES

1983/84 YEAR

WELL NO	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANNUAL TOTAL
J 10	.0	.0	25.7	42.1	35.2	44.7	42.6	0.0	0.0	0.0	0.0	.0	190.3
J 20	.0	.0	28.9	43.1	33.3	43.6	45.4	0.0	0.0	0.0	0.0	.0	194.4
J 30	.7	0.0	23.1	35.6	38.0	11.9	0.0	0.0	0.0	0.0	0.0	0.0	109.3
J 40	12.0	.0	24.1	41.5	34.5	60.2	59.4	0.0	0.0	0.0	0.0	.0	231.7
J 50	.0	.0	17.1	32.4	31.8	44.3	23.6	0.0	0.0	0.0	0.0	.0	149.2
SUB TOT	12.7	.1	118.9	194.6	172.9	204.7	171.0	0.0	0.0	0.0	0.0	.0	874.9
J 60	12.4	.0	24.1	21.4	28.9	24.5	25.9	0.0	0.0	0.0	0.0	.0	137.2
J 70	.6	0.0	12.2	17.0	29.5	3.0	0.0	0.0	0.0	0.0	0.0	0.0	62.3
J 80	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
J 90	23.8	.4	54.7	35.3	58.3	16.7	0.0	0.0	0.0	0.0	0.0	0.0	189.1
J100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUB TOT	36.7	.4	91.1	73.7	116.7	44.1	25.9	0.0	0.0	0.0	0.0	.0	388.7
J110	19.8	19.4	31.1	29.1	30.3	38.2	28.4	0.0	0.0	0.0	0.0	.0	196.3
J120	.1	[illegible]	55.0	21.3	[illegible]	15.2	.7	0.0	0.0	0.0	0.0	0.0	179.2
J130	13.0	104.7	63.7	45.4	[illegible]	36.1	34.2	0.0	0.0	0.0	0.0	0.0	360.4
J140	21.5	[illegible]	41.0	46.3	49.3	30.3	15.5	0.0	0.0	0.0	0.0	.0	203.3
J150	41.4	78.5	52.3	43.6	46.0	44.5	23.9	0.0	0.0	0.0	0.0	.0	330.2
SUB TOT	95.8	226.7	243.2	191.3	235.4	164.3	102.7	0.0	0.0	0.0	0.0	.0	1269.4
TOTAL	145.3	237.2	453.1	459.7	525.0	413.1	299.5	0.0	0.0	0.0	0.0	.1	2533.0

> 300

> 250

2532.9

Negligible

0.1

1981-82

1982-83

[illegible] GROUNDWATER SCHEME DATE 19-[illegible]-83 PAGE

NOTE: DAYS OF RECORD IN EACH MONTH ARE VARIABLE BETWEEN 28 TO 35 DAYS

ANNUAL AND MONTHLY WELLFIELD STATISTICS

PRODUCTION IN 1000 CUBIC METRES

1982/83 YEAR

WELL NO	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANNUAL TOTAL
													143.0
J 16	0.0	520.7 O	6.3	41.8	10.3	29.2	56.3	0.0	0.0	0.0	0.0	0.0	B ~~[illegible]~~
J 27	0.0	0.0	0.0	8.8	2.4	0.0	17.5	0.0	0.0	0.0	0.0	0.0	28.7
J 36	0.0	10.5	0.0	6.2	2.4	0.0	5.5	0.0	0.0	0.0	0.0	0.0	24.7
J 41	0.0	0.0	0.0	4.9	2.3	[illegible]	19.7	0.0	0.0	0.0	0.0	0.0	27.2
J 50	0.0	0.0	4.1	22.2	22.6	16.5	39.5	0.0	0.0	0.0	0.0	0.0	106.3
SUBTOT	0.0	~~540.~~ 10.5 0	10.4	84.0	40.1	45.9	138.5	0.0	0.0	0.0	0.0	0.0	~~[illegible]~~ 330.5
J 60	7.5	0.0	4.1	23.3	23.0	19.0	37.5	0.0	0.0	0.0	0.0	0.0	114.4
J 72	12.3	0.0	.1	5.0	1.4	0.0	13.0	0.0	0.0	0.0	0.0	0.0	31.[illegible]
J 4[illegible]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
J [illegible]	14.0	24.3	54.4	75.8	23.9	[illegible]1.9	67.8	0.0	0.0	0.0	0.0	0.0	322.[illegible]
J109	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUBTOT	33.8	24.8	59.0	104.1	48.[illegible]	80.8	118.5	0.0	0.0	0.0	0.0	0.0	[illegible].4
J113	31.6	[illegible]7.0	24.8	35.3	33.3	34.2	34.8	0.0	0.0	0.0	0.0	0.0	201.1
J120	59.2	84.0	49.2	63.2	68.2	62.3	70.2	0.0	0.0	0.0	0.0	0.0	4[illegible]6.[illegible]
J132	67.3	97.2	56.0	73.7	66.3	70.7	68.4	0.0	0.0	0.0	0.0	0.0	[illegible]90.[illegible]
J14[illegible]	45.6	13.8	41.4	59.4	53.3	56.3	60.[illegible]	0.0	0.0	0.0	0.0	0.0	335.[illegible]
J15[illegible]	51.7	75.6	42.2	53.6	61.5	53.4	51.5	0.0	0.0	0.0	0.0	0.0	379.[illegible]
SUBTOT	255.5	282.6	213.5	285.2	262.[illegible]	276.9	275.5	0.0	0.0	0.0	0.0	0.0	1851.[illegible]
TOTAL	289.3	~~848.~~ 318.4	282.9	473.3	351.0	404.6	532.6	0.0	0.0	0.0	0.0	0.0	~~[illegible]~~ 2551.7

7 250

2651.7

None

0

[illegible] GROUNDWATER [illegible] DATE 13-OCT-82 PAGE [illegible]

ANNUAL AND MONTHLY WELLFIELD STATISTICS

NOTE: DAYS OF RECORD IN EACH MONTH ARE VARIABLE BETWEEN 28 TO 35 DAYS

PRODUCTION IN 1000 CUBIC METRES

1981/82 YEAR

WELL NO	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANNUAL TOTAL
J110	.2	32.8	58.0	27.1	0.0	.5	0.0	0.0	0.0	6.0	0.0	.1	118.9
J120	.5	55.2	56.7	26.1	0.0	0.0	0.6	0.0	.0	0.0	0.0	.0	139.[illegible]
J130	.2	3.8	2.3	12.4	0.0	.6	0.0	0.0	0.0	0.0	0.0	0.0	19.2
J140	10.0	21.1	13.9	17.7	1.5	.5	0.0	0.0	4.6	0.0	0.0	0.0	44.5
J150	0.0	47.9	42.6	24.0	0.0	0.0	1.4	0.0	3.2	0.0	0.0	.0	119.2
SUBTOT	10.6	160.9	188.4	107.3	1.8	2.2	1.4	0.0	7.8	0.0	0.0	.1	480.5
J160	0.0	43.6	30.7	18.4	0.0	.4	0.0	0.0	3.0	0.0	0.0	.0	96.1
J170	0.0	2.5	0.0	0.2	0.0	.2	0.0	0.0	0.0	0.0	0.0	0.0	12.3
J180	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
J190	0.0	43.0	40.1	52.2	27.6	5.3	2.2	0.0	4.[illegible]	0.0	0.0	.0	17[illegible]
J200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUBTOT	0.0	69.1	70.8	75.8	27.6	6.2	2.2	0.0	7.5	0.0	0.0	.1	263.2
J210	12.2	26.0	23.1	33.3	31.5	46.8	16.4	27.2	39.0	0.0	0.0	2.5	[illegible]
J220	22.6	70.4	67.8	45.6	22.9	6.1	2.2	1.8	.7	0.0	0.0	4.3	[illegible]
J230	23.8	75.3	56.8	70.9	69.4	73.8	34.9	57.6	1.4	0.0	0.0	4.4	377.6
J240	20.8	53.3	56.5	52.0	25.0	23.4	4.5	0.0	64.4	0.0	0.0	3.7	30[illegible].0
J250	10.7	58.7	53.7	41.6	2.4	21.5	2.0	1.8	4.6	0.0	0.0	3.5	200.5
SUBTOT	90.0	283.7	262.6	243.4	150.2	172.1	60.1	88.4	110.2	0.0	0.0	18.9	1479.6
TOTAL	100.6	533.7	521.3	43[illegible].4	179.5	180.4	63.7	88.4	125.4	0.0	0.0	19.1	2243.[illegible]

>400

~2009.7

None

~231.9

(2242.6)

1980/81

JANDAKOT
Production in 1000 m^3

ELL NO	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANNUAL TOTAL
10	11.3	43.3	73.2	46.5	52.1	0.5	0.	0.	0.	0.	0.	0.	226.9
20	24.3	40.1	72.8	37.4	20.6	0.5	0.	0	0.	0.	0.	0.	195.7
30	38.5	48.5	73.9	46.6	32.1	0.6	0.	0.	0.	0.	0.	0.	240.2
40	41.6	50.6	74.6	46.3	17.1	0.5	0.	0.	0.	0.	0.	0.	230.7
50	20.3	35.1	50.8	31.7	5.9	0.3	3.6	0.	0.	0.	0.	0.	147.7
Sub Total	136.0	217.6	345.3	208.5	127.8	2.4	3.6	0.	0.	0.	0.	0.	1041.2
60	24.8	37.3	48.1	26.1	17.	0.3	3.3	0.	0.	0.	0.	0.	156.9
70	13.1	42.4	53.6	35.1	31.3	0.3	3.8	0.	0.	0.	0.	0.	179.6
80	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
90	25.5	40.9	55.6	34.5	26.5	0.4	0.	0.	0.	0.	0.	0.	183.4
100	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
Sub Total	63.4	120.6	157.3	95.7	74.8	1.	7.1	0.	0.	0.	0.	0.	519.9
110	11.0	35.9	49.3	13.6	22.3	0.3	0.	0.	0.	0.	0.	0	132.4
120	17.8	42.4	84.2	49.5	78.9	9.6	0.	0.	0.	0.	0.	0.	282.4
130	23.9	47.8	82.5	61.4	97.1	6.3	7.9	0.	0.	0.	0.	0.	326.9
140	13.3	44.7	82.5	46.3	69.5	5.1	5.8	3.3	1.2	1.6	0.3	0.	273.6
150	17.4	57.7	80.4	44.3	53.6	0.5	0.	0.	0.	0.2	1.1	2.1	257.3
Sub Total	83.4	228.5	378.9	215.1	321.4	21.8	13.7	3.3	1.2	1.8	1.4	2.1	1272.6
				2823.9						9.8			
Total	282.8	566.7	881.5	519.3	524.	25.2	24.4	3.3	1.2	1.8	1.4	2.1	2833.7

Source: Forrestdale Lake (Lake Jandakot)

* Not Determined
** Not Detected

Sample Date	Coli-Forms per 100 ml	Faecal E.Coli per 100 ml	$B.O.D_5$ mg/l	Susp. Solids mg/l	Total Solids mg/l	M.B.A.S. mg/l	pH	Nitrogen as N mg/l org.	inorg.	Total	Na Cl mg/l	Phos. as P mg/l	Flouride as F mg/l	T.O.C. mg/l	Fe mg/l	Cr mg/l	Zn mg/l	Cd mg/l	Pb mg/l	Cu mg/l	Hg mg/l
24.3.71	43	43	*	*	*	*	*	*	*	*	*	*	*		*						
8.9.71	23	9	10.0	36	1430	Nil	8.7	*	*	5.0	1230	0.4	0.3		Nil						
24.2.72	75	43	4.8	42	2862	Nil	8.5	3.10	0.30	3.40	2104	0.08	*		Nil						
5.9.72	43	23	2.9	82	2182	Nil	8.3	2.80	0.20	3.00	1620	0.16	*		Nil						
1.2.73	240	93	7.0	<1	8830	**	8.6	7.00	<0.10	7.00	7020	0.25	0.45		**						
9.10.73	400	400	0.8	4	830	<0.01	8.0	1.15	0.15	1.30	537	0.50	0.80		<0.1						
14.3.74	0	0	3.4	<1	2330	<0.01	9.4	3.00	0.60	3.60	1640	0.20	0.35		<0.1						
3.9.74	9	4	3.3	<1	980	<0.01	7.9	2.20	1.00	3.20	625	0.22	0.30		<0.1						
25.2.75	21	4	4.6	52	1740	<0.1	8.9	3.65	0.10	3.75	1110	0.48	0.70		<0.1						
1.10.75	0	0	7.8	74	1330	<0.1	8.8	6.25	0.35	6.60	1095	0.30	0.20		0.12						
25.2.76	93	0	5.4	88	2692	<0.1	8.6	2.30	0.10	2.40	1815	1.2	0.40	111	0.24	<0.02	0.02	<0.01	0.07	<0.01	<.000
12.10.76	240	7	6	42	2170	< 0.1	8.4	4.35	0.05	4.35	1560	0.15	0.40	85	0.16	<0.02	0.03	<0.01	0.04	<0.02	<.000
9.2.77	43	4	5.8	194	5670	<0.1	9.4	13.6	0.45	14.05	4230	0.40	0.50	230	0.08	<0.02	0.03	0.01	0.10	0.02	<.000
[illegible].77	93	15	8	94	[illegible]	<0.1	9.9	3.35	0.25	3.60	2260	<0.05	0.30	•	0.26	<0.02	0.03	<0.01	<0.04	0.03	<.000
[illegible]10.78	•	6	[illegible]	8	1320	<0.1	9.3	1.55	0.10	1.65	760	0.30	0.20	•	0.30	0.03	0.02	<0.01	<0.04	0.01	<0.0
13.2.79	*	4	13.8	34	7620	< 0.1	9.2	8.35	0.10	8.85	5615	0.50	0.05	*	0.26	<0.02	0.03	<0.01	<0.04	0.02	<0.0
2.10.79	*	150	1	22	2770	< 0.1	9.1	3.50	0.20	3.70	1660	0.10	0.20	*	<0.02	<0.02	<0.01	<0.01	<0.04	<0.01	<.00
12.2.80	SAMPLE		POINT	DRY																	
1.10.80	*	0	4	4	1150	0.1	9.3	2.25	0.15	2.40	620	0.15	0.1	*	0.12	0.02	0.01	0.0	0.04	0.02	.000
23.2.81		SAMPLE	POINT	DRY																	
8.10.81	*	0	< 5	*	1200	<0.1	9.1	2.0	0.05	2.05	410	0.10	0.1	*	*	<0.02	<0.01	<0.01	<0.04	<0.01	<0.0
	FAECAL STREPTS/ 100ml										Cl mg/L			SALMON-ELLAE							
17.3.82	SAMPLE POINT DRY																				
23.9.82	0	0	< 5	< 5	1400	< 0.1	9.9	2.2	0.1	2.3	480	0.10	*	"	0.04	< 0.02	< 0.01	< 0.01	< 0.04	< 0.01	< .00
23.3.83	SAMPLE POINT DRY																				
20.9.83	0	0	5	5	1400	*	9.9	*	*	*	500	0.15	*	NOT ISOLATED	0.03	0.02	0.01	*	0.04	*	
		COLIFORMS PER 100ml							DRY												
[illegible]		[illegible]	[illegible]	[illegible]	1550		9.2			0.05	560	0.20	0.15	34	0.11	0.05	0.02		0.1		

Appendix 7

RAOU SURVEY OF WATERBIRDS. QUARTERLY REPORT BY RESERVE PART. 18 DEC 84

UPDATED MAXIMA BY MONTH, FOR ALL SPECIES RECORDED (LAST PRINTOUT - 05 AUG 84 : THIS DATA SUBMITTED 7 DEC 84)

REGION : HARVEY (33/115)

RESERVE : 17 - FORRESTDALE LAKE

PART : 1 - FORRESTDALE LAKE

ATLAS NO.	SPECIES	SVYS RECD	MAX RECD	T P	SVYS RECD BRDG	YEAR RCD	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY
062	HHGB	3	20	P	0	YA 81-82								20 P		3 P	1 P	0
		8	535	T	0	A 82-83			4 T	83 T	535 T	194 T	40 P		0	0		0
		6	86	T	0	A 83-84	0	0		10 P	86 T	40 P		4 P	0	0	0	
		5	80	P	0	A 84-85		0		28 P	30 T	80 P						
061	AUGB	3	20	P	0	YA 81-82								10 P	20 P	4 P		0
		2	6	P	0	A 82-83		6 P					1 P		0	0		0
		4	14	P	1	YA 83-84	0	0			2 T	8 P	8*P	14 P	0	0	0	
		4	5	P	0	A 84-85		0		2 P	1 T	5 P						
106	APEL	2	2	T	0	YA 81-82								2 T		1 T		0
		1	3	T	0	A 84-85		0		0	0	3 T						
101	DART	1	4	T	0	A 82-83		4 T					0		0	0		0
096	GREC	1	1	T	0	A 82-83		1 T					0		0	0		0
097	LIBC	2	2	T	0	A 82-83				1 T	2 T		0		0	0		0
		1	2	P	0	A 83-84	0	0			0			2 P	0	0	0	
		2	3	T	0	A 84-85		0	1 T	3 T	0							
100	LPIC	2	1	P	0	A 81-82								1 P	1 P			0
		10	64	T	0	YA 82-83			1 T	8 T	10 T	53 T	64 T	3 P	0	0		0
		8	40	P	0	A 83-84	0	0		1 T	27 T	10 T		40 P	1 P	0	0	
		7	13	T	0	A 84-85		1 T	1 T	3 T	13 T	4 P						
189	PCHN	6	17	T	0	YA 82-83						12 T	17 T	13 P	0	0		0
		2	1	T	0	A 83-84	0	0			0			1 T	1 T	0	0	
		1	1	T	0	A 84-85		0		0	0	1 T						
188	WFHN	10	80	P	0	YA 81-82								42 P	80 P	30 P	6 T	3 T
		15	51	T	2	YA 82-83	4 T	12 P	1*P	15*T	11 T	35 T	51 T	25 P	0	0		0
		15	161	P	0	YA 83-84	2 T	6 T	1 P		6 T	14 P		108 T	161 P	0	0	6 T
		8	7	P	0	A 84-85	2 T	1 T		2 T	2 T	7 P						
187	GRTE	2	2	T	0	A 81-82								2 T		1 T		0
		3	4	T	0	YA 82-83						1 T	0	4 T	0	0		0
		2	3	P	0	YA 83-84	0	0			0			3 P	0	0	0	
		1	1	T	0	A 84-85		0		0	0	1 T						
192	RNHN	3	11	T	0	YA 82-83						3 T	11 T		0	0		0
		5	7	P	0	YA 83-84	0	0			1 T	1 P		7 P	0	0	0	
		2	7	T	0	A 84-85		0		0	7 T	1 P						
195	LIIB	2	2	P	1	YA 83-84	0	0			0	2*P		0	0	0	0	

71757

RAOU SURVEY OF WATERBIRDS. QUARTERLY REPORT BY RESERVE PART. 18 DEC 84

RESERVE : 17 - FORRESTDALE LAKE

PART : 1 - FORRESTDALE LAKE

MAXIMUM RECORDED AND BREEDING RECORDS (*=DR,SN,E,YN; .=DD)

ATLAS NO.	SPECIES	SVYS RECD	MAX RECD T P	SVYS RECD BRDG	YEAR RCD	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY
178	GLOI	5	18 P	0	YA 81-82								5 P	16 P	5 T		0
179	SACI	1	5 T	0	A 81-82										5 T		0
		4	10 T	0	YA 82-83	1 T			10 T		1 T	1 T		0	0		0
		1	1 P	0	A 83-84	0	0			0	1 P		0	0	0	0	
		1	1 T	0	A 84-85		0		1 T	0							
180	SNKI	1	30 T	0	A 81-82									30 T			0
		7	28 T	0	YA 82-83					28 T	5 T	8 T	24 T	0	0		0
		6	66 T	0	YA 83-84	0	66 T			27 T	4 P		10 P	9 T	0	0	
		2	256 T	0	YA 84-85		0		0	256 T							
182	YBSL	2	10 T	0	A 81-82										10 T	2 T	0
		1	6 T	0	A 83-84	0	0			0			0	6 T	0	0	
203	SWAN	8	366 T	1	YA 81-82								300*T	366 T	292 P	16 T	1 T
		17	564 T	7	YA 82-83	2 T	355 T	564*T	373*T	347*T	322*T	362*T	126 T	0	0		0
		17	360 T	3	YA 83-84	5 T	65 T	360 T	105 T	136*T	192*T		240 T	8 T	0	0	30 P
		12	498 P	5	YA 84-85	264 T	275 T	127*P	174*T	292*T	498*P						
214	FRED	1	2 P	0	YA 82-83		2 P					0		0	0		0
207	SHEL	10	230 T	0	YA 81-82								85 P	10 P	160 P	230 T	48 T
		17	735 P	2	YA 82-83	5 T	73 T	22 T	64*T	293 T	238 T	375 P	735 P	0	0		0
		14	1111 T	3	YA 83-84	0	20 T	2 T	18*P	90*P	100 P		1000 P	1111 T	0	0	12 T
		8	445 T	2	A 84-85		9*P	10*P	8 T	445 T	52 P						
208	PABD	8	1800 P	0	YA 81-82								206 P	674 P	1800 P	466 P	2 T
		17	3500 P	3	YA 82-83	40 T	1500 P	168*T	60 P	238*T	315*T	3500 P	3000 P	0	0		0
		17	3000 P	4	YA 83-84	75 T	600 T	30 T	6 P	284*T	774*P		3000 P	2000 P	0	0	1760 P
		11	391 T	6	YA 84-85	70 T	391 T	10*P	50*T	267*T	300*P						
211	GYTL	8	2560 P	0	YA 81-82								46 P	102 P	2560 P	1110 P	34 T
		18	4500 P	0	YA 82-83	261 P	4500 P	330 P	90 P	8 T	57 P	4000 P	3000 P	0	0		0
		17	3500 P	1	YA 83-84	300 T	1730 T	10 T	2 P	56 T	560*P		2500 P	3500 P	0	0	400 P
		8	239 T	0	A 84-85	210 T	239 T	12 P	16 P	1 T	72 P						
210	CHTL	3	2 P	0	YA 82-83		2 P					0		0	0		0
		2	1 T	0	A 83-84	0	0			1 T			0	0	0	0	1 T
212	SHOV	8	530 P	0	YA 81-82								530 P	240 P	420 P	81 P	2 T
		16	610 P	0	YA 82-83	29 T	90 P	6 P	26 P	22 T	5 T	500 P	610 P	0	0		0
		10	2000 P	0	YA 83-84	0	124 T	4 T		25 T	12 P		2000 P	540 P	0	0	4 P
		10	41 P	2	YA 84-85	1 P	12 P		6 T	33*T	41*P						
213	PEAD	7	322 P	0	YA 81-82								53 P	52 P	322 P	200 P	0
		6	228 P	0	A 82-83		4 T					90 P	228 P	0	0		0
		4	480 P	0	A 83-84	0	0			0			25 T	480 P	0	0	
215	HARD	4	51 P	0	A 81-82								51 P	50 P		40 P	0

RAOU SURVEY OF WATERBIRDS. QUARTERLY REPORT BY RESERVE PART. 18 DEC 84

RESERVE : 17 - FORRESTDALE LAKE

PART : 1 - FORRESTDALE LAKE

ATLAS NO.	SPECIES	SVYS RECD	MAX RECD	T P	SVYS RECD BRDG	RCD	YEAR	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY
		10	1053	T	0	YA	82-83		12 P	29 P	56 T	1053 T	295 P	50 P		0	0		0
		10	195	P	4	YA	83-84	0	1 T	2 T	4 P	118*T	195*P		13*P	0	0	0	1 T
		11	140	T	4	YA	84-85		35 P	6 P	52 T	140*T	82*P						
202	MAND	1	1	P	0	A	84-85		0	1 P	0	0							
216	BBID	3	50	T	0	YA	82-83				50 T	5 P	5 T	0		0	0		0
		6	31	T	1	YA	83-84	0	0		15 T	31 T	16*P		5 T	C	0	0	
		7	45	T	1	YA	84-85		0	6 T	45 T	9*T	8 P						
217	MUSD	2	1	P	0	A	82-83			1 P	1 T			0		0	0		0
		4	1	P	1	YA	83-84	0	0			1*P	1 P		1 P	0	0	0	
		2	1	P	0	A	84-85		0	1 P	0	0	1 P						
219	MAHA	5	2	P	0	A	81-82								1 P	2 P		1 T	0
		11	3	P	0	YA	82-83		1 T	2 T	3 P	3 T	2 T	2 T		0	0		0
		6	2	T	0	A	83-84	1 T	0		1 T	2 T	1 P		1 T	0	0	0	
		4	2	T	0	YA	84-85		0		1 T	1 P	2 T						
046	BBAR	3	2	P	0	YA	82-83		1 P					2 P	1 P	0	0		0
050	BACK	3	2	P	1	YA	83-84	0	0			0			2*P	0	0	0	
049	AUCK	1	1	P	0	A	81-82								1 P				0
051	SPCK	1	1	P	0	A	81-82								1 P				0
		3	8	P	0	YA	82-83		1 P				8 P	1 P		0	0		0
		6	7	P	0	YA	83-84	0	0			7 P	7 P		3 P	0	0	0	
		2	4	P	0	YA	84-85		0		0	4 P							
055	BTNH	3	2	P	0	YA	82-83							1 T	2 P	0	0		0
		2	2	P	0	YA	83-84	0	0			0			1 P	2 P	0	0	
056	DUMU	3	7	T	1	YA	82-83							7*T	1 P	0	0		0
		4	2	P	1	YA	83-84	0	0			2*P	2 P		1 P	0	0	0	
		3	1	P	1	YA	84-85		0		1 P	1 P	1*P						
058	PUSN	4	9	P	1	YA	81-82								6*P	9 P	4 P		0
		16	21	P	2	YA	82-83	2 P	21 P	10 P	10*P	18 P	10 P	10 P	5 P	0	0		0
		12	13	P	4	YA	83-84	0	1 P	1 P	2*P	13*P	9*P		11 P	0	0	0	13 P
		10	12	P	3	YA	84-85	8 P	9*P	3 P	12*P	7 T	8*P						
059	COOT	6	4200	P	0	YA	81-82								2300 P	2589 P	4200 P	171 P	0
		14	2990	P	3	YA	82-83		2 T	309 T	1000 P	1616*P	615*P	1800*P	2990 P	0	0		0
		9	1140	P	4	YA	83-84	0	0		90 P	265*P	580*P		1140 P	1066 P	0	0	
		9	2600	P	6	YA	84-85		120 T	560 P	742*P	433*T	2600*P						
135	HALG	1	3	T	0	A	81-82												3 T
		2	14	T	0	A	82-83							0	14 T	0	0		1 T
		[illegible]	2	T	0	A	[illegible]	[illegible]	[illegible]			[illegible]			[illegible]	[illegible]	[illegible]		

RAOU SURVEY OF WATERBIRDS. QUARTERLY REPORT BY RESERVE PART. 18 DEC 84

RESERVE : 17 - FORRESTDALE LAKE

PART : 1 - FORRESTDALE LAKE

ATLAS NO.	SPECIES	SVYS RECD	MAX T RECD P	SVYS RECD BRDG	RCD	YEAR	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY
136	GRYP	4	2 T	0	YA	82-83							2 T	1 T	0	0		0
132	RKDD	4	4 T	0	YA	82-83							4 T	1 P	0	0		0
		3	1 P	0	YA	83-84	0	0			0			1 P	1 T	0	0	
851	LRIP	4	1 T	0	YA	83-84	0	0			0			0	1 T	0	0	1 T
143	RCAP	9	1283 T	1	YA	81-82									200 P	500 P	1283*T	1130 P
		14	1000 P	2	YA	82-83	500.P	123*T					320 P	1000 P	69 T	2 T		171 T
		15	400 T	2	YA	83-84	135 P	8 P			0			319 T	400 T	16*T	37 T	73 P
144	BFDP	6	4 P	0	A	81-82								2 T	2 P	4 P	2 T	0
		8	17 T	0	YA	82-83		10 P					17 T	1 P	0	0		0
		8	21 T	0	YA	83-84	0	0			0			8 T	21 T	0	0	11 P
		1	2 T	0	A	84-85		2 T		0	0							
146	BWST	8	2530 P	0	YA	81-82								620 P	1200 P	2530 P	894 P	3 T
		10	2530 P	0	YA	82-83	78 T	1560 P	162 T	46 T		164 P	2530 P	2240 P	0	0		0
		16	2000 P	0	YA	83-84	320 T	186 T	1 T		1 T	12 T		2000 P	1675 T	0	0	390 T
		6	60 T	0	A	84-85	60 T	60 T		0	2 T	16 T						
147	BAST	4	306 P	0	YA	81-82								2 P		100 P	306 P	0
		6	34 T	0	YA	82-83		7 P					34 T	8 P	0	0		0
		2	135 T	0	A	83-84	0	0			0			1 T	135 T	0	0	
148	RNAV	3	270 P	0	YA	81-82								1 P	90 P	270 P		0
		5	393 T	0	A	82-83		3 T					137 T	393 T	0	0		0
		2	716 T	0	A	83-84	0	0			0			1 P	716 T	0	0	
154	WOOS	3	11 T	0	YA	81-82										1 P	11 T	0
		1	1 P	0	A	82-83							0	1 P	0	0		0
		1	15 P	0	YA	83-84	0	0			0			15 P	0	0	0	
157	CUMS	1	1 T	0	YA	82-83							0	1 T	0	0		0
158	GANK	4	6 P	0	A	81-82										6 P	3 T	0
		6	12 P	0	A	82-83							11 T	12 P	0	0		0
		4	7 P	0	A	83-84	0	0			0			3 P	7 P	0	0	
159	MARS	1	4 T	0	D	82-83							4 T		0	0		0
152	BLAG	2	12 P	0	YA	81-82										12 P	11 P	0
		4	10 P	0	YA	82-83							9 P	10 P	0	0		0
		1	1 P	0	YA	83-84	0	0			0			1 P	0	0	0	
163	SHTS	5	146 P	0	YA	81-82									54 P	146 P	30 P	0
		6	150 P	0	YA	82-83		11 T					107 T	150 P	0	0		0
		4	[illegible] P	0	A	83-84	0	0			0			30 P	[illegible]	[illegible]	[illegible]	[illegible]

BREEDING RECORDS (*=DR,SN,E,YN; .=DD)

RAOU SURVEY OF WATERBIRDS. QUARTERLY REPORT BY RESERVE PART. 18 DEC 84

RESERVE : 17 - FORRESTDALE LAKE

PART : 1 - FORRESTDALE LAKE

MAXIMUM RECORDED AND BREEDING RECORDS (*=DR,SN,E,YN; .=DD)

ATLAS NO.	SPECIES	SVYS RECD	MAX RECD	T P	SVYS RECD BRDG	YEAR RCD	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY
		2	1	P	0	YA 82-83												
		1	1	P	0	A 83-84	0	0					0	1 P	0	0		0
											0			1 P	0	0	0	
162	RLNS	7	2100	P	0	YA 81-82												
		11	2400	P	0	YA 82-83	2400 P	75 T								1480 P	2100 P	1000 P
		8	1900	P	0	YA 83-84	4 P	9 P					695 P	1800 P	0	0		0
											0			266 T	1900 P	0	0	10 T
905	LOTS	4	26	P	0	YA 81-82												
		3	16	P	0	YA 82-83									2 P	26 P	1 P	2 P
		3	10	P	0	YA 83-84	0	0					7 T	16 P	0	0		0
											0			1 P	10 P	0	0	
161	CURS	4	120	P	0	YA 81-82												
		9	2000	P	0	YA 82-83	73 P	1 T								120 P	14 P	17 P
		7	700	P	0	A 83-84	38 P	2 T					700 P	2000 P	0	0		0
											0			150 P	700 P	0	0	2 T
167	BBIS	1	1	P	0	A 82-83												
													0	1 P	0	0		0 .
125	SIGL	3	2	P	0	A 81-82												
		4	2	T	0	A 82-83	1 T							1 T	1 T	2 P		0
		1	5	T	0	A 83-84	5 T	0					1 T	2 T	0	0		0
		1	240	T	0	A 84-85					0			0	0	0	0	
								240 T		0	0							
110	WHIT	2	1	T	0	A 81-82												
		1	1	T	0	YA 82-83		1 T								1 T	1 P	0
		1	6	T	0	A 84-85							0		0	0		0
								0		0	0	6 T						
524	CREW	5	6	P	1	YA 81-82												
		11	77	P	2	YA 82-83		1 P	8 P	25 P	50*P	77 P		5*P	6 P	2 P	2 P	0
		10	72	P	3	YA 83-84	0	0		6 P	72*P	32*P	41*P	11 P	0	0		0
		10	62	P	1	YA 84-85								14*P	2 P	0	0	2 P
								3 P	5 P	44 P	62 P	18*P						
522	LIGD	1	1	P	0	A 81-82												
		5	4	P	0	A 82-83								1 P				
									4 P	3 P		2 P	1 P					0
		9	9	P	0	A 83-84	0	2 P			9 P	2 P			0	0		0
		8	3	P	0	A 84-85	1 P	0	1 P	3 P	1 P	2 P		2 P	0	0	0	2 P
820	UIGB	1	1	P	0	YA 82-83												
		1	5	P	0	A 84-85							0	1 P	0	0		0
								0		0	5 P							
838	UIDK	1	500	P	0	YA 81-82												
		3	4500	T	0	YA 82-83		10 P						500 P				0
		1	1000	P	0	YA 83-84	0	0					0	4500 T	0	0		0
		1	700	P	0	A 84-85		0			0			0	0	0	0	1000 P
										0	0	700 P						
823	USLT	1	1	P	0	A 82-83												
													0	1 P	0	0		0
835	UIWR	3	60	P	0	YA 81-82												
		2	1	T	0	YA 82-83		1 T							60 P	60 P		0
		1	1	P	0	YA 83-84	0	0					1 P		0	0		0
											0			1 P	0	0	0	

18 DEC 84

RAOU SURVEY OF WATERBIRDS. QUARTERLY REPORT BY RESERVE PART.

RESERVE : 17 - FORRESTDALE LAKE

PART : 1 - FORRESTDALE LAKE

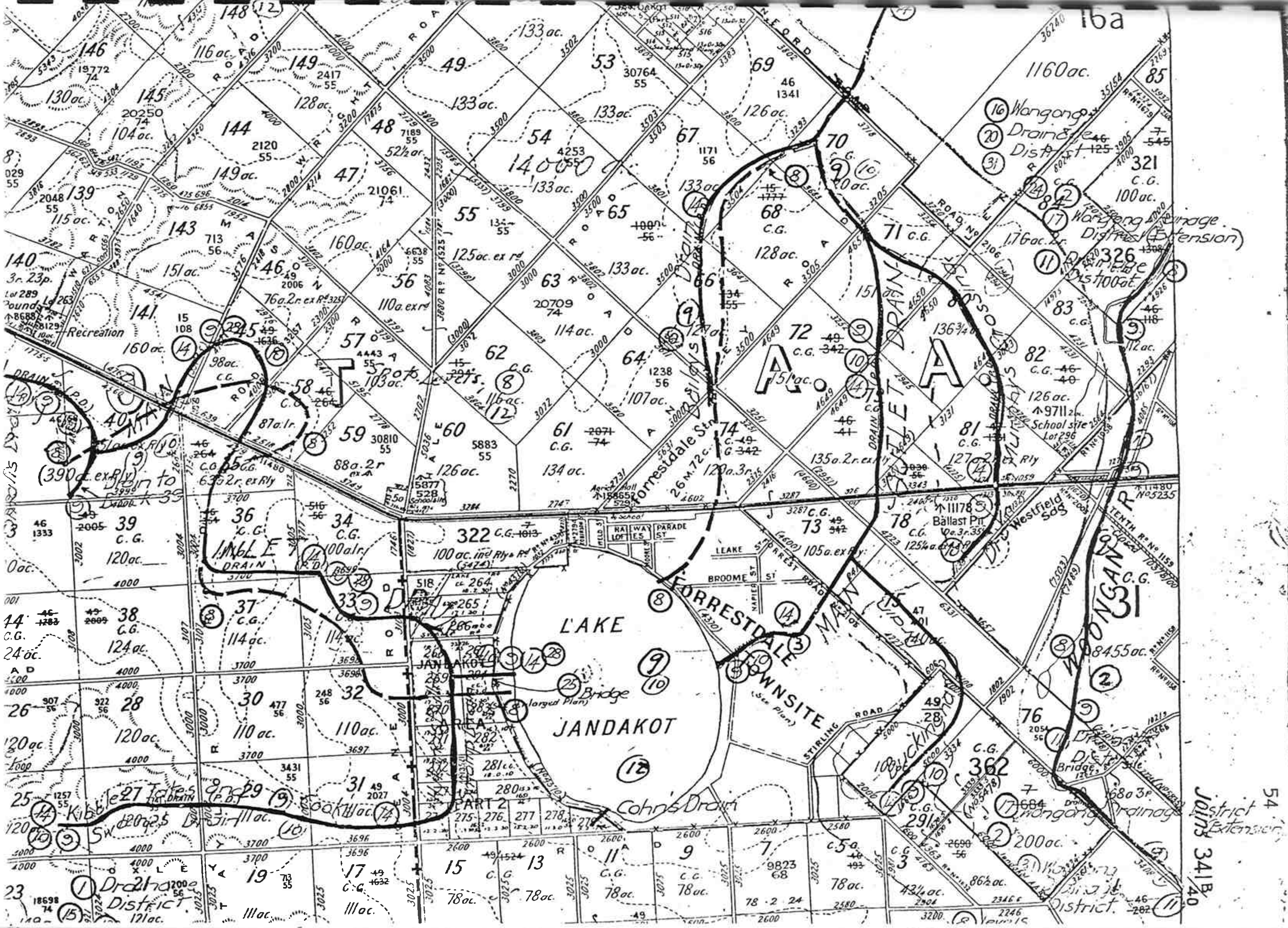
		JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY
SUMMARY : NUMBER OF SURVEYS :	81-82	0A 0N	0A 0N	0A 0N	0A 0N	0A 0N	0A 0N	0A 0N	0A 1N	0A 2N	0A 2N	0A 2N	1A 2N
	82-83	0A 1N	0A 5N	0A 2N	0A 2N	0A 1N	0A 1N	1A 2N	0A 3N	1A 0N	1A 0N	0A 0N	1A 0N
	83-84	1A 0N	1A 1N	0A 1N	0A 1N	1A 1N	0A 3N	0A 1N	1A 4N	1A 2N	2A 0N	1A 0N	0A 7N
	84-85	0A 2N	1A 1N	0A 1N	1A 1N	1A 3N	0A 2N	0A 0N	0A 0N	0A 0N	0A 0N	0A 0N	0A 0N
TOTAL NUMBER OF BIRDS : (ALL SPECIES)	81-82								4296	6358	15398	6984	2245
	82-83	3396	8390	1621	1924	4239	2619	15515	22932	69	2		172
	83-84	865	2822	411	260	1262	2575	8	12948	14785	16	37	3718
	84-85	616	1397	764	1243	2012	4509						
NUMBER OF SPECIES :	81-82								26	23	32	25	12
	82-83	13	28	16	19	16	22	39	36	1	1		2
	83-84	10	15	9	12	23	24	1	41	26	1	1	17
	84-85	8	14	14	19	21	24						
NUMBER BREEDING SPP :	81-82								3	0	0	1	0
	82-83	1	1	3	4	4	3	4	0	0	0		0
	83-84	0	0	0	2	9	9	1	3	0	1	0	0
	84-85	0	2	3	4	6	8						

DATE OF LATEST SURVEY ENTERED IN DATA BANK = 18 NOV 84

NUMBER OF SPECIES RECORDED TO DATE = 61. BREEDING SPECIES = 17

NUMBER OF SURVEYS ENTERED ETC. = 73: NUMBER IN WHICH ALL SPECIES PRESENT WERE RECORDED = 16

OBSERVERS								
JAMES D	7A	29N	WILMOT P	0A	2N	DOUST D	9A	14N
JAENSCH R	0A	7N	WATKINS D	0A	4N	MALONE J	0A	1N


LAKE
JANDAKOT
FORRESTDALE
TOWNSITE
(See Plan)
Forrestdale Stn
26 M. 72 c.
RAILWAY PARADE ST
LEAKE
BROOME ST
NAPIER ST
FORREST ROAD
STIRLING ROAD
Westfield Sdg
Ballast Pit
TENTH R No 1159
Recreation
School site
Bridge
Cohn's Drain
MAIN
INLET DRAIN
Wongong Drainage District
Wongong Drainage District (Extension)
Drainage District
Kibble Tates and Cook
Buckingham
Agric. Hall
Schoolsite
AREA
PART 2
1160 ac.
14000 ac.
8455 ac.
WOONGAN
31
A
A
Joins 341B/40

ex Nº	Plan Nº	F.B. and L.B. Nº		Date	Subject
1	19481			1916.	East Jandakot. Amended Drainage District.
2	22279			1922	Wongong Drainage District. (As Constructed)
3	22524	9502		1923	East Jandakot Drainage. Jandakot Lake. Main Outlet Drain Removal of Silt.
4	21442	9513-4		1920	Peel Estate Drainage. System Nº 1.
5	15093	6395 6397		1910	West Jandakot Drainage. Poole's Line.
6	19616	7300 7302			" " " Thompson's Lake and Briggs Swamp etc.
7	22545	11299		1923	East Jandakot Drainage. Southern River Drain.
8	13029	W.S.D. 1888		1907	Jandakot Drainage Survey. Levels and Pro. Scheme. P.W. 8482/06.
9	19486	7300 9683		1913 1916	East Jandakot and Woongan Brook Drainage. P.W.W.S. 1283/13. (As Constructed) [illegible] 341B/40
10	16298	7375-8 7382-3/5		1911	East Jandakot Drainage. Pro. ([illegible] "As Constructed", [illegible] 19486)
11	19483		Att to 19481	1916	East Jandakot (East Portion) Drainage District, also Woongan River Improvements.
12	22707		And see 22168	1923	Jandakot Drainage. Proposals 1923. Drains and Watershed Areas, Levels. P.W. 736/19. Lands File. 961/23
13	21288			1910	East Jandakot Drainage District. Amended by Gazette 16.6.16. P.W.W.S. 1134/18.
14	22278	7375 7382		1922	" " " " Works (As Constructed)
15	19482		Att. to 19481	1916	East Jandakot (West Portion). Pro. Drainage District.
16	19677		Att. to 19480	1918	Wongong Drainage District. P.W. 2086/18.
17	19480			1917	" " " Pro. Extension. P.W.W.S. 1415/17
18	21254		Att. to 19616	1911	West Jandakot Drainage, Thompson. Kogalup, Yangebup Lakes, etc.
19	16222	7282-3 7299-7302	Att. to 19616	1912	West Jandakot Drainage. Thompson, Kogalup, Yangebup Lakes, etc.
20	13770		Att. to 19484	1908	East Jandakot and Woongan Drainage Districts.
21	19479	W.S.D. 3311	Att. to 13029	Old.	East Jandakot Drainage. Existing Drains and Levels. (not accurate, [illegible])
22	19484			1913	East Jandakot and Woongan Drainage Districts. P.W.W.S. 2650/13.
23	13807			Old	West Jandakot Drainage Area. Pro.
24	14421			1909	East Jandakot - Wongong Drainage Area. Pro.
25	19485			1913	East Jandakot Drainage. Bridge at Jandakot Lake
26	19617			1912.	West Jandakot Drainage Area. Pro., P.W.W.S. 899/12.
27	22370		Tin "C"	1922	Jandakot R.D. Drainage in Canning Vale.
28	23931	7376 12202		1925	East Jandakot Drainage. Levels along bed of Main Inlet Drain, and Pro. Regrading. P.W.W.S. 194/18. ([illegible] 19486)
29	22168	9978-80 11948-54	And see 22707.	1924 1925.	West " " } Bibra-Thompson Lakes Main Drain to Ocean. Pooles open cut Line, Thompson's Lake to Sea. P.W. 793/21
30	21711	9529-30		1921	Spearwood Swamp. Pro. Cleared Channel.
31	22279			1922	Wongong Drainage District. and [illegible] 341B/40
32	26976			1931	East Jandakot Amended Drainage District. (Portion to be Excised.)
		14551		1930	West Jandakot Drainage, Connecting Levels from B.M JA/11 to zero on Gauge post in Browne's Swamp.
		14985 14986		1931	" " " Prelim. Survey. from Nth. Lake To Bull's Ck.