REMNANT VEGETATION on the ALLUVIAL SOILS of the EASTERN SIDE of the SWAN COASTAL PLAIN

Prepared by

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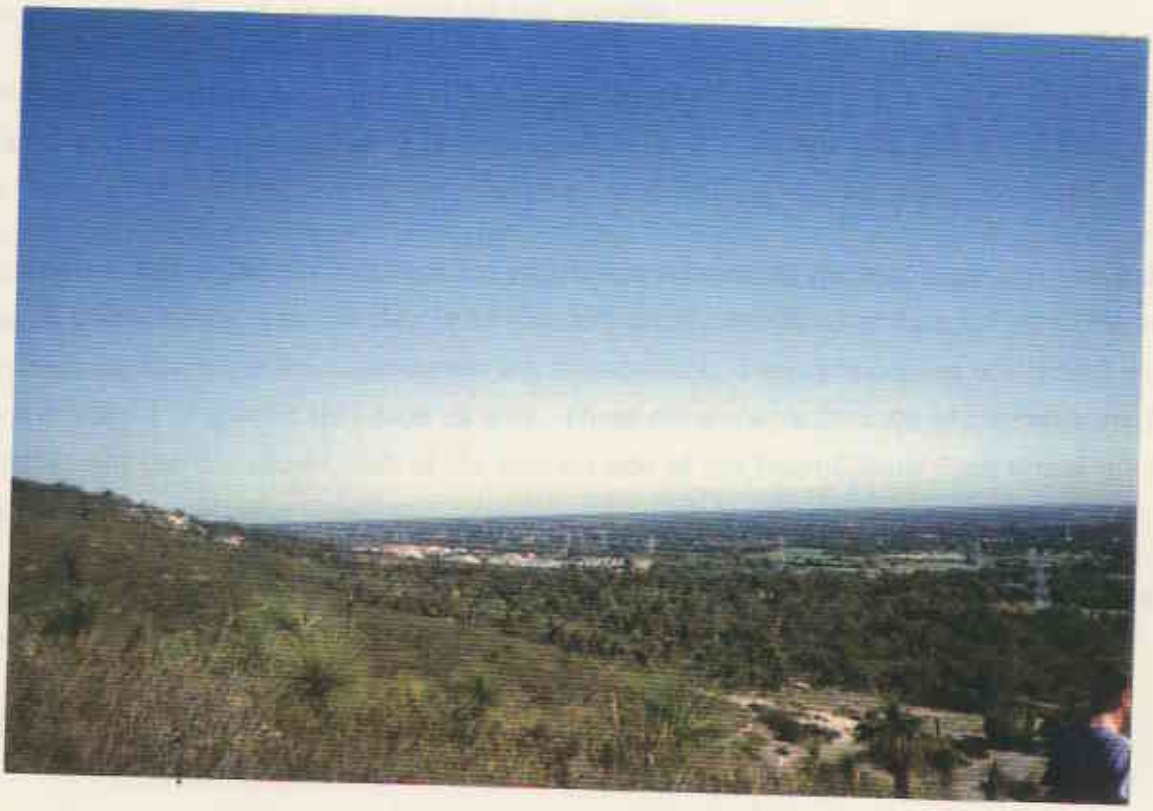

Figure 1 **The Swan Coastal Plain looking south west from Ellis Brook Reserve on the Darling Scarp**

SUMMARY

This survey was commissioned because of concern that clearing for agriculture and urban development had reduced the native vegetation of the eastern side of the Swan Coastal Plain between Pinjarra and GinGin to scattered small remnants. The concern was heightened by the apparent rapid loss and degradation of these remnants and the fact that very little was known about the vegetation and flora of the study area.

The field work, examination of aerial photographs and maps found that this concern was soundly based. In fact, so little of the remnant vegetation of this section of the Swan Coastal Plain remains that it is too late to adequately conserve the vegetation associations, even if all remnants were protected. The study also shows that we will never know for certain what the vegetation of the area was like as insufficient remains even for this purpose.

However, the survey has shown that the vegetation associations of the eastern side of the Swan Coastal Plain between GinGin and Pinjarra are diverse both in structure and in the composition of the flora.

Because so little of this diverse flora and vegetation remains, all remnant vegetation with the basic vegetation structure intact, or able to be regenerated, is considered of flora conservation value and recommendations made for its protection and management. Twenty two areas of remnant vegetation are the subject of specific recommendations. These recommendations would conserve the flora and landscape of the the alluvial soils of the eastern side of the Swan Coastal Plain within the limits of the remaining vegetation.

The characteristic vegetation of the heavy soils on the eastern side of the Swan Coastal Plain (the quintessential Pinjarra Plain) was found to have been:

Eucalyptus calophylla (Marri) Woodland to Open Forest
Casuarina obesa (Salt Water Sheoak) Woodland
Eucalyptus calophylla and *Eucalyptus wandoo* (Wandoo) Woodland to Open Forest
Eucalyptus wandoo Woodland to Open Forest
Eucalyptus rudis (Flooded Gum)Woodland to Forest
Wetland Associations; a complex mosaic of shrublands, heaths, sedgelands and herblands.

The woodlands and open forests are almost extinct having been reduced by clearing to a few small isolated pockets. This indicates a degree of ignorance of the value of native vegetation associations especially when compared to the resources and publicity given to the conservation of individual species.

The ephemeral wetlands show a great diversity of vegetation associations and flora. These wetlands are the centre of endemism on the eastern side of the Plain and contain many poorly known taxa. Of the vegetation associations characteristic of the study area the wetlands remaining are comparatively extensive. A comprehensive flora conservation reserve network for these wetlands could and should be established.

The composition of the flora of these woodlands, forests and wetlands was found to be unusual, having a much closer relationship with the flora of the Darling Scarp than was previously recognised in the botanical literature.

The vegetation associations of the sandier soils of the eastern side of the Plain have close affinities with the vegetation of the Bassendean Sands to the west while still retaining a degree of affinity with the flora of the Darling Scarp. However an area of *Banksia* Woodland was identified, within the metropolitan area, that has close affinities with the flora of the Scarp and the northern sandplains and as such is a unique association in need of reservation.

Some important areas of remnant vegetation on the Ridge Hill Shelf are identified and recommendations made for their reservation. A rare vegetation type, *Eucalyptus lanepoolei* Woodland was identified in this area.

The need for a flora conservation reserve on the Dandaragan Plateau, south of GinGin also became apparent during the survey.

RECOMMENDATIONS

RECOMMENDATION 1

As a consequence of the small amount of remnant vegetation on the alluvial soils of the eastern side of the Swan Coastal Plain all such remnants in the study area with the basic vegetation structure intact or able to be regenerated (Poor or better condition) are of significant flora conservation value, regardless of the remnant's size.

RECOMMENDATION 2

All owners or managing authorities of land containing remnant vegetation should be contacted with information concerning the significance and nature of the remnant vegetation on the alluvial soils of the eastern side of the Swan Coastal Plain with particular reference to the vegetation on their land.

RECOMMENDATION 3

Local Government Authorities in co-operation with the appropriate bodies should develop a Remnant Vegetation Manual outlining guide-lines for the management of remnant bushland. Workshops on the application of the guide-lines should be held periodically with the appropriate management groups.

RECOMMENDATION 4

Immediate action should be taken to ensure that the twenty two areas of remnant vegetation subject to individual recommendations (see Section 6.3) are vested and managed for the conservation of flora as their main purpose, according to the specific recommendation for each area.

RECOMMENDATION 5

The remnant vegetation identified on the Reagan soil unit and Dandaragan Plateau south of GinGin should be urgently surveyed to determine the most suitable area to be acquired for a flora conservation reserve.

RECOMMENDATION 6

A local tree planting programme should be developed for the eastern side of the Swan Coastal Plain to preserve the unique treescapes of the area.

CONTENTS

I.O INTRODUCTION

1.1 Purpose of the Study

This report has been prepared to document the remnant vegetation of the alluvial soils on the eastern side of the Swan Coastal Plain between Pinjarra and GinGin and to assess the conservation value of these remnants. This assessment is urgent because of the degree of clearing and the paucity of knowledge of the vegetation of the study area (see Section 1.3).

1.2 Location

The remnant vegetation surveyed in this study is that on the alluvial soils of the eastern side of the Swan Coastal Plain between Pinjarra and GinGin (Figures 1, 2 &3). The western and eastern boundaries are set on soil types. This band of alluvial soils varies from 1 km to 25 km in width (Beard, 1979).

The soils types surveyed being

- Pinjarra Plain (McArthur and Bettenay, 1960).

and to a lesser extent the soils of the

- Ridge Hill Shelf, the foothills of the Darling Scarp (McArthur and Bettenay, 1960),
- the western margins of the Dandaragan Plateau, Coonambidgee and portions of Reagan geomorphic/soil units (Churchward and McArthur, 1980)

1.3 Extent of Clearing of the Study Area and Previous Vegetation and Flora Studies

It has been estimated that the eastern side of the Swan Coastal Plain is 97% cleared of vegetation (CALM, 1990). The Wheatbelt, considered to be 93% cleared (Beard ,1990) has been the subject of intensive study in the past 15 years but the eastern side of the Swan Coastal Plain has received comparably scant attention even though Beard noted in the same publication that there was "..no virgin vegetation left " on the eastern side of the Swan Coastal Plain.

This situation has been recognized for some time and has led to some speculation in the literature (Speck, 1958; Smith, 1974; Hallam, 1975; Seddon, 1972, Beard, 1979a & 1979b and Heddle et al, 1980) about the vegetation that existed in the study area prior to European settlement.

Beard (1979a & 1979b) and Heddle et al (1980) have produced the most recent small scale (1:250 000) vegetation maps of the study area based on studies of the remaining patches of vegetation and soil maps. Their maps are similar but are not in agreement about certain aspects of the vegetation associations. Also these maps are generally on too small a scale to discern the variation in the vegetation associations on the alluvial soils.

There are few comprehensive treatments of the flora and vegetation of any of the remnant vegetation in the study area that could help elucidate the discrepancies.

One study by Keighery and Keighery (1990) of the flora and vegetation of the Brixton St Wetlands, Kenwick, describes 7 vegetation associations in an area of 19 ha. This is a great diversity of vegetation associations for such a small area. The diversity of associations is reflected in the diversity of flora with the 258 taxa recorded for the wetlands representing 17% of the known flora of the Perth Region.

When the taxa are grouped according to various criteria related to their conservation status and ecological preferences, important aspects of the flora of the study area were illustrated. These were

- the close relationship between the flora of the heavy soils of the Scarp and the heavy soils of the Survey Area.

- the presence of a significant number of taxa endemic to this eastern side of the Swan Coastal Plain.
- the incomplete knowledge of the flora, as indicated by the occurrence of many poorly known taxa.

The only other detailed study is that of Speck and Baird (1984) on the Yule Brook Reserve, Cannington, which supports these same trends. Nine vegetation associations are described and a flora of 350 taxa listed for this Reserve of 28 ha. None of the associations are directly equivalent to those at the Brixton St Wetlands which is located only two kilometres away.

These detailed studies establish that the vegetation associations in the the study area are complex and varied. They also indicate the importance of detailed vegetation and floristic studies in assessing the conservation value of remnant vegetation.

1.4 Geomorphology and Soils

The study area is part of the Swan Coastal Plain. The Swan Coastal Plain is the surface expression of the Phanerozoic sedimentary deposits of the Perth Basin. Its eastern boundary is marked by scarps and associated features. South of Bullsbrook this boundary is the surface expression of the Archaean Yilgarn Block, the Darling Plateau, separated from the Perth Basin by the Darling Fault. The Fault is actually 1-2 km west of the Darling Scarp and obscured by the sediments of the Perth Basin. North of Bullsbrook the Darling Fault is separated from the Swan Coastal Plain by the Dandaragan Plateau, the western edge of which is formed by the GinGin Scarp.

The Swan Coastal Plain consists of a sequence of alluvial deposits in the east, the area of this study, and a series of aeolian deposits in the west.

McArthur and Bettenay (1960) divided the Plain from east to west into a series of geomorphic elements each with a characteristic suite of soils, generally bearing the same name. From east to west these are the alluvial soils of the Ridge Hill Shelf and Pinjarra Plain and the aeolian soils of the Bassendean, Spearwood and Quindalup Dunes.

Since McArthur and Bettenay's pioneering publication more detailed small scale soils maps (1: 250 000) of the Swan Coastal Plain have been made by Churchward and McArthur (1980). Detailed maps at a much larger scale (1: 50 000) of much of the Swan Coastal Plain have also been produced by Van Gool (1990), Wells and Hesp (1989), King and Wells (1990) and McArthur (1987).

This study uses the geomorphic and soil boundaries of the detailed studies and the general boundaries of Churchward and McArthur (1980) where detailed maps are not available.

The study area, the eastern side of the Swan Coastal Plain, can be considered in the three sections related to geomorphology and soils.

i) Dandaragan Plateau, western margins - the Reagan and Coonambidgee units of Churchward and McArthur (1980) and Reagan of King and Wells (1990).

The of western margins of the Dandaragan Plateau are sometimes referred to as the foothills of the Dandaragan Plateau. For this study the western margins of the Dandaragan Plateau includes adjacent portions of the Reagan and Coonambidgee units. The Reagan unit of gently to moderately inclined slopes of yellow or grey sandy soils formed from the weathering of the sedimentary rocks and its remnant lateritic spurs merges to the west with the Coonambidgee unit of deep grey sands.

ii) Ridge Hill Shelf - Foothills, Wells and Hesp (1989); Forrestfield , Churchward and McArthur (1979) and King and Wells (1990)

A narrow dissected strip from 1-3 km in width sloping gently to the west and forming the foothills of the Darling Scarp. It consists of stream deposited coalescing alluvial fans and remnants of marine terraces. In some areas residual laterite occurs on the surface. The soils are moderately well to well drained.

iii) The Pinjarra Plain - Fluviatile Deposits: Coonambidgee, Guildford, Beermullah, Swan,

Serpentine, Cannington and Yanga, Churchward and McArthur (1979); Swan, Guildford and Yanga, Wells and King (1990) and Pinjarra Plain, Van Gool (1990) and Wells and Hesp (1989)

A series of alluvial tracts sloping very gently to the west. The surface of the Plain is flat to very slightly undulating and consists predominantly of Pleistocene fluvial sediments and some Holocene alluvium associated with major current drainage systems. Soils are naturally poorly drained with considerable areas of seasonally inundated wetlands (palusplain, sumplands and damplands, Semeniuk, 1989). These soils form a band to the east from 1-25 km wide (Beard,1990). The Pinjarra Plain shows it greatest development along the main drainage lines of the Swan Coastal Plain, which within the study area, are the Swan, Helena, Canning, Serpentine and Murray Rivers.

The general soil boundaries of Churchward and McArthur (1979), used widely in vegetation mapping of the Swan Coastal Plain, were often quite different to those of the detailed studies. Consequently the detailed mapping was a better indicator of vegetation than the general maps. This indicates that care must be taken when making extrapolations from soil maps to conclusions about the expected vegetation to be found at a particular location. For example the Cardup Nature Reserve was considered to be an area of vegetation representative of the Pinjarra Plain vegetation (Conservation Reserves for Western Australia, The Darling System - System 6, 1983). On the broad scale maps of Churchward and McArthur it is entirely located on alluvial soils but the detailed soil map of Van Gool places the Reserve mostly on Bassendean Sands overlying Pinjarra Plain.

2.0 METHODS and LIMITATIONS

2.1 Introduction

This survey was designed to give sufficient detail of the vegetation associations, including their condition, of the remnant vegetation of the eastern side of the Swan Coastal Plain between Pinjarra and GinGin to provide a basis for recommendations on the flora conservation value of these remnants.

2.2 Selection of Areas of Remnant Vegetation

2.2.1 Soils

The vegetation survey in this study was tied to soil type, the alluvial soils of the eastern side of the Swan Coastal Plain. The study area is considered in the three sections related to geomorphology and soil outlined previously (see Section 1.4).

i) Dandaragan Plateau, western margins
ii) Ridge Hill Shelf
iii) The Pinjarra Plain

For the purposes of this study divisions of the Pinjarra Plain were made based on the detailed soil maps and experience gained in the study.

These broad divisions relate to

a) Slightly Elevated Plain
b) Wetlands
c) Drainage Lines
d) Lakes

On the Pinjarra Plain this survey concentrated on the heavier soils, clays and loams, and the overlying Bassendean Sands where the influence of these soils was evident. Much of the Pinjarra Plain, particularly the area between Welshpool Rd and Maida Vale Rd and west of Ellen Brook from Wannamal to GinGin has a varying degree of surface expression of Bassendean Sands. Some of these areas were, on consideration of the vegetation, obviously influenced by the presence of alluvial soils of the Pinjarra Plain underlying them and included in this Study. Experience in the southern area, where detailed soil maps were available, was used to establish a concept of the vegetation associated with soils that had a surface expression of Bassendean Sands but influenced by the underlying alluvium. Consequently areas of the Southern River unit, an aeolian deposit (Churchward and McArthur), were included in the study and some of the Yanga unit, a alluvial deposit(Churchward and McArthur), were excluded from the Study.

This pattern of overlying sand was further complicated north of Bullsbrook where the sandy soils of varying origin from the Reagan, Coonambidgee and Yanga units occur in very close proximity.

2.2.2 Locating the Areas of Remnant Vegetation

The areas of remnant vegetation were identified using aerial photographs, soil maps and by field examination of the study area. Individual areas of remnant vegetation are referred to as locations. One hundred and forty locations were described.

This selection procedure was supplemented by maps produced by the the Geographic Information System (GIS) Unit of the Department of Agriculture showing remnant vegetation, soils and cadastre. These were not available until part way through the study so could not always be used in planning the ground survey.

It should also be noted that the criteria for mapping remnant vegetation mapped by the GIS Unit were apparently different than those for this study. Remnant vegetation in the context of the GIS Unit mapping is related to agricultural land use and orientated towards tree cover as an indicator of areas of remnant vegetation. Areas of scattered trees classified as being Completely Degraded Condition (see Table 2) by this study and not areas of remnant vegetation; were considered areas of remnant vegetation when classified, by the GIS criteria. Such areas have little flora conservation value. At the other end of the scale areas of high flora conservation value were not mapped by the GIS Unit, or mapped as modified remnant vegetation, as they were areas without significant tree cover. Examples of such discrepancies were found at Forrestdale Lake (Location 1) which GIS mapped as modified and Abernathy Rd (Location 8) which the GIS Unit did not map.

The position of each of the locations is shown on the Location Maps 1-15, page 102, these maps are the maps supplied by the GIS Unit and the Metropolitan Street Directory (1992).

2.2.3 Size of Remnants

Originally only areas >20 hectares were to be surveyed as these were considered to represent viable areas for conservation. Early in the study of the aerial photos it became obvious that this would not be possible as clearing was so extensive that very few such areas of remnant vegetation are extant in the study area.

Also the early selective clearing of the more agriculturally valuable alluvial soils and the consequent poor knowledge of the vegetation associations of the alluvial soils necessitated the survey of the extant fragments of vegetation on the alluvial soils to gain an accurate as possible idea of the vegetation associations of the alluvial soils.

2.3 Describing Remnant Vegetation

Each of the remnant vegetation locations identified was visited to describe the vegetation associations (Tables 1a & b) present and the condition of the vegetation according to the Condition Ratings developed by Trudgen (Table 2).

Locations with remnant vegetation in Poor or better Condition and/or of high flora conservation value were surveyed by foot and described (see Appendix 1). In locations of sufficient size, sites were described in each vegetation association present. They were located in the least disturbed sections of each of the vegetation associations discerned at a location. When only one site was determined in a location the description of that site generally applies to the whole of that location. The sites were relevees of about 10 by 10 metres. The number of sites varied at a location ranged from 1 - 9. Over 130 detailed sites were described.

The site descriptions include the listing of the dominant species, significant species (see Section 2.4) and weeds. The type and abundance of weed species is an important factor in assessing condition.

Common plant species well known to the author were recorded but not collected. Specimens were collected when necessary and identified using Marchant et al (1987) and by comparison with material at the Western Australian Herbarium. Specimens were retained when a species was considered to be of particular interest.

Site descriptions also include details of the soils, drainage and aspect.

A vegetation map was compiled for most locations. Vegetation Maps for the locations subject to specific recommendations (see Section 6.3) begin on page 81 and other remnant areas are in Appendix 2.

At some locations the vegetation was so disturbed and/or the location so small in area that a site

could not described and only a general description of the location was made. To describe an individual site would have been uninformative and in these cases the whole location was described after survey of the entire area. These general description include detailed listings of species present and probable vegetation associations when the location is considered to be of particular significance.

Much of the vegetation in the study area is Completely Degraded and warranted only a brief description for example that for Bird Rd, Location 14. (Appendix 1). These descriptions are included as they give an idea of the extent of the vegetation associations before European settlement and as such are important in assessing the flora conservation value of the remnants. Small remnants of once widespread associations are of significant flora conservation value even though their size and condition alone would not indicate this.

Areas of remnant vegetation of high conservation value with enough relatively undisturbed vegetation associations and with a reasonable chance of being retained for conservation purposes were selected for detailed flora and vegetation survey as part of the Swan Coastal Plain Survey (see Appendix 3). This detailed Survey will be the subject of a three to four year study from 1990 to 1994.

2.4 Assessment of the Flora

A detailed flora survey was beyond the scope and requirements of this Study. However limited data on the flora of the eastern side of the Swan Coastal Plain from various sources:

- flora data collected in this Survey
- detailed flora data being accumulated through the Swan Coastal Plain Survey (Keighery and Keighery, 1992a, b &c, 1993 in prep)
- Flora of the Perth Region (Marchant et al)
- Herbarium records
- Metropolitan Region Rare Flora Survey (Kelly, 1990- onwards)

was collated in a similar manner to flora data for the Brixton St Wetlands (see Section 1.3)
The three groupings are:

1) Taxa probably confined the eastern side of the Swan Coastal Plain and the Darling Scarp in the Perth Region and possibly found elsewhere (see Table 4, annotated with 4# in the location descriptions)
2) Taxa probably confined to the eastern side of the Swan Coastal Plain and occurring in other regions (Table 5, annotated with 5# in the location descriptions)
3) Taxa probably confined to the eastern side of the Swan Coastal Plain and endemic to the Swan Coastal Plain (Table 6, annotated with 6# in the location descriptions)

2.5 Limitations

A few locations were not the subject of detailed site decriptions. Private land that was fenced was generally surveyed from the fenceline. Some of the locations were not accessible, these are noted in the descriptions (see Appendix 1).

Locations that were known to be the subject of previous studies are included using these reports when they were available for use.

Sections of many locations were under water or extremely boggy at the time of the study. The drying soils in these areas often support Herblands of annual and geophytic species if they have not been too disturbed. Disturbance in these areas is characterised by weed invasion and can only be assessed when the areas are drier. Consequently the condition rating of such areas is conditional and can only be fully assessed when the areas are drier. This assessment needs to be made when conditions are appropriate and can take several years.

Not all patches of remnant vegetation were visited. However it was considered that sufficient were surveyed to establish

- a clearer picture of the vegetation of the area prior to European settlement
- an indication of areas suitable for flora conservation
- directions and priorities for further studies in the study area

3.0 LAND USE

The flat to undulating area of alluvial soils on the eastern side of the Swan Coastal Plain in the vicinity of the Swan River is reported to have been of an open park-like appearance when the Europeans arrived, as described by Charles Fraser (1827, reprinted with comments from 1906 in Seddon, 1972). This description and observations by Captain Stirling concerning the fertility and abundance of water in the vicinity of the Swan River from the same survey were the basis on which the settlement on the Swan River was established.

The review of many early records by Hallam (1975) considered that such park-like vegetation was the result of firestick farming by the Aboriginal people and was the typical vegetation of the eastern side of the Swan Coastal Plain (see Section 5.4.1).

Consequently the study area was of early interest to the European settlers having relatively fertile soils and being flat and openly vegetated. The rivers formed natural transport routes for the Europeans and led to the areas of more fertile alluvial soils at the base of the Scarp. The alluvial tracts along the Swan River were areas of the first land grants in the settlement in 1829. Other areas of alluvial soils were settled soon after. Kelmscott was established as early as 1830 and an area from Lake Bambun to Lennards Brook, south west of GinGin, was the site of a land grant in 1831.

By the 1860's much of the land in the study area was subject to grants or leases. In the south of the study area much of the land was encompassed in Thomas Peel's 250,000 acre land grant which stretched from Wungong to Pinjarra. To the north of Midland much of the land was encompassed by grazing leases.

Initial land use involved timber milling, grazing and the production of general farm produce and dairy products. Considering the early interest development of the area was slow. Much of the land was waterlogged and transport except in summer was hampered by the frequent creek and river crossings and the numerous swamplands.

The development of the railway through Armadale, Pinjarra and Bunbury and through Midland to GinGin in the late 1880's and early 1890's opened the study area to closer settlement. Many people attracted to the State by mining redirected their interest to farming and the railway not only gave them access to the alluvial soils at the base of the Scarp, recognized as superior to the sands to the west, but could be used to get produce to markets.

Much of the poorly drained land was not settled until drains were constructed. For example the lands of the Peel estate were not extensively cleared until the 1920's when the Peel Estate became part of the Group Settlement Scheme. Blocks were only 45 hectares and clearing was done with *all due haste* (Coy, 1989). Transport was provided by unballasted narrow gauge lines. Again timber cutting was important, this time for firewood which undoubtably encouraged the felling of most of the trees. As most of the land was swampy, even more so than now as there were no dams on the Serpentine River or Wungong Brook, drainage was essential. Drains were constructed throughout the area dug by excavators and hand. This land is still waterlogged in winter. Today the long term agricultural viability of the area is related to the ability of the land to support summer pasture, the basis of the present day dairy industry in the area today.

Drainage of the swampy land south of Armadale has resulted in almost the entire area being developed for agriculture, particularly for orchards and pasture for dairy cattle. North of Midland the predominant land use is grazing of beef cattle while viticulture is the main land use in the Swan Valley. The orchards that were once a feature of the alluvial soils from GinGin to Kelmscott have been superseded by housing between Kelmscott and Midland and abandoned in GinGin.

The scattered intact areas of remnant native vegetation are consequently generally associated with

- poorer soils, sand overlying alluvial soils
- sumplands and adjacent damplands
- undeveloped townsites
- recreation reserves

- Mines, gravel or sand
- Transport corridors; roadsides, rail verges
- Public Utilities: SEC lines, drainage channels, rubbish tips

The largest tracts of remnant vegetation within the study area are on the pockets of sandy soils.

4.0 FLORA

The limited treatment of aspects of the flora in this study (see Tables 3-6 and Appendix 1) was sufficient to establish that the flora of the study area has some interesting relationships and features.

These are

(i) **The close association of the flora of the study area with the flora of the Darling Scarp**(Table 4).
The study area and the Scarp share over 120 taxa. These taxa are predominantly taxa that show a preference for heavy soils and are able to tolerate seasonal waterlogging. Many of these taxa were poorly known on the the Swan Coastal Plain before this study.

(ii) **The significant number of taxa in the study area from geographically removed areas** (Table 5).
Ten taxa from the northern sandplains occur in the study area and are apparently not found in the connecting lands.

(iii) **The apparent high degree of endemism** (Table 6).
Thirty four taxa are apparently endemic to the eastern side of the Swan Coastal Plain. Thirty two of these taxa are dependant on the heavy seasonally inundated soils of the wetlands. Ten of these taxa are confined to ponds. Four taxa, *Hydrocotyle lemnoides*, *Aponogeton hexatapalus*, *Haloragis tenuifolia* and *Myriophyllum echinatum*, flower in filled ponds and six taxa flower as the ponds dry. Only two of these taxa, *Conospermum undulatum* and *Chamelaucium* sp., are found on sandy soils.

(iv) **The large number of poorly known taxa** (Tables 4, 5 &6)
Nineteen taxa are newly described or recently recognised undescribed taxa which were not treated in the Flora of the Perth Region (Marchant et al 1987). Five taxa were not recorded in the Flora of the Perth Region.

(v) **The large number of taxa that are considered threatened** (Tables 4,5 &6)
Five taxa from the study area are Declared Rare Flora (DRF). Three presumed extinct taxa are recorded from the study area. All these taxa are apparently confined to the seasonally inundated soils of the wetlands. One DRF taxon, *Calytrix breviseta* ssp. *breviseta*, was presumed extinct until a recent survey (Kelly, 1990-). There are 28 priority taxa in the study area.

Those relationships established for the flora of the Brixton St Wetlands (see Section 1.3) can be seen from this data to be characteristic of the study area as a whole. The flora of the study area is very diverse and has a high degree of endemism, related to the seasonally innundated heavy soils and the degree of ponding on these soils.

This study and the Swan Coastal Plain Survey have made significant records for the study area and indicate the poor state of knowledge of the distribution of flora of the Swan Coastal Plain.

Some other interesting observations can be made from this limited flora data and the flora data for each Location (Appendix 1). The vegetation associations generally contain a diverse shrub flora. This shrub flora is particularly rich in species of Proteaceae and Myrtaceae but poor in the Epacridaceae and Mimosaceae. All four families are generally well represented in the shrub flora of the south west of western Australia.

The vegetation associations occurring on seasonally inundated soils are rich in herb and sedge species with significant representations from the Stylidiaceae, Apiaceae, Droseraceae, Anthericaceae, Cyperaceae and Restionaceae.

The more detailed flora treatments for the Swan Coastal Plain Survey further support these trends. These detailed studies highlight the substantial additions to knowledge of our flora that can be made from detailed floristic studies, for example the occurrence of *Dasypogon obliquifolius* in *Banksia* Woodland as far south as Cardup (Location 11).

5.0 VEGETATION

5.1 Catalogue of Remnant Vegetation Associations

The principal vegetation associations in the study area are outlined below. These are considered in the groupings related to geomorphic/soil units outlined previously (see Section 1.4 & 2.2.1). These are

i) the western margins of the Dandaragan Plateau
ii) the Ridge Hill Shelf
iii) the Pinjarra Plain
    a) Slightly Elevated Plain
    b) Wetlands
    c) Drainage lines
    d) Lakes

The principal broad vegetation associations are given for each of these geomorphic/soil units and the areas considered of highest conservation value on each are listed. The locations being surveyed in the Swan Coastal Plain Survey are in bold print.

5.2 Western Margins of Dandaragan Plateau

The characteristic vegetation of the lateritic spurs of the Reagan unit is Wandoo or Powderbark Wandoo Open Forest to Woodland over tall Shrubland and a Low Open Heath or Heath (Figure 7). Similarly with the associations of the Ridge Hill Shelf the vegetation of the Reagan unit has many species characteristic of the associations on the Darling Scarp, such as *Gompholobium aristatum*, *Hakea lissocarpha*, *Dryandra armata*, *Gastrolobium spinosum* and *Hakea trifurcata*

Marri and Jarrah trees are found throughout the unit and on the sandier soils further to the west, form areas of Woodland to Open Forest (Figure 8) dominated by either or both species . At times the Marri may occur with scattered Jarrah over scattered *Banksia* forming a mixed woodland or as scattered trees over *Banksia* Low Woodland containing scattered *Eucalyptus todtiana* (Figure 10).

The characteristic understorey is a well developed shrub strata, being at times high shrubland and/or shrubland, open heath and heath. The shrub species in these associations become increasingly similar to those found in much *Banksia* Woodland such as *Adenanthos cygnorum*, *Allocasuarina humilis*, *Conospermum stoechadis*, *Stirlingia latifolia*, *Eremaea pauciflora*, *Mesomelaena pseudostygia* and *Alexgeorgea nitens.* In the shrub strata in the Marri and Jarrah Open Forest or Woodland and the Marri Woodland there is a considerable element of Scarp species. This is particularly evident in the drainage lines descending from the Scarp. Characteristic species are *Gompholobium aristatum*, *Baeckea camphorosmae*, *Isopogon asper*, *Isopogon dubius* and *Hakea trifurcata.*

Within the Marri and Jarrah Woodland, apparently on patches of deeper sand, the shrub strata occur as an association with scattered trees, often of a mallee form (Figure 11). This Open Heath over Low Shrubland is similar floristically to the shrub strata of *Banksia* woodland, having *Allocasuarina humilis*, *Calytrix angulata*, *Conostephium pendulum*, *Bossiaea eriocarpa*, *Alexgeorgea nitens* and Mesomelaena *pseudostygia.*

Possible Conservation Areas-

w/pw W/F — Wandoo and Powderbark Wandoo Woodland/Forest
Burley Park, Swan, approx 43 ha (Location 105) - local government reserve, Figure 7.

w W/F — Wandoo Woodland/Forest
Bushland between Chittering Rd and Ashton Rd, Swan, approx 12 ha (Location 103) - reserve, ?local gov.

jm W/F — Jarrah and Marri Woodland

1) Bullsbrook District High School, Swan, approx ?10 ha (Location 102), reserve 3178

2) Burley Park (Location 105)

3) System 6 Reserve, M14, Swan, approx 117 ha (Location 109) - local gov. reserve C1645, Figure 8

m W — Marri Woodland

1) Bushland between Chittering Rd and Ashton Rd, Swan, (Location 103)

2) Bullsbrook Recreation Reserve, Swan (Location 107) - local government reserve, 27583, Figure 9

3) Ioppolo Rd, Chittering (Location 119) - private land

b LW — Banksia Low Woodland

1) System 6 Reserve, M14, Swan (Location 109)

2) Bullsbrook Recreation Reserve, Swan (Location 107) .

3) Ioppolo Rd, Chittering (Location 119), Figure 10

4) Breera Rd, Chittering (Location 121) - private land

OHt — Open Heath

1) Burley Park, Swan (Location 105), Figure 11

2) System 6 Reserve, M14 (Location 109)

3) Bullsbrook Recreation Reserve, Swan (Location 107)

5.3. Ridge Hill Shelf

A series of vegetation associations related to topography are characteristic of the Ridge Hill Shelf. These are

- on the higher slopes of the Ridge Hill Shelf; Marri and Jarrah Open Forest to Open Woodland (Figure 12)
- on the well drained heavier gravelly soils; Marri, Jarrah and Wandoo Open Forest to Open Woodland (Figure 13)
- in the drainage lines on the upper and lower slopes; *Eucalyptus rudis* and *Melaleuca rhaphiophylla* Open Forest to Woodland or Marri, Flooded Gum and Jarrah Open Forest
- on the lower slopes the well drained sandy rises are dominated by; Jarrah, *Allocasuarina* and *Banksia* Woodland.

At several locations on the sandier soils on the western margins of the Ridge Hill Shelf the Jarrah, *Allocasuarina* and *Banksia* Woodland are replaced with associations of *Banksia* Woodland, *Jacksonia sternbergiana* Open Scrub (Figure 15), *Allocasuarina* Woodland and mixed Low Heath. These associations show a great degree of affinity with the sandier soils on the Pinjarra Plain.

The characteristic structure of the understorey of the Woodland associations is low open heath or shrubland over open herbland and/or open sedgeland and is very similar both structurally and floristically to the understorey of similar woodlands on the Darling Scarp. Many species characteristic of the Darling Scarp (Table 4) in the Perth Region are found in these areas; for example *Lambertia multiflora, Dryandra armata, Xanthosia candida, Gompholobium polymorphum, Hakea erinacea, Pentapeltis pelitigera, Stylidium affine, Isopogon asper, Isopogon dubius, Grevillea*

wilsonii, G. bipinnatifida, Acacia teretifolia, Chorizema dicksonii and *Hakea undulatum.* The Talbot Rd Location (Location 86) was particuarly rich in such species, many of which were not observed elsewhere such as *Beaufortia purpurea, Grevillea glabrata,* and *Synaphea pinnata.* One species found at Talbot Rd, *Aristida contorta,* was a new record for the Perth Region.

Nemcia ?spathulatum, a species of particular interest found at only one location, Page Rd (Location 30),is further indication of the close relationship between the flora of the Scarp and the Ridge Hill Shelf.

Marri- *Eucalyptus lanepoolei* Low Woodland or Open Woodland (Figure 14) was only found on the Ridge Hill Shelf and an adjacent relatively flat area of the Pinjarra Plain (Lambert Lane, Location 5), included here under the Ridge Hill Shelf because of its vegetation and soils.

Between Armadale and Pinjarra *Eucalyptus lanepoolei* and Wandoo are confined to within approximately 1 km of the Scarp and were not found extending on to the main body of the Swan Coastal Plain. North of Armadale the Wandoo extends further on to the Swan Coastal Plain, occurring on the Pinjarra Plain as it also does, south of Pinjarra between Brunswick Junction and Kirup (south of the study area). The *Eucalyptus lanepoolei* and Wandoo Woodland have particularly diverse shrub, herb and sedge strata.

Previous descriptions of the vegetation of the Ridge Hill Shelf (Speck, 1956; Smith, 1974; Seddon, 1972; Beard, 1979 and Heddle et al 1980) describe the same associations as being characteristic of these soils but give less detail on the understorey and its relationship with the flora of the Scarp. Some of the less common associations such as the *Jacksonia sternbergiana* Open Scrub were generally not described by these authors. However it was interesting to find that Speck described this association in his pioneering study of the Swan Coastal Plain as there was some speculation in the early stages of this study that this association was the result of long term dieback infestation. As Speck described the association it is likely that it is an association that forms in relation to sandy soils on the lower slopes of the Ridge Hill Shelf adjacent to areas of lateritic soil.

Possible Conservation Areas-

j W Jarrah Woodland

1) Page Road, Serpentine -Jarrahdale, approx. 1 ha (Location 30) - private land

2) NW junction Connel Ave Ciro Rd, approx 17 ha (Location 48) - local government land

mj OF/W Marri - Jarrah Open Forest or Woodland,

1) Byford Townsite, the area enclosed by John Cres and Park Rd, Serpentine - Jarrahdale, approx 1 ha (Location 4) - ?local government land, Figure 12

2) S of Norman Rd along South Western Hwy,Serpentine -Jarrahdale, approx 42 ha (Location 18) - private land

3) Page Rd, Serpentine -Jarrahdale, approx 1 ha (Location 29) - private land

4) Rushton Rd, Martin, approx 12 ha (Location 54) - private land

5) Adjacent to Lesmurdie Falls, Lesmurdie,approx 8 ha (Location 67) - private land

6) Adjacent to Talbot Rd Reserve, Stratton, approx 28 ha (Location 86/2) - local government land

7) Bushmead Rifle Range, Helena Valley, approx 70 ha (Location 89) - commonwealth government land

8) Watsonia Rd, Gooseberry Hill, approx 9 ha (Location 90) - state government land

mw OF/W Marri-Wandoo Open Forest to Open Woodland

1) Old Wungong Townsite, south-west intersection of Butcher Rd (track) and South Western Hwy, Serpentine -Jarrahdale, approx. 3 ha (Locations 2) - local

government land

2) Ex Byford Rifle Range, east side of North Rd, approx 200 m N intersection Stanley Rd, Serpentine-Jarrahdale, approx 3 ha (Location 3) - local government land

3) Lloyd Hughes Park, Martin Rd Kelmscott, approx 17 ha (Location 47), state government land, Figure 13

4) NW junction Connel Ave Ciro Rd (Location 48)

5) Adjacent to Talbot Rd Reserve, Stratton (Location 86/2)

6) Ridge Hill Rd, Helena Valley, approx 24 ha (Location 86/2) - ?private land

7) Bushmead Rifle Range,(Location 89)

8) Watsonia Rd, Gooseberry Hill(Location 90)

m OF/W Marri Open Forest to Woodland
Talbot Rd Reserve, Stratton, approx 60 ha (Location 86/1) - local government land

ml LW. Marri- *Eucalyptus lanepoolei* Low Woodland or Open Woodland
North east of Lambert Lane and the Perth to Bunbury Railway Line, Armadale, approx 4 ha (Location 5) - ?local government land, Figure 14

jab W Jarrah, *Allocasuarina* and *Banksia* Woodland
NW junction Connel Ave Ciro Rd,(Location 48)

b W *Banksia* Woodland,
1) NW junction Connel Ave Ciro Rd (Location 48), Figure 15

2) Adjacent to Talbot Rd Reserve, Stratton (Location 86/2)

3) Bushmead Rifle Range(Location 89)

a W *Allocasuarina* Woodland
1) NW junction Connel Ave Ciro (Location 48)

2) **Talbot Rd Reserve** (Location 86/1)

3)Adjacent to Talbot Rd Reserve, Stratton(Location 86/2)

mi LH Mixed Low Heath
1) Adjacent to Talbot Rd Reserve, Stratton (Location 86/2)

2) **Talbot Rd Reserve** (Location 86/1)

s Sc *Jacksonia sternbergiana* Open Scrub
1) NW junction Connel Ave Ciro Rd (Location 48), Figure 15

2) **Talbot Rd Reserve** (Location 86/1)

r W *Eucalyptus rudis* Woodland,
Lloyd Hughes Park (Location 47)

mr/j F Marri, Flooded Gum and Jarrah Open Forest
1) Creekline Connel Rd, Kelmscott (Location 49)

2) Adjacent to Talbot Rd Reserve, Stratton (Location 86/2)

r/mr W *Eucalyptus rudis* and *Melaleuca raphiophylla* Open Forest to Woodland,
This, the predominant association along drainage lines, was not found in anything but Very Degraded Condition. A foot survey of the lines may find some areas in better condition.

5.4 Pinjarra Plain

Drainage and soil type are apparently the determining factors of the occurrence of vegetation associations on the Pinjarra Plain and consequently associations are grouped below according to these two factors. However the whole area of the Pinjarra Plain is so flat and drainage so poor that these divisions are at times arbitrary and the vegetation associations form mosaics as described in the section on Wetlands.

5.4.1 Slightly Elevated Plain

(a) Well drained sandy rises

Jarrah Woodland is the most common association on the summits of the sandy rises in the study area. However the Jarrah generally occurs with Marri, *Allocasuarina fraseriana* and *Banksia* species (*B. attenuata, B. menziesii* and *B. grandis*) in various combinations and densities (Figure 17). Marri is more common (Figure 18) on the heavier soils and *Banksia* and *Allocasuarina* on the sandier soils. *Xylomelum occidentale* and *Persoonia elliptica* are relatively common but always in low density. *Persoonia elliptica* was only observed between Location 58 and Location 82 but it was also observed south of the study area, west of Capel.

On the slopes of the rises, on the lower rises and on the sandy well drained flats the proportion of *Banksia* increases to form *Banksia* Low Woodland or Open Forest.

Dense shrub strata are characteristic of these associations, generally low open heath to low shrubland with open herbland and/or open sedgeland. Species of particular interest associated with this association are *Grevillea pilulifera, Lambertia multiflora* and *Mesomelaena pseudostygia.* (this contrasts with *Mesomelaena tetragona* which is typically found in the heavy soil Pinjarra Plain associations and is uncommon in the sandier soils). In those associations in which Marri is significant, on the heavier soils, *Kingia australis* is generally present (Location 68 and 73).

Between Welshpool Rd and the Great Eastern Hwy Bypass the various combinations of aeolian sands, sandy alluvial deposits and heavy alluvial deposits at depth have resulted in unique understories containing species that are typical of the adjacent communities with other species normally found much further away, particularly to the north. Some of these species occur north and south of this part of the study area but the number of these species occurring in the same association results in these apparently unique associations. The adjacent vegetated areas of the Ridge Hill Shelf are also rich in these species, particularly those underlined in the paragraph below.

Examples of such species are:

- from the sandplains to the north: *Calytrix aurea* (Darling Scarp and north to Eneabba), *Conothamnus trinervis, Actinostrobus acuminatus, Hakea conchifolia* (north to Cliff Head) *Eremaea fimbriata* (Eneabba), *Isopogon drummondii* (Jurien Bay), *Banksia incana* (Badgingarra to 35 km N Eneabba,Taylor and Hopper, 1988), *Dasypogon obliquifolius* (north to Eneabba) and *Pityrodia bartlingii* (Geraldton to Busselton and inland to the wheatbelt)(Table 5)
- from the Scarp: *Stylidium affine, Lambertia multiflora, Calytrix aurea* (Darling Scarp and north to Eneabba),*Jacksonia restioides, Dryandra armata, Hakea undulata, Hakea stenocarpa, Cyathochaeta avenacea, Mesomelaena tetragona* and *Persoonia elliptica* (Table 4)

- from the *Banksia* Woodlands of the Bassendean Sands: *Bossiaea eriocarpa, Adenanthos cygnorum, Eremaea pauciflora, Petrophile linearis, Patersonia occidentalis, Mesomelaena pseudostygia, Alexgeorgea nitens* and *Lyginia barbata.*

One species of particular interest is *Conospermum undulatum* which is confined to the sandier soils of the eastern side of the Swan Coastal on both the Pinjarra Plain and the Ridge Hill Shelf between Location 58 and Location 82, the same general area as *Persoonia elliptica* is found in in the study area.

The most unusual vegetation association in the this area is the *Banksia* Low Open Forest which has a great diversity of species (approx 80 in one 10 x 10 m quadrat). A large proportion of these species are of special interest both individually and in association (see Tables 4 &5). This association is best developed at Sultana Rd (Location 75) and Activ Industries (Location 81), Figures 19 &20.

North of Ellen Brook the sandy soils again become very common. Extensive *Banksia* Woodlands with understories that reflect the adjacent *Banksia* Woodland associations on the Bassendean Sands to the west are found. These *Banksia* Woodlands were considered to be a formation more typical of the Bassendean Sands and thus outside the limits of this Study.

Possible Conservation Areas

jx W Jarrah-*Xylomelum* Woodland

1) Cardup Nature Reserve, Cardup Siding Road, Serpentine-Jarrahdale (Location 11)

2) Watkins Road Reserve, Watkins Rd Res 23012, Serpentine-Jarrahdale (Location 20).- ?local government

jba W Jarrah, *Banksia* and *Allocasuarina* Woodland

1) Armadale Flora Reserve, Williams Rd , Armadale, approx 5 ha (Location 41) - local government

2) Activ Industries Site, Tonkin Hwy, approx. 20 ha (Location 81) - government, vested for institutional purposes, Figure 17

3) Bushland in the area of the Fire Training Centre, Dundas Rd, Forrestfield System 6 Reserve M53, approx. 55 ha (Location 73) - state government

mj W Marri and Jarrah Open Woodland to Woodland

1) Armadale Flora (Location 41), Figure 18

2) Hartfield Country Club, Hartfield Rd, approx 40 ha (Location 68) - local government

b LOF *Banksia* Low Open Forest

1) Sultana Rd, High Wycombe, approx. 12 ha (Location 75) - private, Figure 19

2) Activ Industries (Location 81), Figure 20

b LW *Banksia* Low Woodland

1) Cardup Nature Reserve, Cardup Siding Road, Serpentine-Jarrahdale (Location 11)

2) Watkins Road Reserve (Location 20)

3) Adjacent to Kelmscott Senior High School, approx. 4 ha (Location 43) - state government

4) Yule Brook Reserve, Kenwick, System 6 M 69, approx. 38 ha (Location 63) - University of W.A. designated Reserve for flora and research.

5) Fire Training Centre, Forrestfield (Location 73)

6) Hartfield Country Club, Forrestfield(Location 68)

7) Twin Swamps Nature Reserve, System 6 Reserve M 17, approx. 143 ha (Location 96) - CALM

8) Bushland west of GinGin (Location 130) - private, minimally assessed, outside study area

(b) Poorly drained loamy rises

On the poorly drained very slight rises of sandy loams to loams Marri Open Forest to Woodland (Figures 22 &23) is found. The characteristic structure of the understorey of this association is low open shrubland over closed herbland to herbland and closed sedgeland to sedgeland.

Towards the Darling Scarp and south of Talbot Rd *Kingia* is scattered through the understorey sometimes forming a shrubland or open shrubland stratum. This stratum is apparently absent on the western side of the Pinjarra Plain (*Kingia* is also found on the sandy loams with Marri discussed in the previous section). Characteristic species of this association are *Mesomeleana tetragona*, *Caesia micrantha*, *Cyathochaeta avenacea*, *Grevillea pilulifera* and a robust form of *Drosera micrantha*.

Wandoo and Marri Woodland and Wandoo Woodland are confined to the areas of the Pinjarra Plain associated with drainage lines. The understorey of this association was probably similar to that of the Marri Open Forest to Woodland, perhaps with a denser low shrub stratum as described for the the Wandoo Woodland remnant at Talbot Rd. This association had its greatest area of development on the Pinjarra Plain on the eastern sides and immediate banks of watercourses such as Ellen Brook, the Swan River (north of the Helena River), Helena River, Bickely Brook and the Canning River. The extent of these Wandoo Woodlands can now only be surmised from the scattered remnant trees and the few isolated pockets of remaining partially intact Wandoo Woodland.

The floristics of these woodland associations indicate a close association with the Scarp and many of the species found in these small remnants are commonly thought to be confined to the Scarp. Of particular interest in the one patch of Marri Open Forest (Duckpond Rd, Location 15) was the presence of a new record for the Perth Region, *Opercularia apiciflora*, *Kennedia stirlingii* at its eastern most limit and the robust form of *Drosera micrantha* a taxon characteristic of the Marri Woodland and Forest on the Pinjarra Plain. This vegetation association was apparently the only western remnant of the once widespread Marri Open Forest of the Pinjarra Plain.

The results of this study indicate that Marri Open Forest to Woodland, was the predominant association of much of the Pinjarra Plain as indicated by topography and presence of remnant Marri over much of the area. The absence of Jarrah is not considered to be result of selective logging. Jarrah trees are found to the east on the Ridge Hill Shelf soils and the well drained sandy rises of the Pinjarra Plain (see section 5.4.1a) where logging should have removed these trees if logging is used to account for the absence of these this species on this section of the Pinjarra Plain. It is well known that Jarrah will regrow from lignotubers after logging but there was no such Jarrah found on the poorly drained loamy rises.

The Marri Open Forest to Woodland, the Wandoo Woodland and Wandoo and Marri Woodland are effectively completely cleared. There are no substantial areas of these associations remaining, these associations being confined to several isolated pockets and small areas generally associated with the wetlands. No large tract remains as these associations were found on the soils most favoured for agricultural development.

The structure of the understorey described, low open shrubland over closed herbland to herbland and closed sedgeland to sedgeland, does not conform with some descriptions in the literature of the understorey of this area of the Pinjarra Plain. Historical accounts of the Pinjarra Plain referred to previously (see Section 3), principally that of Fraser (March, 1827 in Seddon, 1972) describe the "...magnificent Angophoras (*Eucalyptus calophylla*)" and "The Brome, or Kangaroo-grass of New South Wales in great luxuriance "and observations of other early settlers have developed the concept that the area had an "open, park-like appearance...with scattered trees and the grassy ground layer.".

It is very probable that the grasses Fraser describes, that is the "Brome or Kangaroo-grass", are in fact *Mesomelaena tetragona* and *Cyathochaeta avenacea*. These two species, members of the Cyperaceae, are very common and conspicuous in the understorey of the remnants of this vegetation associations and have inflorescences that would give the semblance of the Bromes (members of the genus *Bromus*) and Kangaroo Grass (members of the genus *Themeda*). The grasses described by Fraser are common components of the eucalyptus woodlands of the eastern states and Fraser would have been an expected to see these understorey species. *Mesomelaena tetragona* would have been completely new to Fraser being from a genus endemic to WA.

Fraser's description of "Brome or Kangaroo-grass" as a conspicuous component of the understorey should apparently be modified as was the reference to magnificent " Angophoras" . The mystery of the grasses mentioned in Beard (1979a) should now be considered resolved and the conclusions of Beard of that the area was "....open woodland of *E. calophylla* .....little but herbaceous under growth" is supported, except that the undergrowth was a mixture of herbs and sedges.

A further conclusion reached by another author concerning this section of the study area , is also not supported by this study. The remnant vegetation described in this survey indicates that Marri Open Forest to Woodland over closed herbland to herbland and closed sedgeland to sedgeland, is climax association of the Plain, not a consequence of fire as suggested by Hallam (1975). This association after fire is characterised by an additional stratum of *Hakea trifurcata* Closed Scrub (Brickwood Reserve, Location 10 and Duckpond Rd, Location 15).

Possible Conservation Areas-

m W/OF Marri Open Forest to Woodland
Duckpond Rd and Mundijong Rd intersection, Serpentine-Jarrahdale, approx. 3 ha (Location 15) - ?Local Government land

mk W Marri Open Forest to Woodland over *Kingia* Shrubland .

1) **Brickwood Reserve and adjacent bushland, Soldiers Rd, Serpentine-Jarrahdale,** approx. 43 ha (Location 10) - Local Government land. Much of this area is shown on the soils maps as being Ridge Hill Shelf but the vegetation indicates a closer affinity with the Pinjarra Plain and it is treated in this section

2) **Cardup Nature Reserve** (Location 11)

w W Wandoo Woodland

1) Bushland in Pearce Townsite, Swan, approx. 13 ha (Location 100) - commonwealth

2) Pearce Airforce Base, Location 101- commonwealth

3) Hallet Gardens, Swan, approx. 2 ha (Location 93) - ?local government

5.4 2 Wetlands

The vegetation associations of the wetlands of this study are dependant on the seasonal innundation of these soils over winter and much of spring. Again the vegetation is influenced by small changes in topography and the association of sand and clay. Some of these associations occur over hectares such as the *Pericalymma* Heath and others are too small to be described as a site such as the herblands and sedgelands. Only the larger units were mapped as distinct associations the wetland associations generally being mapped as a wetland mosaic (WM).

These wetlands show a great deal of variation in their floristics. Structurally the associations are often similar but floristically they are significantly different. This is particularly evident in the *Melaleuca* Open Heaths and Mixed Low Open Heaths where the combination of dominants, generally Myrtaceous species is very variable (Figures 5, 6 &29-33). One of these associations, a Mixed Low Open Heath in the Bushland north of Yule Brook (Location 65, Site 65d) is floristically unique and contains the Declared Rare Flora taxon *Calytrix breviseta* ssp. *breviseta.* The Mixed Low Open Heaths of the adjacent wetlands in the Kenwick and Cannington area (Locations 62 - 65), along

Mundijong Rd (Locatioin 23) and at the M 14 (Location 109) show similar levels of diversity.

Another study (Griffin and Keighery, 1989), which included the wetlands of the Swan Coastal Plain, mostly on the Bassendean Sands between GinGin and Jurien,.showed the same diversity between wetland areas.

This floristic diversity between wetlands is matched in the study area by a floristic diversity expressed over time within the associations . The wetlands are very rich in geophytes and annuals as well as a series of perennials that are inconspicuous for most of the year; for example, *Drosera* species, *Borya* species and *Stylidium* species. These species grow and flower over short periods of time when conditions are optimal. This may be when

- the soils are just wet in early winter; for example, many sedges, *Baumea* species
- the soils are ponding in winter; for example, *Aponogeton hexatapalus*, *Wurmbea* species and *Tribonanthes* species
- the soils of the ponds are drying, but still inundated, in Spring; for example, *Stylidium* species, *Amphibromus neesii* (Swamp Wallaby Grass), Asteraceae species, Apiaceae species, annual sedges, Centrolepidaceae species and Cyperaceae species
- the soils of the ponds are nearly dry in early summer; for example, another suite of *Stylidium* species, Asteraceae species, Apiaceae species, annual sedges, Centrolepidaceae and Cyperaceae species.

These cycles of waterlogging and drying and the small changes in topography and drainage within the one location provide a series of conditions that will support a varied flora. The apparently endemic flora of the eastern side of the Swan Coastal Plain is mostly, related to these wetland conditions (see Table 6 and Section 4).

This diversity is probably best documented in the Brixton St Wetlands (see Sections 1.3 &4.0)

Today the wetlands are the most common remnant vegetation associations on the Pinjarra Plain (Figures 2a &2b). This is no doubt related to the difficulties associated with developing areas that are seasonally innundated but this is also related to the original extent of these wetlands. Previous work on the vegetation of the Pinjarra Plain have apparently underestimated the extent of these wetlands and concentrated on the areas of woodland.

Most vegetation associations of the Pinjarra Plain, excepting those on the sandy rises, are seasonally innundated to some extent. The Marri and Wandoo Woodlands of the Pinjarra Plain are associated with winter wet soils and scattered through them are areas of wetland, for example at Duckpond Rd (Location 15) and the Pearce Townsite (Location 100). All the *Casuarina obesa* Woodlands (Figures 25 &26) documented in this study were associated with understories typical of the wetland vegetation associations. Also the soils of the *Casuarina obesa* Woodlands were often innundated to the extent that there was free water on the surface, so these Woodlands are grouped with the wetlands in this study.

To consider the wetlands in detail they are divided according to the presence of sand and clay and the degree of innudation.

Permanent or near permanent lakes were not studied in detail.

a) Very poorly drained loams and clay flats

Casuarina obesa Low Open Woodland to Low Woodland is characteristic of the very poorly drained loams and clay flats found south of Forrestdale Lake and north of Pearce. In the south this association has been almost completely cleared. The most extensive remnants observed are confined to the roadside on the Drain Reserve and Road Reserve along Abernathy, Orton and Mundijong Roads and one small pocket of private land on Abernathy Rd. To the north two pockets remain near GinGin at Lake Bambun and the T/O to GinGin from the Brand Hwy. Substantial, though disturbed, remnants are to found along the railway line between Muchea and GinGin.

It was apparent from the study of these small disjunct remnants that the *Casuarina* Low Woodlands were associated with a mosaic of smaller vegetation associations similar to those described for the clayey areas subject to ponding (see Section 5.4.2c). These associations are: *Melaleuca* Shrublands

and Low Shrublands, Sedgelands, Herblands and more rarely Samphire Low Shrublands. The structure of the understorey of areas with the greater *Casuarina obesa* cover was probably similar to that of the Marri Open Forest to Woodland as is indicated at one location in Mundijong Road (Location 23, Site 23e).

Casuarina obesa is generally considered in the literature to indicate the presence of saline soils. However in the study area *Casuarina obesa* was rarely found with other species, such as samphires, that are associated with saline soils. These *Casuarina* Low Woodlands are the result of the waterlogging rather than salinity.

It is likely that in the original association in the area *Casuarina* trees were less abundant, the high densities in some remnant tree clumps being the result of suckering after the other vegetation had been cleared. This extensive suckering is evident on Kargotich Rd, Ioppolo Rd (Figure 4b) and Orton Rd. The roadside trees form a very attractive avenue.

The extent of this *Casuarina obesa* Woodland along the roads, generally in a Completely Degraded Condition (Figures 4a & 4b), is indicated on the GIS Maps.

Possible Conservation Areas-

c LW *Casuarina obesa* Low Open Woodland to Low Woodland

1) Abernathy Rd, south side of road, roadside and adjacent private land between Hopkinson Rd and drain, 1 km to the west,approx 22 ha (Locations 8a) - private land, road verge

2) Scattered locations on Orton (Location 9) and Mundijong Rds (Location 23, site 23c), all are in Very Poor or Completely Degraded Condition - road verges.

3) Bushland between Brand Hwy and southern T/O to GinGin, approx 5 ha (Location 127) - private land, J.M. Dewar

4) Reserve 22831, east Lake Bambun, approx. 12 ha (Location 123) - local government

b) Sandy innundated flats

The characteristic vegetation of these flats are *Pericalymma* Heath (Figure 2a & 27) or *Regelia ciliata* Heath These are generally associated with the wetland areas with sand over clay and may also occur patchily in the more clayey associations.

The *Pericalymma* Heath varies from Low Heath to Heath which reflects the fire history of the association. Scattered to clumped *Melaleuca preissiana* and occasional *Nuytsia* trees are the trees characteristic of this association. Characteristic shrub species are *Kingia australis*, *Actinostrobus pyramidalis*, *Hakea sulcata*, *Hakea varia*, *Mesomelaena tetragona*, *Leptocarpus canus* and *Leptocarpus coangustatus.*

Possible Conservation Areas

p Ht *Pericalymma* Heath

1) Forrestdale Lake, Reserve 27165, south-west Forrest Rd and north of Oxley Rd, Armadale (Location 1)- local government

2) Brickwood Reserve (Location 10, Site 10d)

3) Alcoa Drive, east junction South West Hwy, north and south of the road, Murray (Location 33) - local government

4) Phillips Rd Industrial Area, Pinjarra, Murray,portion of total bushland area of approx. 38 ha (Location 38, Site 38a,d) - private

5) Cole St, Pinjarra, Murray, approx. 16 ha (Location 39) - private

Other lands with similar vegetation association but mapped on Bassendean Sands are adjacent to Location 37 and 38.

6) Hartfield Park, Forrestfield (Location 68)

7) Fire Training, Forrestfield (Location 73), Figures 2a &27

rg Ht *Regelia ciliata* Heath

1) Abernathy Rd, south side of road, roadside and adjacent private land between Hopkinson Rd and drain, 1 km to the west, approx 22 ha (Locations 8a) - private land, road verge

2) Twin Swamps Nature Reserve (Location 96)

mp W *Melaleuca preissiana* Woodland

1) Ioppolo Rd, Chittering (Location 119)

2) Breera Rd, Chittering (Location 121)

c) Clayey flats subject to ponding

These clayey areas are vegetated with complex mosaics of associations.

The characteristic associations in these mosaics are:

Viminaria juncea High Shrubland, Figure 28
This is generally over *Melaleuca* Open Heath.

Melaleuca Open Heath to Shrubland, Figures 29 - 31
The height variation is related to the areas fire history and /or the dominant species.
Characteristic species of this association are: *Melaleuca raphiophylla,* tree and shrub form, *Hakea varia*, *Kingia australis* (south of Talbot Rd), *Kunzea recurva*, *Actinostrobus pyramidalis* and *M. viminea* and less commonly, but often, *M. lateritia*, *M.uncinata*, *M. lateriflora* , *M.bracteosa*, *M.hamulosa* and *M. polygaloides.*

Mixed Low Open Heath, Figures 5a & 32-34
Characteristic species of this association are: *Pericalymma ellipticum*, *Kunzea micrantha*, *Melaleuca* species, *Regelia ciliata*, *Actinostrobus pyramidalis*, *Verticordia plumosa*, *Verticordia lindleyi*, *Verticordia acerosa* and *Grevillea* species.

The Samphire Low Shrubland, Herblands and Sedgelands are rarely of a size that would accommodate a site description but they are characteristic associations in these soils and warrant recognition.

Samphire Low Shrubland, Figure 26
Characteristic species of this association are: *Halosarcia indica*, *Sarcocornia quinqueflora*, *Wilsonia* species, *Pogonolepis stricta* and *Isotoma scapigera.*

Sedgelands, Figures 32 & 41
Characteristic species of this association are: *Leptocarpus canus* and *Leptocarpus coangustatus.*

Herblands, Figures 25, 29, 35 & 36
Characteristic species of this association are: -*Wurmbea* species, *Tribonanthes* species, *Polypompholyx multifida*, *Stylidium* species and many annual and geophytic species of Asteraceae, Restionaceae, Apiaceae and Centrolepidaceae.

The rises in these wetlands are vegetated with Marri Woodland (see Section 5.4.1b) on the heavier soils and *Banksia* Woodland on the sandier soils (see Section 5.4.1a).

Significant in being consistently absent from these soils is *Kunzea ericifolia* and being relatively rare in them is *Melaleuca preissiana.* Both species appear to indicate areas of substantial deposits of

sand overlying clay, the wetlands of the Bassendean Sands and the Coonambidgee unit, Section 5.4.2a if the Pinjarra Plain, an area more closely related to the wetlands of the Bassendean Sands. Areas with these two species are dominant species were not considered in detail.

Possible Conservation Areas-

v Sh Viminaria Shrubland

1) Brixton St Wetlands (Location 62), Figure 28

2) J&B Martyn Reserve, System 6 Reserve M17, approx. 58 ha (Location 95) - CALM, Figure 29

me OHt/Sh Melaleuca Open Heath to Shrubland

1) Forrestdale Lake, Armadale (Location 1)

2) Brickwood Reserve and adjacent bushland, (Location 10, Site 10d)

3) Lambkin Reserve, east Hardey Rd and north of Leslie St,. Serpentine-Jarrahdale, approx 3 ha (Location 24, Site 24a) - CALM land

4) Phillips Rd Industrial Area, (Location 38, Site 36a,d)

5) Cole St, Pinjarra (Location 39)

6) Brixton St Wetlands (Location 62), Figure 2

7) Brook Rd Wetlands, Kenwick, approx. 38 ha (Location 63) - private

8) Yule Brook Wetlands (Location 64)

9) Wetland north of Yule Brook, Kenwick, approx. 34 ha (Location 65) - private,, Figures 29

10) J&B Martyn Reserve (Location 95)

11) Twin Swamps Nature Reserve (Location 96)

12) System 6 Reserve M14 (Location 109)

13) Lake Chandalla (Location 120)

14) T/O to GinGin, (Location 127), Figure 30

15) Reserve 22831, east Lake Bambun (Location 123)

Other lands with similar vegetation associations but mapped on Bassendean Sands are adjacent to Location 38 and 39.

mi Ht Mixed Heath

1) Mundijong Rd, Serpentine-Jarrahdale (Location 23)

2) Punrack Rd, Serpentine-Jarrahdale (Location 32)

3) Brixton St Wetlands (Location 62)

4) Brook St Wetlands (Location 63)

5) Yule Brook Wetlands (Location 64)

6) Wetlands north Yule Brook (Location 65),

Figure 5a, 32, 35 &36

7) Fire Training, Forrestfield (Location 73), Figure 2a &27

8) J&B Martyn Reserve (Location 95)

9) Twin Swamps Nature Reserve (Location 96)

10) System 6 Reserve M14 (Location 109), Figure 34

11) ?Lake Chandalla (Location 120)

sm Sh Samphire Shrublands

1) Yule Brook Wetlands (Location 64)

2) Wetlands north of Yule Brook (Location 65)

3) System 6 Reserve M14 (Location 109)

4) ?Lake Chandalla (Location 120)

5) T/O to GinGin (Location 127), Figure 26

6) ?Lake Chandalla (Location 120)

S Sedgelands

1) Forrestdale Lake (Location 1)

2) Abernathy Rd (Locations 8a)

3) **Brickwood Reserve and adjacent bushland,** (Location 10, Site 10d)

4) **Mundijong Rd,** Serpentine-Jarrahdale (Location 23)

5) Phillips Rd Industrial Area, (Location 38)

6) Cole St, Pinjarra (Location 39)

7) Brixton St Wetlands (Location 62)

8) Brook St Wetlands (Location 63)

9) Yule Brook Wetlands (Location 64)

10) Wetlands north of Yule Brook (Location 65), Figure 32

11) J&B Martyn Reserve (Location 95)

12) Twin Swamps Nature Reserve (Location 96)

13) System 6 Reserve M14 (Location 109)

14) ?Lake Chandalla (Location 120)

15) T/O to GinGin, (Location 127)

16) Reserve 22831, east Lake Bambun (Location 123)

17) Lake Chandalla (Location 120)

Other lands with similar vegetation association but mapped on Bassendean Sands are adjacent to Location 38 and 39.

Hb Herblands

1) Forrestdale Lake (Location 1)

2) Abernathy Rd (Locations 8a)

3) Brickwood Reserve and adjacent bushland, (Location 10, Site 10d)

4) Mundijong Rd, Serpentine-Jarrahdale (Location 23)

5) Phillips Rd Industrial Area, (Location 38)

6) Cole St, Pinjarra (Location 39)

7) Brixton St Wetlands (Location 62)

8) Brook St Wetlands (Location 63)

9) Yule Brook Wetlands (Location 64)

10) Wetlands north Yule Brook (Location 65), Figures 29, 35 & 36

11) J&B Martyn Reserve (Location 95)

12) Twin Swamps Nature Reserve (Location 96)

13) System 6 Reserve M14 (Location 109)

14) ?Lake Chandalla (Location 120)

15) T/O to GinGin, (Location 127)

16) Reserve 22831, east Lake Bambun (Location 123)

17) ?Lake Chandalla (Location 120)

5.4.3 Drainage Lines

The characteristic vegetation associations of the drainage lines are *Eucalyptus rudis* and *Melaleuca raphiophylla* Woodland to Open Forest, Marri Woodland and Marri and *Eucalyptus rudis* Woodland.

The *Eucalyptus rudis* and *Melaleuca raphiophylla* Woodland to Open Forest is the typical association of the drainage lines. Other species found in this association were *Agonis linearifoila* and occasionally *Paraserianthes lophantha.* This association was only found in completely degraded or in very poor condition with an understorey of exotic herbs and grasses.

The Marri Woodland was found along several drainage lines running vertically to the Scarp to the north of Welshpool Rd. This Marri Woodland is associated with a dense shrub stratum. Floristically the shrub stratum is similar to that of the creeks on the Scarp and the Ridge Hill Shelf, containing *Trymalium floribundum*, *Trymalium ledifolium*, *Thomasia macrocarpa*, *Lasiopetalum floribundum* and Isopogon *dubius.*

Eucalyptus rudis and Marri Woodland were found in the northern section of the study area.

Possible Conservation Areas-

r/mr W/F *Eucalyptus rudis* and *Melaleuca raphiophylla* Woodland to Open Forest
Murray River Ravenswood Speedway, Pinjarra, approx 5 ha
(Location 40) - ? private land

Location 13 could be an approximation of the association along the drainage lines but this location's

position at the junction between Pinjarra Plain and Bassendean Sands would undoubtably make it a typical of the vegetation along drainage lines on the Pinjarra Plain.

m/r W Marri and *Eucalyptus rudis* Woodland

1) Muchea Townsite, portion of System 6 Reserve C 25, Chittering, approx 12 ha (Location 118) - local government

2) J&B Martyn Reserve (Location 95)

m W Marri Woodland

1) Fire Training, Forrestfield (Location 73), Figure 2a &27

2) Raven Rd, High Wycombe, approx. 1 ha (Location 77) - private

3) Bullsbrook Recreation Reserve, Swan (Location 107)

5.4.4 Lakes

These are included in the Survey but the vegetation associated with them is generally of of little flora conservation value even though the lakes are of conservation value according to other criteria. The vegetation around most lakes within the study area is restricted to a fringe of *Melaleuca raphiophylla, Melaleuca preissiana, Eucalyptus rudis* Woodland to Forest and sedges associated with them, Mary Carrol Lakes (Location 51), Hazelmere Lakes (Location 87) and Lake Bambun (Location 124). Two lakes, Lake Chandalla and Forrestdale Lake, have wetlands associated with them in Very Good to Poor Condition. These associations as described in Section 5.4.2. Both of these Lakes are associated with soils that are predominantly sandy with intrusions of heavier soils. The Lakes on predominantly heavy soils are Completely Degraded, for example Lake Bambun

Possible Conservation Areas

1) Forrestdale Lake (Location 1)

2) Lake Chandalla (Location 120)

6.0 CONSERVATION of REMNANT VEGETATION on the EASTERN SIDE of the SWAN COASTAL PLAIN and RECOMMENDATIONS

6.1 Conservation Value of Remnant Vegetation

The area of native vegetation remaining in the study area is very small being confined to small scattered remnants that have escaped clearing for agriculture and urbanisation as they were generally unsuitable for these purposes being on the poorer sandy soils or soils that are seasonally inundated. A few of these remnants are areas that were set aside for a public purpose which has not eventuated (such as townsites), or the purpose has only impacted on a portion of the area, such as rail verges and gravel mines.

The remnants are, or have been, affected by many disturbance factors, such as; partial clearing, timber cutting, repetitive burning, weed invasion, soil movement, removal and dumping, rubbish dumping, fertilizer drift, mining, grazing of stock and draining . Consequently they are

i) small
ii) often irregular in shape
iii) disjunct and in most cases have been so for in excess of 50 years and
iv) altered to varying degrees.

There is so little remnant vegetation in the study area that it is not possible to designate areas for conservation in the ideal sense; that is large areas of land encompassing the range of vegetation associations of the area. In the study area this would be at least two, possibly three tracts of land extending from the Scarp to the Bassendean Sands to the west but it is too late for this.

The existing nature reserves in the area while being valuable conservation reserves were not designed to conserve a representation of the flora and vegetation of the study area. At this stage to conserve the unusual and variable vegetation in the study area all areas of remnant vegetation in Poor or better Condition in the study area must be considered of conservation value.

RECOMMENDATION 1
As a consequence of the small amount of remnant vegetation on the alluvial soils of the eastern side of the Swan Coastal Plain all such remnants in the study area with the basic vegetation structure intact or able to be regenerated (Poor or better Condition) are of significant flora conservation value, regardless of the remnant's size.

6.2 Ownership, Vesting and Management

Much of the remnant vegetation considered to have flora conservation value is in private ownership or vested in local government for purposes not related to flora conservation. All owners and managers of remnant bushland in good or better condition in the study area should be encouraged to retain and manage remnant vegetation on their lands.

Despite the long history of disturbance, much of the remnant vegetation, even in many of the very small patches, is in Good Condition. A characteristic feature of many of the locations was the proximity of severely disturbed areas and areas that were still intact and in Good to Very Good Condition. This is apparently related to the dense shrub, herb and sedge strata characteristic of most vegetation associations in the study area which, when intact, provides few opportunities for weed establishment. However once these strata are repetitively disturbed to the extent that density of these strata is reduced and the store of perenniating organs in the soil is depleted, weeds will become established.

Many activities in remnant vegetation disturb it. Such disturbance in unmanaged areas of remnant vegetation in the study area are:

- proliferation of tracks (Figures 39 &40)
- rubbish dumping (Figure 39 &45)

- off road vehicle use (Figures 39 &40)
- repetitive burning (Figures 43 &44)
- drainage (Figures 40 &41)
- weed invasion (Figure 38)
- use as service corridors (Figure 31).

While some managed areas are subject to disturbance caused by
- "enrichment" planting (Figure 41)
- proliferation of tracks (Figures 38,39, 40 &42)
- rubbish dumping (Figure 46)
- repetitive burning (Figure 18)

Some of these activities in the managed areas are well meaning but show a lack of understanding of the value and nature of the remnant vegetation.

These disturbance factors can destroy or reduce the density of the critical shrub, herb and sedge strata. To maintain the areas in Good Condition it is essential that the remnants be managed to maintain these strata and to re-establish these strata in the severely disturbed areas. Guidelines for the management of remnant vegetation in urban or near urban areas need to be established and must be based on an understanding of native vegetation and the factors that constitute disturbance.

The Serpentine -Jarrahdale (Locations 19a &b) and Armadale (Location 41 &10) Councils are commended for their efforts in retaining areas of remnant vegetation as designated flora reserves and managing these reserves. Such measures could be taken for the remnant vegetation of local government lands identified in this study .

In the long term the conservation of these small areas of remnant vegetation will only be achieved with grassroots community support for intensive management programmes. Such programmes have been instigated in some urban reserves such as Point Walter (Melville) and Star Swamp (Stirling). Training courses for individuals who wish to be involved in bush regeneration are available at the APACE Centre in North Fremantle. These courses, although relatively new in Western Australia, are well attended and indicate the substantial level of community interest in participating in the maintenance of remnant vegetation. Considering the location of the study area, close to large groups of people, such community support is available.

Of particular significance are the areas of remnant vegetation adjacent to schools, for example adjacent to Kelmscott Senior High School (Location 43), Grovelands Primary School in Kelmscott (Location 52), Maddington Senior High School (Location 56), Edney Primary School in High Wycombe (Location 79) and Bullsbrook District High School (Location 102). Remnant vegetation associated with schools is a unique teaching resource. The remnant vegetation provides a living resource for study of the wonder, diversity and management of bushland, an important part of our heritage. Many schools are running educational programmes on bushland. Retaining these areas near schools supports these programmes and relieves the pressures on nature reserves. Also, in the long term the educational programmes in schools will lead to a better appreciation of the importance of retaining native remnant vegetation.

RECOMMENDATION 2
All owners or managing authorities of land containing remnant vegetation should be contacted with information concerning the significance and nature of the remnant vegetation on the alluvial soils of the eastern side of the Swan Coastal Plain with particular reference to the vegetation on their land.

RECOMMENDATION 3
Local Government Authorities in co-operation with the appropriate bodies should develop a Remnant Vegetation Manual outlining guide-lines for the management of remnant bushland. Workshops on the application of the guide-lines should be held periodically with the appropriate management groups.

6 3 Remnant Vegetation of High Conservation Value

Although it is considered that all remnant vegetation in Poor or better Condition in the study area is

of conservation value some areas are of high conservation value.

The following factors were considered in assessing the conservation value of an area of remnant vegetation:

- size of the remnant
- condition of the vegetation associations present
- diversity of vegetation associations present
- distribution and extent of the vegetation associations both in the remnant and elsewhere
- representation of the vegetation associations in conservation reserves
- floristics of the association
- the variation found in the association.

On the basis of these factors recommendations are made to protect as good a representative of the vegetation of the study area as is reasonably practical. However it must be understood that these recommendations are made within the limits of the extant remnant vegetation. The distribution of these recommendations according to the area of the remnant outlined below is of interest.

Area (ha)	Number of Recommendations
0 - 5	4
6 - 20	5
21 -40	3
41-90	3
>90	3 (includes all of Forrestdale Lake Reserve)

Roadside and Rail remnants, Recommendations 5 -8 are excluded.

Excluding the 3 larger areas, there are under 400 ha (approx 374) encompassed by 15 of the recommendations. This again highlights the paucity of remnant vegetation in the study area.

Present Nature Reserves are not included in this assessment unless they were seen as part of a larger area recommended for flora conservation. The status of all Nature Reserves should be maintained. This study identifies the flora conservation values of the Nature Reserves in relation to the flora and vegetation of the study area. This information is contained in the Location Descriptions (Appendix 1) and the Sections on Flora (Section 4) and Vegetation (Section 5).These Reserves should be managed to maintain and enhance their flora conservation value.

Full descriptions of each area are given on the location descriptions in Appendix 1.

6.3.1 Smaller Areas of Remnant Vegetation

All the areas identified below for special recommendations are very small in area, less than 5 ha in area. Normally such small areas would not be considered as areas suitable for flora conservation but these areas are significant representatives of vegetation associations identified by this study that are poorly conserved or not conserved at all. Some are the only extant remnants of the association.

Two main categories can be distinguished:

6.3.1a Woodlands to Open Forests

These woodlands to open forests have an extremely floristically rich shrub, herb and sedge flora. All are on lands with very little relief. None of these associations remain in large tracts. Several were apparently widespread, as is indicated by the extent of these associations in a Completely Degraded Condition in the study area. The others were probably restricted. These vegetation associations are

i) remnants of previously widespread associations

Area 1 - Marri Open Forest to Woodland, Pinjarra Plain
Duckpond and Mundijong Rd intersection, Serpentine - Jarrahdale, approx 3 ha (Location 16) - local government

Value - Vegetation Map, page 83.
Largest intact area of remnant of Marri Open Forest, other Marri Woodland to Open Forest is found

in isolated nodes in larger locations
Significant taxa, 9 taxa:
Of interest are: 4#*Grevillea pilulifera*, 1,5#*Opercularia apiciflora*, 4#*Baeckea camphorosmae*, 4#*Hibbertia commutata*, 4#*Neurachne alopecuroidea*, 4#*Trichocline spathulata*, *Drosera macrantha* 'robust', 2,4#*Kennedia stirlingii* and4#*Mesomelaena tetragona*.

Recommendation
CALM liaise urgently with the Local Government Authority to retain and manage the area for its flora conservation values.

Area 2 - *Casuarina obesa* Low Woodland to Low Open Forest, Pinjarra Plain
Bushland between Brand Hwy and southern T/O to GinGin, GinGin, approx 5 ha (Location 127) - private land

Value - Vegetation Map, page 83.
One of only two areas of *Casuarina obesa* Low Woodland identified in this Study. This association is unknown in a conservation reserve. This area of *Casuarina obesa* Low Woodland and the associated Wetland Mosaic Associations is in Good Condition with areas of severe localised disturbance.
Significant taxa: 8, especially *Isotropis* aff.*cuneifolia*, a new taxa confined to *Casuarina obesa* Low Woodland, to be proposed for listing as DRF
Of interest are: 6#*Isotropis* aff.*cuneifolia*, 5#*Burchardia bairdii*, 6#*Eryngium pinnatifida* ssp. '*palustris*', *Podolepis gracilis* 'pink', 6#*Tribonanthes* sp, 5#*Stylidium ecorne*, 5#*Arthropodium preissii*, 4#*Dampiera coronata*, 6#*Myriocephalus helichrysoides*, *4#Microtis alba* and 5#*Pogonolepis stricta*.

Recommendation
CALM liaise urgently with the landowner to retain and manage the area for its flora conservation values.

ii) restricted associations

Area 3 - Marri and *Eucalyptus lanepoolei* Low Woodland, Ridge Hill Shelf
North east of Lambert Lane and the Perth to Bunbury Railway Line, Armadale - Kelmscott, approx 4 ha (Location 5) - local government

Value - Vegetation Map, page 84.
The only area Marri and *Eucalyptus lanepoolei* Low Woodland identified in the study that was not Completely Degraded, being in Very Good to Good Condition with severe localised disturbance
Significant taxa: >15, 5#*E. lanepoolei*, 4#*Kingia australis*, 4#*Hakea trifurcata*, 4#*Hakea auriculata*, 4#*Chorizema dicksonii*, 4#*Acacia drewiana*, 4#*Acacia teretifolia*, 4#*Andersonia lehmanniana*, 4#*Dryandra armata*, *Hakea incrassata*, 2#*Grevillea wilsonii*, *4#Baeckea camphorosmae*, 4#*Conostylis caricina* , 3,4#*Gonocarpus pithyoides*, 4#*Mesomelaena tetragona*, *Mesomelaena stygia* and 4#*Cyathochaeta avenacea*.

Recommendation
CALM liaise with the Local Government Authority to retain and manage the area for its flora conservation values.

Area 4 - Jarrah Woodland, Ridge Hill Shelf
Page Rd, Serpentine Jarrahdale, approx 1 ha (Location 30) - private land

Value - Vegetation Map, page 85.
An intrusion of Ridge Hill Shelf soils onto the flats of the Pinjarra Plain, the largest area of Jarrah Woodland with an unusual understorey
Significant taxa: 7, especially a *Nemcia ? spathulatum* of unusual form, taxonomic status yet to be determined.

Recommendation
CALM liaise urgently with the land owner to retain and manage the area for its flora conservation values.

6.3.1b Roadside and Railway Remnants

Area 5 - Mixed Open Heath, Pinjarra Plain
Punrack Rd, drain and road reserve, south of the road between Rapid Rd and Lightbody Rd, Serpentine - Jarrahdale (Location 32) - local government, ?WAWA.

Value
A southern remnant of Mixed Open Heath associated with heavy seasonally innundated soils on the flats of the Pinjarra Plain, Good Condition with severe localised disturbance.
Significant taxa: > 1, minimal survey.

Recommendation
CALM liaise urgently with the Local Government Authority to retain and manage the area for its flora conservation values, in accordance with the Management Guidelines recommended by the Roadside Conservation Committee for roads of High Conservation Value.

Area 6 - Wetland Associations, Pinjarra Plain
Mundijong Rd, road and drain reserve to the south of road between Webb Rd and Lightbody Rd, Serpentine - Jarrahdale (Location 23) - local government, ?WAWA.

Value
An E W transect of the vegetation associations of the heavy seasonally innundated soils of flats of the southern Pinjarra Plain; *Melaleuca* Shrubland, Mixed Low Heath, Herblands and Sedgelands in Very Good to Completely Degraded Condition.
Significant taxa: >15, 2 priority species.

Recommendation
CALM liaise urgently with the Local Government Authority to retain and manage the area for its flora conservation values, in accordance with the Management Guidelines recommended by the Roadside Conservation Committee for roads of High Conservation Value.

Area 7 - Wetland Associations, Pinjarra Plain
Muchea to GinGin Railway Line Reserve and associated road reserve- Westrail, GinGin and Swan

Value
An N S transect of the vegetation associations of the heavy seasonally innundated soils of flats of the northern Pinjarra Plain. Surveyed by Mattiske and Assoc (1991) for Westrail. The particular areas identified in this study are the areas of *Casuarina obesa* Low Woodland and associated *Melaleuca* Shrubland, Mixed Low Heath, Herblands and Sedgelands in Good to Completely Degraded Condition on the eastern side of the line along Ioppolo Rd (Location 119a). The entire railway line reserve is of value.
Significant taxa: 0-5, especially *Isotropis* aff. *cuneifolia*, a new taxa confined to *Casuarina obesa* Low Woodland, to be proposed for DRF (Location 119a).

Recommendation
CALM liaise urgently with Westrail and the Local Government Authorities, to retain and manage the area for its flora conservation values, in accordance with the Management Guidelines recommended by the Roadside Conservation Committee for roads of High Conservation Value.

Area 8 - Pinjarra Plain and Ridge Hill Shelf
Road and rail reserves associated with the **Kelmscott to Pinjarra section of the Perth to Bunbury Railway**, Westrail, Armadale - Kelmscott, Serpentine - Jarrahdale and Pinjarra - various locations.

Value
A NS transect of the Ridge Hill Shelf and Pinjarra Plain vegetation, Very Good to Completely Degraded Condition. Of particular significance are the locations at Lambert Lane, Brickwood Reserve (Byford), Serpentine and Mundijong townsites.

Recommendation
CALM liaise urgently with Westrail and the Local Government Authorities, to retain and manage the area for its flora conservation values, in accordance with the Management Guidelines recommended by the Roadside Conservation Committee for roads of High Conservation. Also that Westrail survey the rail reserve in the manner established for Westrail by Mattiske (1991).

6 3.2 Larger Areas of Remnant Vegetation

These areas are grouped from the north to the south of the study area.

Area 9 - Pinjarra Plain
Bambun Rd, east Lake Bambun, Reserve 22831, GinGin, approx 12 ha (Location 123) - local government.

Value - Vegetation Map, page 86.
The largest area of *Casuarina obesa* Low Woodlands to Forest and the mosaic of wetland associations associated with this Woodland: *Melaleuca* Shrublands, Herblands and Sedgelands in Good to Very Poor Condition. The Location also contains *Banksia prionotes* Woodland.
Significant taxa: 9, *Isotropis* aff.*cuneifolia*, a new taxa confined to *Casuarina obesa* Low Woodland, to be proposed for DRF.
Of interest are:4#*Haemodorum simplex*, 5#*Prasophyllum drummondii*, 5#*Burchardia bairdii*, 6#*Podolepis gracilis' pink*', 5#*Microtis alba*, 6#*Isotropis* aff. *cuneifolia*, 6#*Myriocephalus helichrysoides*, 6#*Restio stenostachyus* and 2#*Eleocharis sp.*

Recommendation
CALM liaise urgently with the Local Government Authority to retain and manage the area for its flora conservation values.

Area 10 - Marri and Flooded Gum Woodland, Pinjarra Plain
Muchea Townsite, part of System 6 Reserve C 25, Chittering, approx 12 ha (Location 118b)

Value - Vegetation Map, page 87.
The only area of Marri and Flooded Gum Woodland and associated *Melaleuca* Shrubland over Low Shrubland remaining with significant understorey even though the area is in Poor Condition. A small remnant of a larger remnant identified in the System 6 Report.
Significant species: 5#*Darwinia* aff *neildiana*, 5#*Grevillea biternata* - minimal survey.

Recommendation
CALM liaise urgently with the Local Government Authority to retain and manage the area for its flora conservation values.

Area 11 - western margins of the Dandaragan Plateau and Pinjarra Plain
Bullsbrook Bushland, Swan
The areas of remnant vegetation as indicated on Location Maps, p102 onwards, including:
Bushland in Pearce, between Great Northern Hwy and Chittering Rd (Location 100), Vegetation Map, page 89.

Pearce Aerodrome, System 6 Reserve M15 (Location 101)
Bullsbrook District High School, 15 ha (Location 102), Vegetation Map, page 89.
Bushland between Ashton Rd and Chittering Rd, 12 ha (Location 103), Vegetation. Map, page 89.
Burley Park, 43 ha (Location 105), Vegetation. Map, page 88.
S E corner of the junction Great Northern Hwy and Sounness Rd (Location 106), Vegetation. Map, page 89.
Bullsbrook Recreation Reserve (Location 107), Vegetation Map, page 90.
Wetland adjacent to Location 107 (Location 108), Vegetation Map, page 90.
Recreation Reserve, System 6 Reserve M14, 117 ha (Location 109), Vegetation Map, page 91.
and other remnant vegetation on Commonwealth, local government and private land in the area indicated.
The ownership of the lands in this area is both public and private and the public lands have a variety of vestings from defence to cemetery.

Value - see above for vegetation maps
The Bullsbrook Bushland is significant as it includes the suite of vegetation associations found on the flats of the northern Pinjarra Plain from Flooded Gum and *Melaleuca raphiophylla* Forest along Ellen Brook in the west through the Wandoo Woodland, Marri and Wandoo Woodlands, *Casuarina obesa* Woodlands, Wetland Mosaic Associations on the flats of the Pinjarra Plain and the Banksia Low Woodlands, Marri Woodlands, Jarrah Woodlands, Heaths and the Wandoo and Powderbark Wandoo Woodland of the foothills of the Dandaragan Plateau. This area is of greater significance because of its location adjacent to where the Dandaragan Plateau and the Ridge Hill Shelf meet. All vegetation associations are in Very Good to Good Condition. The condition of the Flooded Gum and *Melaleuca raphiophylla* Forest along Ellen Brook in the Pearce Aerodrome was not assessed. The *Casuarina obesa* Woodlands assessed are in a Completely Degraded Condition.
Significant species: > 25, 5 Priority species: 4#*Synaphea acutiloba*, 3,6#*Restio stenostachyus*, 3,6#*Stylidium utricularioides* and 3,6#*Eryngium pinnatifida* ssp. '*palustris*'.

Recommendation
The area be included in a Regional Park, the areas of remnant vegetation being retained and managed for their flora conservation values. The Regional Park should be established and managed according to the guide-lines being developed by DPUD.

Area 12 - Ridge Hill Shelf
Talbot Rd Reserve and adjacent bushland, Midland, approx 88 ha (Location 86) - local government with a variety of vestings from Cemetery to Recreation.

Value - Vegetation Map, page 92.
The area encompasses a significant number of the vegetation associations typical of the Ridge Hill Shelf soils: Wandoo Open Woodland, Marri and Wandoo Open Woodland, Mixed Sand Heath, Mixed Lateritic Heath, Marri Open Woodland, *Banksia* Low Woodland and *Jacksonia sternbergiana* High Shrubland in Very Good to Good Condition with severe localised disturbance. The Wandoo Woodland has a diversity of flora far in excess of any other Wandoo Woodland studied (this study and W. Loneragan, pers com.).
Significant species: >20, including 4 priority species
Of interest are:*Eucalyptus wandoo*, 4#*Hakea erinacea*, 4#*Hakea lissocarpha*, 4#*Dryandra armata*, *3*, 4#*Synaphea acutiloba*, 4#*Pultenaea ericifolia*, 4#*Daviesia horrida*, 3,4#*Hakea myrtoides*, 4#*Nemcia spathulatum*, , 4#*Chorizema dicksonii*, 4#*Hakea undulata*, 4#*Pimelea imbricata*, 4#*Neurachne alopecuroidea*, 4#*Stylidium affine*, 4#*Xanthosia candida*, 4#*Trichocline*, 4#*Tribonanthes brachypetala*, 6#*Drosera macrantha*, 3#*Arthropodium preissii*, 4#*Chamaescilla versicolor*, 4#*Stylidium bulbiferum*,4#*Kingia australis*, 4#*Cyathochaeta avenacea*, 4#*Mesomelaena tetragona*, 3, 5#*Isopogon drummondii*, 4#*Lambertia multiflora*, 4#*Andersonia lehmanniana*, *Harperia lateriflora* and3,4#*Beaufortia purpurea* .

Recommendation
CALM liaise with the body in which the land is vested to retain and manage the area for its flora conservation values. Any development should be confined to the severely degraded areas.

Area 13 - Pinjarra Plain in association with Bassendean Sands
Activ Industries Site, SW intersection Adelaide St and Roe Hwy, High Wycombe, approx 20 ha (Location 81).

Value - Vegetation Map, page 93.
The area contains a significant area of *Banksia* Low Open Woodland to Low Open Forest, similar in structure to that at Sultana Rd which is presently unknown outside of the High Wycombe area, and Jarrah, *Allocasuarina fraseriana* and *Banksia* Open Woodland in Very Good to Good Condition with severe localised disturbance.
Significant taxa: >10, 3 priority species
Of interest are: 4#*Lambertia multiflora*, 5#*Hakea conchifolia*, 4#*Jacksonia restioides*, 3,4#*Isopogon drummondii*, 3,4#*Conospermum undulatum*, 5#*Pityrodia bartlingii*, 5#*Banksia incana*, 3#*Daviesia physodes*, 4#*Cyathochaeta avenacea*, 5#*Caustis dioica*, 4#*Persoonia elliptica*, 5#*Dasypogon obliquifolius* and 5#*Blancoa canescens.*

Recommendation
CALM liaise with the body to which the land is vested to retain and manage the area for its flora conservation values. Any development should be confined to the severely degraded areas.

Area 14 - *Banksia attenuata* and *Banksia menziesii* Low Open Forest, Pinjarra Plain in association with Bassendean Sands
Sultana Rd, High Wycombe, approx 14 ha (Location 75) - private lands.

Value - Vegetation Map, page 93.
This Location of *Banksia attenuata* and *Banksia menziesii* Low Open Forest has a unique shrub flora, presently not known outside the High Wycombe area. The shrub strata are apparently an association formed in response to the presence of sands over alluvium in this general area. The shrub flora is of further interest as it has not been burnt for a long period and the shrubs have reached maturity. The association is in Very Good Condition.
Significant taxa: > 10, 4 Priority taxa
Of interest are: 4#*Persoonia elliptica*,4# *Lambertia multiflora*, 3,4#*Isopogon drummondii*, 5#*Banksia incana*, 5#*Petrophile seminuda*, 5#*Actinostrobus acuminatus*, 5#*Eremaea fimbriata* , 3, 5#*Conospermum undulata*, 5#*Conothamnus trinervis*, 5#*Hakea conchifolia*, 4#*Calytrix aurea*, 5#*Pityrodia bartlingii*, 4#*Jacksonia restioides*, 5#*Dasypogon obliquifolius*, 3,5#*Haemodorum loratum* and 4#*Mesomelaena tetragona.*

Recommendation
CALM liaise urgently with the owners to retain and manage the area for its flora conservation values with a view to purchasing the area for a Nature Reserve, vested in the NPNCA.

Area 15 - Pinjarra Plain in association with Bassendean Sands
Bushland in the area of the Fire Training Centre, Forrestfield, System 6 Reserve M 53, approx 55 ha (Location 73) - various government authorities.

Value - Vegetation Map, page 94.
This Location with *Pericalymma ellipticum* Low Open Heath to *Pericalymma ellipticum* Closed Scrub, *Banksia*, *Allocasuarina fraseriana* and *Eucalyptus marginata* Woodland, Marri and Jarrah Woodland to Open Woodland over scattered *Kingia*, Marri Woodland and Scattered Marri and *Nuytsia* over Shrubland with scattered *Kingia* over Sedgeland is representative of most of the associations characteristic of the sandy and to a lesser extent the heavy soils of the Pinjarra Plain. The associations are generally in Very Good to Good Condition with some areas in Very Poor and Completely Degraded Condition.
Significant taxa: >15 taxa, including 3 priority taxa
Of interest are:4#*Kingia australis*, 5#*Byblis gigantea*, 4#*Mesomelaena tetragona*, *Mesomelaena graciliceps*, 5# *Pityrodia bartlingii*, 3, 6#*Conospermum undulata*, 3,6#*Isopogon drummondii*, 5#*Dasypogon oblquifolius*, 4#*Cyathochaeta avenacea*, 4#*Jacksonia restioides*, 2#*Persoonia elliptica*, 4#*Lambertia multiflora*, 3#*Daviesia physodes*,4#*Thomasia macrocarpa*, 5#*Allocasuarina thuyoides*, 4#*Hemigenia sericea*, 4#*Caustis dioica* and 4#*Calytrix aurea*.

Recommendation
CALM liaise urgently with the body in which the land is vested to retain and manage the area for its

flora conservation values. Any development should be confined to the severely degraded areas.

Area 16 - Pinjarra Plain in association with Bassendean Sands
Hartfield Country Club Area, Forrestfield, greater 40 ha (Location 68) - local government

Value - Vegetation Map, page 95.
The vegetation associations at this Location *Banksia* and *Allocasuarina fraseriana* Low Woodland to Low Open Woodland and Marri, Jarrah and *Allocasuarina fraseriana* Open Forest over *Kingia* High Open Shrubland have areas in Very Good to Good Condition but have been fragmented by developments for recreation constituting widespread localised disturbance. The *Pericalymma ellipticum* and *Hakea sulcata* Closed Heath with rises of *Banksia menziesii* and *Allocasuarina fraseriana* Low Woodland are in Very Good to Good Condition but bisected by Tonkin Hwy. These associations are characteristic of the sandy and to a lesser extent the heavy soils of the Pinjarra Plain.
Significant taxa: .10 taxa, including 2 priority species
Of interest are: 4#*Kingia australis*, 5#*Beaufortia squarrosa*, 3,6#*Conospermum undulatum*, 4#*Cyathochaeta avenacea*, 4#*Lambertia multiflora*, 3,5#*Isopogon drummondii*, 4#*Jacksonia restioides*, 5#*Dasypogon obliquifolius*, 4#*Isopogon asper*, 4#*Pentapeltis peltigera* and 4#*Mesomelaena tetragona.*

Recommendation
CALM liaise urgently with the body in which the land is vested to retain and manage the area for its flora conservation values. Any development should be confined to the severely degraded areas.

Area 17 - Wetland Associations, Pinjarra Plain
Canning Wetlands, Locations 62-65
Brixton St Wetlands, Kenwick, approx 19 ha (Location 62) - government land, proposed Nature Reserve, Vegetation Map, page 96.
North Brixton St Wetlands, Kenwick, approx. 38 ha (Location 63) - private land currently subject to environmental assessment, Vegetation Map, page 96.
Yule Brook Reserve, System 6 Reserve M 69, Kenwick, approx. 28 ha (Location 64) - Flora Conservation Reserve, owned by the University of WA, Vegetation Map, page 97.
Wetlands NE of the Yule Brook Reserve between Brook and Boundary Rds, Kenwick, approx. 34 ha (Location 65) - private, Vegetation. Map, page 97.

Value - see above for vegetation maps
This area is the only substantial area of the Wetland Associations characteristic of the heavy seasonally innundated soils of the flats of the Pinjarra Plain extant. The associations encompassed in these locations give some idea of the complexity and diversity of these wetlands that were once widespread on the Pinjarra Plain. The characteristic associations are: *Viminaria juncea* High Shrubland, *Melaleuca* Open Heath, Mixed Low Open Heath, Samphire Low Shrubland, Herblands and Sedgelands. The *Melaleuca* Open Heath and Mixed Low Open Heath are extremely variable. THe dominant species are generally a suite of myrtaceous shrubs with scattered clumped *Actinostrobus pyramidalis* and/or *Viminaria juncea* . Although there are areas in Very Poor Condition and areas of severe localised disturbance most of the area is in Very Good to Good Condition.
Significant taxa: >30 taxa, 4 DRF, 6 priority taxa and DRF
Of interest are: 6#*Aponogeton hexatepalus*, 6#*Schoenus capillifolius*, 6#*Hydatella dioica*, 4#*Acanthocarpus cannaliculatus*, 4#*Agrostocrinum scabrum*, 5#*Tricoryne humilis*, 4#*Anigozanthos bicolor*, 6#*Tribonanthes* sp, 4#*Patersonia juncea*, 4#*Grevillea bipinnatifida*, 4#*Hakea auriculata*, 4#*Hakea erinacea*, 6#*Petrophile media* var *juncifolia*, 5#*Drosera heterophylla*, 3, 6#*Erynium 'subdecumbens'*, DRF, 6#*Hydrocotyle lemnoides*, 3, 5#*Villarsia submersa*, 6#*Hyalospermum pyrethrum*, 6#*Trichocline* sp, 6#*Banksia telmatiaea*, 5#*Calothamnus hirsutus*, 4#*Verticordia acerosa*, 3, 6#*Grevillea thelemanniana* ssp. *thelemanniana*, 3#*Daviesia physodes*, 4#*Jacksonia alata*, 4#*Andersonia aristata*, 4#*Melaleuca lateritia*, 4#*Scaevola lanceolata*,5#*Conostylis festucacea*, 5#*Restio tremulus*, 5#*Burchardia bairdii*, 4#*Stylidium ecorne*, 4#*Stylidium dichotomum*, 4#*Stylidium divaricatum*, 3, 5#*Schoenus andrewsii*, 5#*Isotoma scapigera*, 6#*Calandrinia composita*, 4#*Verticordia acerosa*, 4#*Verticordia plumosa*, DEF *Calytrix breviseta* ssp. *breviseta* , 4#*Philydrella drummondii*, 4#*Tribonanthes*

brachypetala, 3, 6#*Stylidium utricularioides*, 5#*Melaleuca uncinata*, 6#*Eryngium pinnatifida* ssp. '*palustris*' and 5#*Prasophyllum drummondii*.

Recommendation
CALM liaise urgently with the owners to retain and manage the area for its flora conservation values. Locations 63 and 65 should be acquired for a Nature Reserve encompassing all four locations, vested in the NPNCA.

Area 18 - Ridge Hill Shelf
NW junction Connel Ave and Ciro Rd, Kelmscott, approx. 22 ha (Location 48)- local government.

Value - Vegetation Map, page 98.
The vegetation at this Location includes a series of associations typical of the Ridge Hill Shelf: *Melaleuca preissiana* Open Forest and *Melaleuca raphiophylla* High Open Shrubland on the low lying areas to the west and moving upslope to the east *Jacksonia sternbergiana* Open Scrub, *Allocasuarina fraseriana* Woodland, Jarrah and *Allocasuarina fraseriana* Open Forest and Wandoo Open Woodland. To the east of this Location is a considerable area of bushland, principally Jarrah and *Allocasuarina fraseriana* Open Forest and Wandoo Open Woodland which together with this Location would form a Reserve that encompasses the Ridge Hill Shelf and the Darling Scarp.
Significant taxa: .>10 taxa
Of interest are: 4#*Melaleuca polygaloides*, 4#*Hakea erinacea*, 4#*Mesomelaena tetragona* , 4#*Cyathochaeta avenacea*, 4#*Baeckea camphorosmae*, 4#*Isopogon dubius*, 4#*Neurachne aleopecuriodea*, 4#*Chorizema dicksonii*, 4#*Verticordia pennigera*, 4#*Pimelea imbricata*, 4#*Darwinia thymoides* ssp.*thymoides* and4#*Hakea stenocarpa*.

Recommendation
CALM liaise urgently with the Local Government Authority to retain and manage the area for its flora conservation values. Any development should be confined to the severely degraded areas.

Area 19 - Ridge Hill Shelf and Darling Scarp
Lloyd Hughes Park, Martin St Kelmscott, approx 17 ha (Location 47) - local government

Value - Vegetation Map, page 98.
The Flooded Gum Woodland along the watercourse at this Location, is in a relatively natural condition, with Marri Woodland on the lower slopes and Wandoo Woodland on the higher slopes. Much of the Location is in Very Good to Good Condition with areas of severe localised disturbance. This Location encompassing the Scarp and the Ridge Hill Shelf and being continuous with Scarp vegetation to the north is an important area.
Of interest are: 4#*Trichocline spathulata*, 4#*Stypandra glauca*, 4#*Hakea undulata* , 4#*Lasiopetalum floribunbum*, 4#*Hakea trifurcata*, 4#*Acacia lateritia*, 4#*Daviesia horrida*, 4#*Hibbertia commutata*, 4#*Hakea lissocarpha*, 4#*Bossiaea ornata*, 4#*Pimelea imbricata*, 4#*Isopogon asper*, 4#*Gompholobium polymorphum*, 4#*Stylidium affine*, 4#*Xanthosia candida* and 4#*Acanthocarpus cannaliculatus*.

Recommendation
CALM liaise urgently with the Local Government Authority to retain and manage the area for its flora conservation values. Any development should be confined to the severely degraded areas.

Area 20 - Wetland Associations, Pinjarra Plain in association with Bassendean Sands
Wetlands to the east of Forrestdale Lake, Armadale - Kelmscott (Location 1) - local government.

Value - Vegetation Map, page 99.
The vegetaion associations at this Location include: *Melaleuca* Closed Heath to Open Heath in the wetter low lying areas with Herblands and Sedgelands, Low Closed Heath to Open Heath on the edges

and *Banksia* and Marri Low Woodland on the sandy rises. The Location is in Very Good to Good.Condition and represents an example of the Pinjarra Plain associations on heavy seasonally innundated soils alongside vegetation associations on Bassendean Sands.
Significant taxa: >5, including DRF *Diuris purdiei*
Of interest are: 3#*Jacksonia 'swamp'*, 4#*Melaleuca uncinata*, 4#*Melaleuca polygaloides* , 4#*Banksia telmatiaea*, 3, 6#*Eryngium pinnatifida* ssp. *'palustris'*, 4#*Stylidium dichotomum*, 4#*Harperia lateriflora*, 4#*Schoenolaena juncea* and 4#*Melaleuca lateritia*.

Recommendation
CALM liaise with the Local Government Authority to retain and manage the area for its flora conservation values towards having the location declared an A Class Reserve and included in the Forrestdale Lake Nature Reserve.

Area 21 - Marri Open Woodland, Banksia Woodland and Wetland Associations, Pinjarra Plain, Ridge Hill Shelf and Bassendean Sands
Brickwood Reserve and adjacent bushlands, Serpentine-Jarrahdale, approx 43 ha (Location 10) - local government

Value - Vegetation Map, page 100.
This Location contains an unusual suite of soils, Ridge Hill Shelf, Pinjarra Plain and a ridge of Bassendean Sands. The Ridge Hill Shelf and Pinjarra Plain are indistinguishable vegetatively and are treated as Pinjarra Plain as the associations are typical of associations of the flats of the Plain. The Location has the most extensive areas of Marri Open Woodland with scattered *Kingia* found in the study alongside *Pericalymma ellipticum* Closed Heath, *Melaleuca viminea* Open Scrub, Herbland and Sedgeland on the areas where the soils are innundated for longer periods. *Banksia* Woodland occurs on the Ridge of sand. All associations are in Very Good to Good Condition.
Significant taxa: .> 20, including 3 priority taxa
Of interest are: 4#*Lambertia multiflora*, 4#*Kingia australis*, 4#*Cyathochaeta avenacea*, 4#*Mesomelaena tetragona*, 4#*Lomandra odora*, 4#*Baeckea camphorosmae*, 4#*Melaleuca lateriflora*, 4#*Hake trifurcata*, 4#*Verticordia plumosa*, 4#*Synaphea petiolaris*, 4#*Tricoryne humilis*, 5#*Prasophyllum drummondii*, 4#*Petrophile seminuda*, 5#*Petrophile media* var. *juncifolia*, 4#*Grevillea pilulifera*, 4#*Darwinia thymoides* , 5#*Calytrix aurea*, 4#*Acacia drewiana*, 3, 6#*Verticordia lindleyi ssp. lindleyi*, 3, 6#*Stylidium utricularioides*, 4#*Isopogon asper*, 4#*Grevillea bipinnatifida*, 4#*Hakea auriculata*, 4#*Hakea erinacea*, 6#*Petrophile media* var *juncifolia*, 5#*Drosera heterophylla*, 4#*Verticordia acerosa*, 3#*Daviesia physodes*, 4#*Jacksonia alata*, 4#*Andersonia aristata*, 4#*Melaleuca lateritia*, 4#*Scaevola lanceolata*, 4#*Stylidium dichotomum*, , 4#*Philydrella drummondii*, 4#*Tribonanthes brachypetala* and 5#*Melaleuca uncinata*.

Recommendation
CALM liaise urgently with the Local Government Authority to retain and manage the entire area for its flora conservation values.

Area 22 - Pinjarra Plain in association with Bassendean Sands
Phillips Rd, Industrial Area west Pinjarra, approx. 38 ha (Location 38) - ?local government, private

Value - Vegetation Map, page 101
This area of bushland is at the junction of Bassendean Sand and the Pinjarra Plain. The area to the north of the Location, adjacent to Pinjarra Rd, is apparently a continuation of the Bassendean Sands wetland to the north of the road. The area to the west of Phillips Rd shows the greatest affinities with the welands of the Pinjarra Plain as *Kingia* are present. The vegetation in the Bassendean Sands section of the Location is Mixed Low Open Heath with scattered *Melaleuca preissiana*.. This area is a recorded site for of the DRF, *Diuris purdiei*. This Location is generally in Good Condition with severe localised disturbance The associations of the Pinjarra Plain present at this Location are: *Melaleuca* Open Heath, *Melaleuca* Open Scrub, *Pericalymma ellipticum* Open Heath, Herblands and Sedgelands. The flora of the Location was not fully assessed as the Location was visited in winter when the area was under water.
Significant taxa: >10, including the DRF, *Diuris purdiei*.

Of interest are: 5#*Melaleuca uncinata*, 4#*Melaleuca polygaloides*,4#*Melaleuca lateritia*, 2#*Hakea candolleana*, 4#*Acacia incurva*, 6#*Petrophile media* var. *juncifolia*, 4#*Neurachne aleopecuroidea*, 4#*Mesomelaena tetragona* and 4#*Grevillea bipinnatifida*.

Recommendation

CALM liaise urgently with the Local Government Authority and/or land owners to retain and manage the area for its flora conservation values towards having the location acquired and declared an A Class Reserve for the conservation of flora, vested in the NPNCA.

RECOMMENDATION 4

Immediate action should be taken to ensure that the twenty two areas of remnant vegetation subject to individual recommendations (see Section 6.3) are vested and managed for the conservation of flora as their main purpose, according to the specific recommendation for each area.

6.3.3 Areas of Remnant Vegetation Adjacent to the Study Area

The most extensive areas of remnant vegetation identified in the course of this study were outside the study area to the north-east and north-west of Muchea.

Much of the area to the north west of Muchea is in the Gnangara Water Mound and is under no immediate threat from clearing.

The vegetation to the north-east of Muchea is on the Dandaragan Plateau and its western margins and all in private ownership.

Presently there are no significant reserves on the Dandaragan Plateau south of GinGin even though there are considerable amounts of remnant vegetation in Good Condition extant. There is an opportunity at present for a reserve of considerable size to be established that includes the Dandaragan Plateau and its western margins. The Ioppolo Rd (Location 119) and Breera Rd (Location 121) areas are in need of further investigation with the view to establishing a flora conservation reserve in this section of the study area including the Pinjarra Plain to the west, the Reagan unit and the Dandaragan Plateau to the east. The occurrence of an undescribed *Chamelaucium* in one small area along Ioppolo Rd (Location 119) supports this need for further investigation.

The Ioppolo Rd area, east and south east to the remnant vegetation block south of Yalal Brook, with a connection to Lake Chandalla to the west is perhaps the best option (Location Map 2). This would create a buffer to the east for Lake Chandalla Nature Reserve. All of this land is in private hands and much is subject to sand mining leases.

RECOMMENDATION 5

The remnant vegetation identified on the Reagan soil unit and Dandaragan Plateau south of GinGin should be urgently surveyed to determine the most suitable area to be acquired for a flora conservation reserve.

There are a series of locations identified in the study that still require further investigation or are the subject of other surveys. Recommendations on these areas await the outcomes of these investigations. The recommendations in this study and the descriptions of the vegetation associations characteristic of the study area can be used to supplement the work of these investigations. One area, the Pearce Airforce Base is included in the recommendations made in this study but these recommendations are subject to future survey.

These areas are

- Private land on Eilen Brook (Location 113)
- Pearce Airforce Base (Location 101)
- Bushmead Rifle Range and adjacent lands(Location 88 &89).

6.5 Landscape Conservation

The Swan Coastal Plain with its backdrop of the Hills, the Darling Range, is a unique landscape (Figures 2a,2b, 4a & 4b). The significance of the Darling Range has long been recognised by planners and large tracts of the Scarp have been acquired or designated for the Darling Range Regional Park. Being adjacent to the Hills the eastern side of the Plain is critical in this panorama but has not been subject to the same planning procedures. At various locations in the study area it is still possible to look east to the Hills through an area vegetated, to the eye, much as it was before European settlement (Figures 2a &2b). At other locations the remnant trees, particularly *Casuarina obesa* (Figure 4a and 4b) form a unique and attractive treescape.

To conserve this landscape the remnant vegetation of the study area needs to be conserved as well as the vegetation in a Completely Degraded Condition. As the trees and shrubs are now unable to regenerate naturally the conservation of these plants will involve planting programmes. Such a programme is of some urgency as many of these trees and shrubs are reaching maturity.

RECOMMENDATION 6
A local tree planting programme should be developed for the eastern side of the Swan Coastal Plain to preserve the unique treescapes of the area.

7.0 CONCLUSION

This survey has confirmed that there is very little remnant vegetation on the eastern side of the Swan Coastal Plain. The few remaining remnants are small, scattered and disjunct. They have escaped clearing for agriculture and urbanisation as they were generally unsuitable for these purposes being on the poorer, sandy soils or soils that are seasonally inundated. A few of these remnants are areas that were set aside for a public purpose which has not eventuated, such as townsites, or the purpose has only impacted on a portion of the area, such as rail verges and gravel mines.

There is so little native vegetation remaining in this extensive area that it is recommended that action be taken to conserve all of the vegetation in Poor or better Condition on both public and private lands regardless of the size of these remnants. Such a recommendation is unusual as such small areas are not generally seen as viable conservation areas. However, with the appropriate management, at the local government and community level many of these small remnants can maintain their conservation values which otherwise will be lost entirely as they are not replicated elsewhere. If action is not taken to conserve these remaining remnants the future for the unique vegetation associations of the eastern side of the Swan Coastal Plain is bleak and all the associations will be reduced to a few isolated pockets of vegetation facing extinction.

Twenty two specific recommendations are made concerning areas of high conservation value. A series of criteria were used in the selection of these areas to ensure that the areas selected would encompass the range of vegetation associations characteristic of the vegetation associations that are still extant in the study area. Unfortunately the areas involved are relatively small.

As a result of selective clearing of the vegetation on agriculturally desirable soils the remnant vegetation in the study area is not representative of the vegetation that occurred on the eastern side of the Swan Coastal Plain at the time of European settlement. This fact was appreciated early in the study and it was necessary to survey as many areas of remnant vegetation as possible, regardless of their size and condition to establish with any degree of certainty the vegetation associations that were characteristic of the study area before clearing. The vegetation of the study area was found to have been a complex of vegetation associations that are structurally and floristically diverse.

For the purposes of this study the eastern side of the Swan Coastal Plain was divided into three geomorphological/soil units: the western margins of the Dandaragan Plateau, the Ridge Hill Shelf and the Pinjarra Plain. The characteristic vegetation associations of these three main units were determined.

Dandaragan Plateau and the Ridge Hill Shelf

The vegetation associations described for the western margins of the Dandaragan Plateau and the Ridge Hill Shelf were directly comparable with those of previous small scale vegetation studies. Some important areas of remnant vegetation on these two geomorphological/soil units were identified and recommendations made for their reservation. A rare and previously undescribed vegetation association, Marri and *Eucalyptus lanepoolei* Low Woodland was identified on the Ridge Hill Shelf.

Pinjarra Plain

The complex suite of vegetation associations identified on the Pinjarra Plain were related to a complex suite of soils and drainage conditions. The main associations are:

Eucalyptus calophylla (Marri) Woodland to Open Forest
Casuarina obesa (Salt Water Sheoak) Woodland
Eucalyptus calophylla and *Eucalyptus wandoo* (Wandoo) Woodland to Open Forest
Eucalyptus wandoo Woodland to Open Forest
Eucalyptus rudis (Flooded Gum) Woodland to Forest
Wetland Associations, a complex mosaic of shrublands, heaths, sedgelands and herblands.

Three of these associations, the *Eucalyptus calophylla* Woodland to Open Forest, *Casuarina obesa* Woodland and the Wetland Associations are recognised as having been the most common vegetation associations of the Pinjarra Plain prior to European settlement. Only one of these associations, the wetlands, is presently significantly represented in the remnant vegetation areas. Previous studies

of the Pinjarra Plain were in disagreement about the extent of these associations and all underestimated the extent of the wetlands. This confusion was undoubtably due to the small fragmented nature of the remnant vegetation.

The Woodlands and Open Forests of the Pinjarra Plain are almost extinct, having been reduced by clearing to a few small isolated pockets. That this has happened is an indictment on our nature conservation planning process as there has been evidence in the literature for some years that these Woodlands were at risk and no comprehensive measures were taken, until now, to even critically assess the situation. This indicates a degree of ignorance within our society, particularly among planners, of the value of native vegetation especially when compared to the resources and publicity given to the conservation of individual species.

This study has probably been the last opportunity to document the extent of these woodlands and forests and to describe some aspects of their vegetation and flora. Most of the remnants of these woodlands and open forests are so degraded and small compared to their original extent that we will never know for certain what their vegetation and flora was. More detailed study is urgently required.

The ephemeral wetlands show great diversity of vegetation association and flora and have the highest number of endemic species of the different vegetation associations on the eastern side of the Swan Coastal Plain and contain many poorly known taxa. Of the vegetation associations characteristic of the study area the wetlands are comparatively extensive and a comprehensive flora conservation reserve network for these Wetlands could and should be urgently established.

The composition of the flora of these woodlands, open forests and wetlands was found to be unusual and to have a much closer relationship with the flora of the Darling Scarp than was previously recognised in the botanical literature.

The characteristic vegetation associations of the sandier soils of the Pinjarra Plain have close affinities with the vegetation of the Bassendean Sands to the west while still retaining a degree of affinity with the flora of the Darling Scarp. A unique area of *Banksia* Woodland was identified, within the metropolitan area, that has close affinities with the flora of the Darling Scarp and the northern sandplains.

In conclusion, the remnant vegetation in the study area has very significant value for the conservation of vegetation associations and flora as well as for its contribution to the landscape. Undoubtably these values are sufficient to warrant their protection and proper management.

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Table 1a Vegetation Associations
- major structural formations (Aplin, 1979)
- key to Symbols used to represent Vegetation Associations

Life-form and height of tallest stratum	*Projective foliage cover of tallest stratum, as per cent*	*Description*	*Symbol*	
Trees over 30 m	70-100	High closed forest		
	30-70	High open forest		
	10-30	High woodland		
	under 10	High open woodland		
Trees 10-30 m	70-100	Closed forest	CF	F
	30-70	Open forest	OF	
	10-30	Woodland	W	W
	under 10	Open woodland	OW	
Trees under 10 m	70-100	Low closed forest	LCF	LF
	30-70	Low open forest	LOF	
	10-30	Low woodland	LW	LW
	under 10	Low open woodland	LOW	
Shrubs over 2 m	70-100	Closed scrub	CSc	Sc
	30-70	Open scrub	OSc	
	10-30	High shrubland	HSh	HSh
	under 10	High open shrubland	HSh	
Shrubs 1-2 m	70-100	Closed heath	CHt	Ht
	30-70	Open heath	OHt	
	10-30	Shrubland	Sh	Sh
	under 10	Open shrubland	OSh	
Shrubs under 1 m	70-100	Low closed heath	LCHt	LHt
	30-70	Low open heath	LOHt	
	10-30	Low shrubland	LSh	LSh
	under 10	Low open shrubland	LOSh	
Herbs	70-100	Closed herbland, closed tussock grassland, closed sedgeland, etc.		CH, CS
	30-70	Herbland, tussock grassland, sedgeland, etc.		
	10-30	Open herbland, open tussock grassland, open sedgeland, etc.		H, S
Hummock grasses	10-30	Hummock grassland		
	under 10	Open hummock grassland		

Table 1b: Key to symbols used to represent dominant species in the vegetation associations

Vegetation Associations

WM Wetland Mosaic

Species

Trees

Eucalypts

j	Jarrah (*Eucalyptus marginata*)
l	*Eucalyptus lanepoolei*
m	Marri (*Eucalyptus calophylla*)
pw	Powderbark Wandoo (*Eucalyptus accedens*)
r	Flooded Gum (*Eucalyptus rudis*)
t	*Eucalyptus todtiana*
w	Wandoo (*Eucalyptus wandoo*)

Shrubs

ac	*Actinostrobus pyramidalis*
k	*Kingia australis*
me	*Melaleuca* species
mi	mixed shrubs
s	*Jacksonia sternbergiana*
sm	Samphires
p	*Pericalymma ellipticum*
rg	*Regelia ciliata*
v	*Viminaria juncea*

Others

a	*Allocasuarina fraseriana*
c	*Casuarina obesa*
mp	*Melaleuca preissiana*
mr	*Melaleuca raphiophylla*
x	*Xylomelum occidentalis*

Table 2: **Vegetation Condition Scale** (Trudgen, 1990)

E = **Excellent.** Pristine or nearly so, no obvious signs of damage caused by the activities of Europaean man.

VG = **Very good.** Some relatively slight signs of damage caused by the activities of Europaen man. E.g. some signs of damage to tree trunks caused by repeated fire and the presence of some relatively non-agressive weeds such as Ursinia anthemoides or Briza spp., or occasional vehicle tracks.

G = **Good.** More obvious signs of damage caused by the activities of Europaen man, including some obvious impact on the vegetation structure such as caused by low levels of grazing or by selective logging. Weeds as above, possibly plus some more aggressive ones.

P = **Poor.** Still retains basic vegetation structure or ability to regenerate to it after very obvious impacts of activities of Europaen man such as grazing or partial clearing (chaining) or very frequent fires. Weeds as above, probably plus some more aggressive ones such as *Ehrharta* spp.

VP = **Very poor.** Severely impacted by grazing, fire, clearing or a combination of these activities. Scope for some regeneration but, not to a state approaching good condition without intensive management. Usually with a number of weed species including aggressive species.

D = **Completely degraded.** Areas that are completely or amost completely without native species in the structure of their vegetation. I.e. areas that are cleared or "parkland cleared" with their flora comprising weed or crop species with isolated native trees or shrubs.

Table 3:

Key to the Notation on Significant Flora of the Survey Area, Tables 4-6

Column 1 Taxa in family, listed alphabetically. Names follow Marchant et al unless indicated.

Column 2 Habitat, distinguished according to seasonal innundation

+	indicates recorded but no additional information
Upland:	S/A: sand over alluvium, RH: Ridge Hill Shelf, Re: Reagan
Wet:	DP: Dry pond, P: Pond, W:waterlogged, C: Creekline
Adj	adjacent to land seasonally waterlogged

Column 3 Conservation Code, Priority Code. Atkins, 21/11/1991 (Table 4)

R: Declared Rare Flora - Extant Taxa
X: Declared Rare Flora - Presumed Extinct Taxa
1: Priority One - Poorly Known Taxa
2: Priority Two - Poorly Known Taxa
3: Priority Three - Poorly Known Taxa
4: Priority Four - Rare Taxa
5: Priority Five - Proposed Declared Rare Flora

Column 4 Taxa recorded during the Survey

Column 5 recorded in the Flora of the Perth Region, Marchant et al, 1987

+	indicates recorded but no additional information
NT	New taxa
NR	New record from this Survey
NR, a	New record from the literature, reference
SR	Poorly known from the Study Area previous to this Survey
DN	Distribution disjunct, main populations on the northern sandplain
UT	Unresolved Taxa
south	Most northerly record of species to the south
north	Most southerly record of species to north
east	most westerly record

References - a: Speck and Baird 1984, b: Keighery & Keighery 1990, c: Hosking & Greaves 1936, d: Keighery & Keighery 1992.

Table 4

Taxa probably confined to the eastern side of the Swan Coastal Plain and the Darling Scarp in the Perth Region and possibly found elsewhere (4#)

TAXA	SITE Dry	Wet	Adj	PRIO CODE	STUDY REC	PERTH FLORA
AMARANTHACEAE						
Ptilotus declinatus		W			+	+
Ptilotus manglesii			+		+	+
ANTHERICACEAE						
Agrostocrinum scabrum	+				+	SR
Arthropodium preissii	+	W	+		+	SR
Borya sphaerocephala		W	+		+	+
Chamaescilla versicolor	RH	W	+		+	SR
Laxmannia grandiflora	RH				+	SR
Thysanotus arbuscular			+		+	+
Thysanotus dichotomus		W			+	SR
Thysanotus glaucus	+		+	5	+	SR
Tricoryne humilis	+		+		+	SR
APIACEAE						
Pentapeltis peltigera	+				+	SR
Schoenolaena juncea		DP,W			+	SR
Xanthosia candida	RH	C			+	+
Xanthosia ciliata	RH				+	+
ASTERACEAE						
Helichrysum manglesii		W			+	SR
Millotia tenuifolia		W				+
Trichocline spathulata		W			+	+, east
BYBLIDACEAE						
Byblis gigantea		W			+	+
CAESALPINIACEAE						
Labichea lanceolata	+				+	+
CYPERACEAE						
Caustis dioica	+	W	+		+	+
Mesomelaena tetragona	+	W	+		+	+
Mesomelaena graciliceps	RH				+	+
DASYPOGONACEAE						
Acanthocarpus canaliculatus	RH		+		+	SR
Kingia australis	+	W	+		+	+
Lomandra brittanii	+				+	SR
Lomandra odora	+		+		+	SR
DILLENIACEAE						
Hibbertia commutata	+				+	+, east
Hibbertia nymphaea			W			+
Hibbertia vaginata	+				+	+

Table 4 (cont)

DROSERACEAE					
Drosera bulbosa		W		+	+
Drosera heterophylla		DP,W		+	+
EPACRIDACEAE					
Andersonia aristata		W	+	+	+
Styphelia tenuifolia	+			+	+
EUPHORBIACEAE					
Stachystemon vermicularis	+			+	+
FABACEAE (PAPILIONACEAE)					
Aotus cordifolia		W	3		+
Bossiaea ornata	RH	W		+	SR
Daviesia cordata	RH/Re			+	SR
Gastrolobium spinosum	+			+	SR
Gompholobium aristatum	+			+	+
Gompholobium marginatum	+			+	SR
Gompholobium polymorphum	RH/Re			+	+
Jacksonia alata	RH	W		+	+
Jacksonia condensata	RH			+	+
Jacksonia restioides		W		+	+
Kennedia stirlingii	RH/Re		+	+	east, north
Latrobea tenella					+
Templetonia biloba	RH			+	+
GOODENIACEAE					
Dampiera coronata	+		+	+	+
Scaevola lanceolata		W		+	SR
HAEMODORACEAE					
Anigozanthos bicolor		W		+	+
Conostylis caricina	+	W		+	SR
Conostylis setosa	+			+	SR
Haemodorum simplex		W		+	SR
Tribonanthes brachypetala		W		+	SR
Tribonanthes longipetala		DP,W		+	+
IRIDACEAE					
Patersonia juncea	+			+	SR
MIMOSACEAE					
Acacia drewiana		W		+	+
Acacia latericola	+			+	SR
Acacia nervosa	+			+	SR
Acacia teretifolia	+			+	SR
MYRTACEAE					
Baeckea camphorosmae	+			+	+
Beaufortia macrostemon	+				+, End
Beaufortia purpurea	RH			+	+, End
Calothamnus hirsutus		W	+	+	+
Calothamnus quadrifidus	RH		+	+	+, Coast
Calothamnus sanguineus			+	+	+, Coast
Calytrix aurea	+	W	+	+	+, south
Calytrix simplex					+
Calytrix variabilis					+, north
Darwinia citriodora	+	W		+	+

Darwinia thymoides ssp. *thymoides*	RH				+	+
Eucalyptus lanepoolei	RH				+	+
Eucalyptus wandoo	+	W			+	+
Kunzea micrantha		W			+	+
Kunzea recurva		W			+	+
Leptospermum erubescens	+				+	+
Melaleuca lateriflora		DP,W			+	+
Melaleuca lateritia		DP,W			+	SR
Melaleuca polygaloides		Dp,W			+	UT
Melaleuca radula	RH				+	+
Melaleuca uncinata		DP,W			+	SR
Verticordia acerosa		W			+	+
Verticordia huegelii		W			+	SR
Verticordia pennigera		W	+		+	+
Verticordia serrata						+
ORCHIDACEAE						
Diuris laxiflora		W			+	+
Elythranthera emarginata		W	+		+	+
PHORMIACEAE						
Stypandra glauca	+				+	SR
PHILYDRACEAE						
Philydrella drummondii		W		3	+	NT
Philydrella pygmaea		W			+	+
PROTEACEAE						
Conospermum huegelii		W	+		+	SR
Dryandra armata	+				+	+
Dryandra bipinnatifida	Re				+	+
Grevillea bipinnatifida	+				+	SR
Grevillea diversifolia	+				+	SR
Grevillea pilulifera	+				+	SR
Grevillea glabrata	+				+	SR
Grevillea synaphaea	RH				+	SR
Grevillea wilsonii	+				+	SR
Hakea auriculata	+				+	SR
Hakea cyclocarpa	RH				+	SR
Hakea erinacea	+				+	SR
Hakea lasianthoides	RH				+	+, north
Hakea lissocarpha	+				+	SR
Hakea myrtoides	RH			3	+	SR
Hakea trifurcata	+		+		+	+
Hakea undulata	+				+	SR
Hakea stenocarpa	+				+	SR
Isopogon asper	+				+	SR
Isopogon dubius	+				+	SR
Lambertia multiflora	+				+	SR
Persoonia elliptica	+				+	SR
Petrophile biloba	RH				+	SR
Petrophile seminuda		W			+	SR
Petrophile squamata		W			+	SR
Stirlingia simplex	RH	W			+	SR
Synaphea acutiloba	RH	W		3	+	SR
Synaphea pinnata	RH			4	+	SR
Synaphea petiolaris	+		+		+	+

RESTIONACEAE					
Harperia lateriflora		W		+	SR
RHAMNACEAE					
Trymalium floribundum		C		+	SR
Trymalium ledifolium		C		+	SR
RUTACEAE					
Boronia ovata	Re			+	+
STERCULIACEAE					
Guichenotia sarotes	+				+
Lasiopetalum bracteatum	+				+
Lasiopetalum floribundum		W		+	SR
Thomasia glutinosa		W		+	SR
Thomasia macrocarpa		W		+	SR
Thomasia foliosa					+
STYLIDIACEAE					
Stylidium affine	+			+	SR
Stylidium breviscapum	+			+	SR
Stylidium canaliculatum		DP,W		+	SR
Stylidium dichotomum		DP,W		+	SR
Stylidium divaricatum		DP,W	+	+	SR
Stylidium ecorne		W	+	+	SR
THYMELAEACEAE					
Pimelea imbricata var. *piligera*	RH			+	+

Table 5:

Taxa confined to the eastern side of the Swan Coastal Plain in the Perth Region and occurring in other regions (5#)..

TAXA	Habitat			PRIO	STUDY	PERTH
	Upland	Wet	Adj	CODE	REC	FLORA
ASTERACEAE						
Millotia tenuifolia		W				+
Pogonolepis stricta		DP,W			+	NR, a
APIACEAE						
Hydrocotyle lemnoides		P		R		+, b
DASYPOGONACEAE						
Calectasia grandiflora				+		+
Dasypogon obliquifolius	S/A,RH				+	SR
HAEMODORACEAE						
Blancoa canescens	+				+	+, north
Conostylis festucacea		W			+	DN
Haemodorum loratum	S/A			2	+	DN
Tribonanthes sp		DP,W			+	SR
Tribonanthes aff. *longipetala*		DP,W			+	NT
CASUARINIACEAE						
Allocasuarina microstachya	S/A				+	SR
Allocasuarina thuyoides	S/A				+	SR
CLOANTHACEAE						
Pityrodia bartlingii	S/A				+	DN
COLCHICACEAE						
Burchardia bairdii		W	+		+	+
CUPRESSACEAE						
Actinostrobus acuminatus	S/A				+	DN
CYPERACEAE						
Caustis dioica		W	+		+	SR
Cyathochaeta avenacea	+	W	+		+	+, south
Eleocharis sp		DP		1	+	NT, b
Schoenus andrewsii		W		1	+	SR
Schoenus pennisetus		W		1		+
DROSERACEAE						
Drosera macrantha 'robust'		W	+		+	NT
EPACRIDACEAE						
Andersonia gracilis		W	+			DN
GOODENIACEAE						
Anthotium junciforme		W			+	+
LOBELIACEAE						
Isotoma pusilla		DP,W			+	+
Isotoma scapigera		DP,W			+	+

MALVACEAE						
Lawrencia squamata		W			+	+
MIMOSACEAE						
Acacia acuminata		? W			+	c
MENYANTHACEAE						
Villarsia submersa		P		3	+	+
MYRTACEAE						
Beaufortia squarrosa	S/A	W			+	+
Conothamnus trinervis	S/A,RH				+	DN
Darwinia aff. *neildiana*			W		+	+
Eremaea fimbriata	S/A				+	DN
Melaleuca bracteosa		W			+	+
LOGANIACEAE						
Mitrasacme palustris		W		1		south
ORCHIDACEAE						
Microtis alba		W			+	SR, north
Prasophyllum drummondii		W			+	SR, north
POACEAE						
Aristida contorta	+				+	NR
PROTEACEAE						
Banksia incana	S/A				+	+,DN
Banksia telmatiaea	S/A				+	+,DN
Dryandra mimica		W		R		..+
Hakea ceratophylla		W			+	+
Hakea conchifolia	S/A				+	+,DN
Hakea marginata		W			+	+
Isopogon drummondii	S/A,RH			1	+	+,DN
RESTIONACEAE						
Leptocarpus tennellus		W			+	NR, b
Restio tremulus		W			+	+
ROSACEAE						
Stylobasium australe		+				+, north
RUBIACEAE						
Opercularia apiciflora		W			+	NR
STYLIDIACEAE						
Stylidium guttatum		W			+	+

Table 6

Taxa probably confined to the eastern side of the Swan Coastal Plain and endemic to the Swan Coastal Plain (6#)

TAXA	SITE Dry	Wet	Adj	PRIO CODE	STUDY REC	PERTH FLORA
ASTERACEAE						
Trichocline sp (GK 6382)		W			Res	NT, b
Hyalospermum pyrethrum		P		3		+,b
Podolepis gracilis 'pink'		+	+		+	+, NT
Myriocephalus helichrysoides		DP			+	+
APIACEAE						
Eryngium "subdecumbens"		DP		1		NT, b
Eryngium pinnatifida ssp. '*palustris*'		W		1	+	NT, b
APONOGETONACEAE						
Aponogeton hexatepalus		P		R	?+	+
CENTROLEPIDACEAE						
Centrolepis caespitosa		+		X	?+	+
CYPERACEAE						
Schoenus capillifolius		DP		2	?+	+
Schoenus natans		DP		X		+
Tetraria australiensis		DP		X		+
DROSERACEAE						
Drosera bulbigena		+			+	+
Drosera occidentalis		+		3	+	+
FABACEAE (PAPILIONACEAE)						
Isotropis aff.*cuneifolia*		W	+		+	NT
HALORAGACEAE						
Haloragis tenuifolia		P		1		+
Myriophyllum echinatum		P		1		+
HYDATELLACEAE						
Hydatella dioica		P		2		+, b
MYRTACEAE						
Calytrix breviseta ssp. *breviseta*		W		R	+	+
Chamelaucium sp. (GinGin)	+				+	NT
Verticordia lindleyi ssp. *lindleyi*		W	+	1	+	NT, d
Verticordia plumosa ssp..*pleiobotrya*		W	+	1	+	NT, d
Verticordia serrata var. *linearis*	?			1		+
ORCHIDACEAE						
Diuris purdei		W		R		+
PORTULACACEAE						
Calandrinia aff.*composita*		DP,W		1		NT, b
Calandrinia composita		DP,W			+	NT, b

PROTEACEAE						
Conospermum undulatum	S/A, RH			1	+	NT
Grevillea obtusifolia		W	+		+	UT, +
Grevillea thelemanniana ssp. *thelemanniana*		W	+	1	+	+
Grevillea biternata		W	+		+	UT, +
Petrophile media var. *juncifolia*		W	+		+	NR, b
RESTIONACEAE						
Restio stenostachyus		W	+	3	+	SR
STACKHOUSIACEAE						
Tripterococcus sp (Cannington)		W		1		NT, b
STYLIDIACEAE						
Stylidium longitubum		+			+	+
Stylidium utricularioides		+		3	+	+
THYMELAEACEAE						
Pimelea imbricata ssp. *gracillima*		W	+		+	+

FIGURES

Figure 2a: Looking east to the Scarp from the Brixton St Wetlands (Location 62)

Figure 2b: Looking east to the Scarp from the System 6 Reserve M 53 (Location 73, Site 73)

Figure 3 Map of General Location of the Study Area From Conservation Reserves for W.A. The Darling System - System 6 Part I, 1983

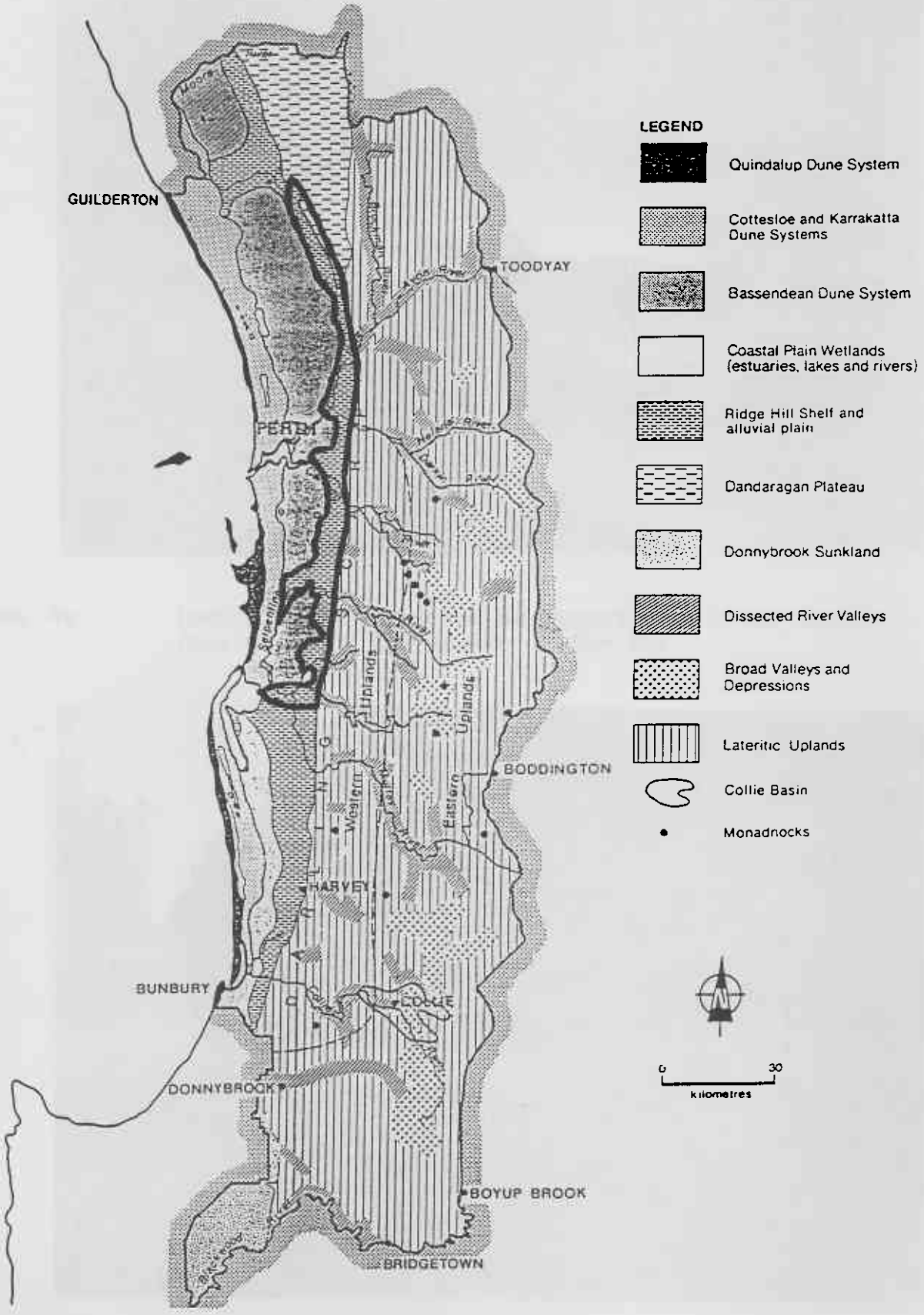


Figure 4a Looking south east across the Pinjarra Plain to the Scarp from Abernathy Rd (Location 8, Site 8b)

Figure 4b Looking north along Ioppolo Rd (Location 119, adjacent to Site 119a)

Figures 5 &6 Contrasting Wetlands on the Pinjarra Plain less than 2 kms apart

Figure 5 Brixton St Wetlands (Location 62): *Viminaria* Shrubland, Sedgeland, *Melaleuca lateritia* Low Open Heath and Marri Woodland

Figure 6 North of Yule Brook Reserve (Location 65): Mixed Low Open Heath, *Melaleuca* and *Actinostrobus* Open Heath.

Figure 7 Wandoo and Powderbark Wandoo Woodland/Forest, Burley Park (Location 105, site 105a)

Figure 8 Jarrah and Marri Woodland, System 6 Reserve, M14, Swan,(Location 109, Site 109a)

Figure 9 Marri Woodland, Bullsbrook Recreation Reserve (Location 107, Site 107a)

Figure 10 Banksia Low Woodland, Ioppolo Rd (Location 119, Site 119d)

Figure 11 Open Heath, Burley Park(Location 105, Site 105b)

Figure 12 Marri and Jarrah Open Forest or Woodland (Location 4)

Figure 13 Marri-Wandoo Open Forest to Open Woodland, Lloyd Hughes Park, Martin (Location 47, Site 47c)

Figure 14 Marri and *Eucalyptus lanepoolei* Low Woodland or Open Woodland, North east of Lambert Lane and the Perth to Bunbury Railway Line (Location 5, Site 5a)

Figure 15 *Jacksonia sternbergiana* Open Scrub, NW junction Connel Ave and Ciro Rd (Location 48, Site 48c)

Figure 16 Marri, Flooded Gum and Jarrah Open Forest, Creekline Connel Rd (Location 49)

Figure 17 Jarrah, *Banksia* and *Allocasuarina* Woodland, Activ Industry Site (Location 81, Site 81a)

Figure 18 Marri and Jarrah Open Woodland to Woodland, Armadale Flora Reserve (Location 41)

Figure 19 *Banksia* Low Open Forest, Sultana Rd (Location 75)

Figure 20 *Banksia* Low Open Forest,
Activ Industries Site (Location 81, Site 81a)

Figure 21 *Banksia* Low Woodland, adjacent to Kelmscott Senior High School(Location 43)

Figure 22 Marri Open Forest, Duckpond Rd (Location 15, Site 15a)

Figure 23 Marri Open Woodland with scattered *Kingia* (Location 10, Site 10g).
Photo by Neil Coy, Swan Coastal Plain Survey Volunteer.

Figure 24 Wandoo Open Woodland, Pearce Townsite (Location 100, Site100b)

Figure 25 *Casuarina obesa* Woodland,
Bambun Rd, Reserve 22831(Location 127, Site 127c)

Figure 26 *Casuarina obesa* Woodland,
Bushland at T/O to GinGin (Location 123, Site 123b)

Figure 27 *Pericalymma* Low Open Heath, System 6 Reserve M 53 (Location 73, Site 73a)

Figure 28 *Viminaria juncea* Shrubland, Brixton St Wetlands (Location 62)

Figure 29 *Melaleuca* Shrubland,
North of Yule Brook Reserve (Location 65, Site 65f)

Figure 30 *Melaleuca* Shrubland,
Bushland at T/O to GinGin(Location 123, Site 123a)

Figure 31 *Melaleuca* Open Heath,
Phillips Rd Industrial Area (Location 38, Site 38c)

Figure 32 Mixed Closed to Open Heath, background, Sedgeland, foreground,
North of Yule Brook Reserve (Location 65, Site 65a)

Figure 33 Mixed Low Closed Heath, Yule brook Reserve (Location 64)

Figure 34 Mixed Low Closed Heath,
System 6 Reserve M 14 (Location 107, Site 107b)

Figure 35

Mounds with Mixed Open Heath, background Herbland, foreground North of Yule Brook Reserve
(Location 65, adjacent to Site 65c)

Figure 36
Herbland, *Burchardia bairdii*, *Brachycome iberidifolia* and miscellaneous annual herbs and sedges North of Yule Brook Reserve
(Location 65, adjacent to Site 65c)

Figure 37 Marri Woodland, Creekline, Bullsbrook Recreation Reserve (Location 107, Site 107b)

Figure 38 Weed infestation, **Ehrharta calycina*, along tracks,NW junction Connel Ave and Ciro Rd (Location 48, adjacent Site 48d)

Figure 39 Off Road vehicle use and rubbish dumping, North of Yule Brook Reserve (Location 65)

Figure 40 Off Road vehicle use and drainage channels, North of Yule Brook Reserve (Location 65)

Figure 41 'Enrichment' Planting, Alcoa Drive (Location 33)

Figure 42 Tracks, Hartfield Park (Location 69)

Figure 43 &44 The effects of repetitive burning in urban bushland, Adjacent to Edney Park Primary School (Location 52)

Figure 43 Weed infestation, **Ehrharta calycina* and **Ursinia anthemoides* after long term repetitive fires

Figure 44 *Stipa compressa*, a native fire weed, after fire, illustrating the growth of a native grasses after fire.

Figure 45 **Rubbish dumping and weed invasion, North of Yule Brook Reserve (Location 65)**

Vegetation Maps

Vegetation Maps of Areas 1, 2, 4, 9, 10, 11a - c, 12 - 16,17a & b and 18 - 22 are 200% enlargements of the 1: 20,000 Aerial Photographs made for the Metropolitan Street Directory, 5th January, 1991 and the Water Authority of W.A.for the Gnangarra Water Mound Studies, 15 th March, 1989.

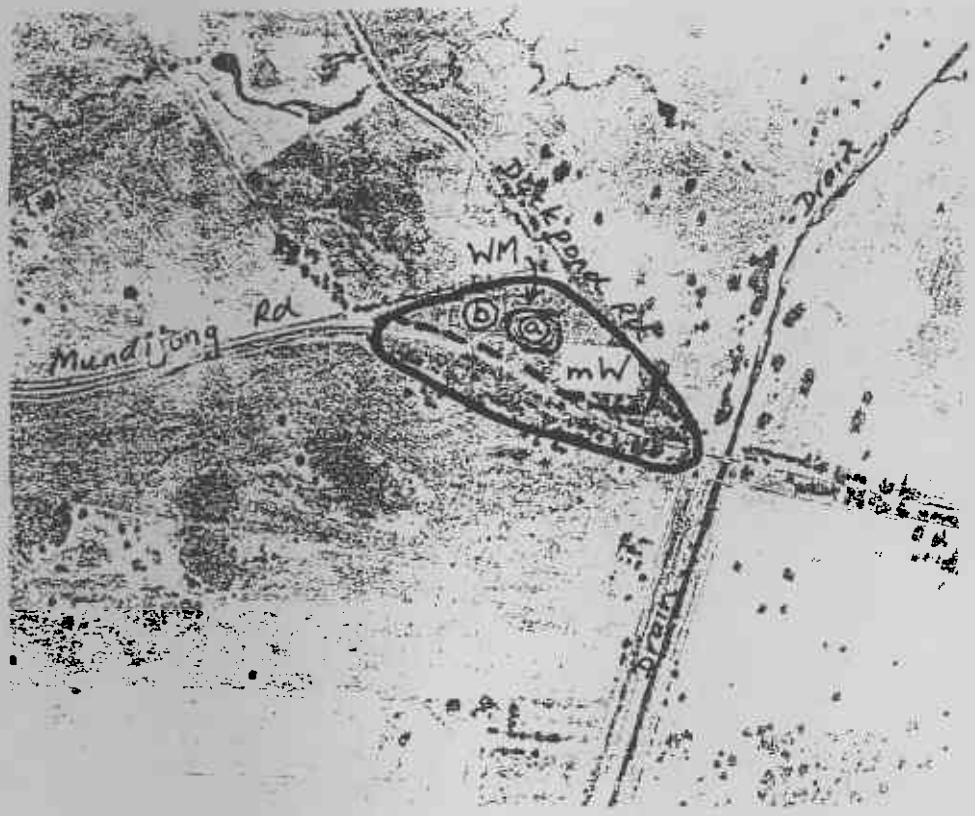
Vegetation Maps of Areas 3 and 11d are a 300% enlargement of the 1: 20,000 Aerial Photographs made for the Metropolitan Street Directory, 5th January, 1991 and the Water Authority of W.A.for the Gnangarra Water Mound Studies, 15 th March, 1989.

Key to Symbols

j W etc	Symbols for general vegetation associations, **Table 2a &2b.**
ⓧ	Site position, single site
ⓐ	Site position, more than one sites
———	Boundary of the Remnant Vegetation and of the vegetation associations
▬▬▬	Boundary of the mapped alluvial soil at the Location
— — —	Boundary of remnant vegetation in Completely Degraded to Very Poor Condition of size that can be mapped.
—.—.—	Poorly defined boundary.
— — —	System 6 Reserve

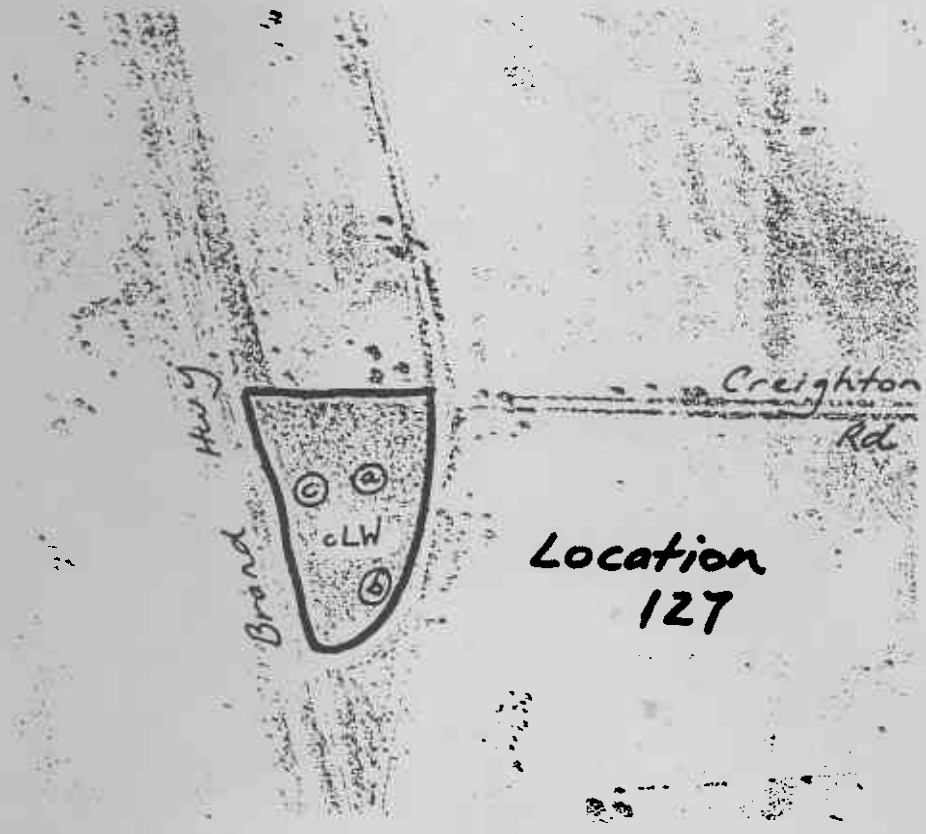
Vegetation Map Area 1

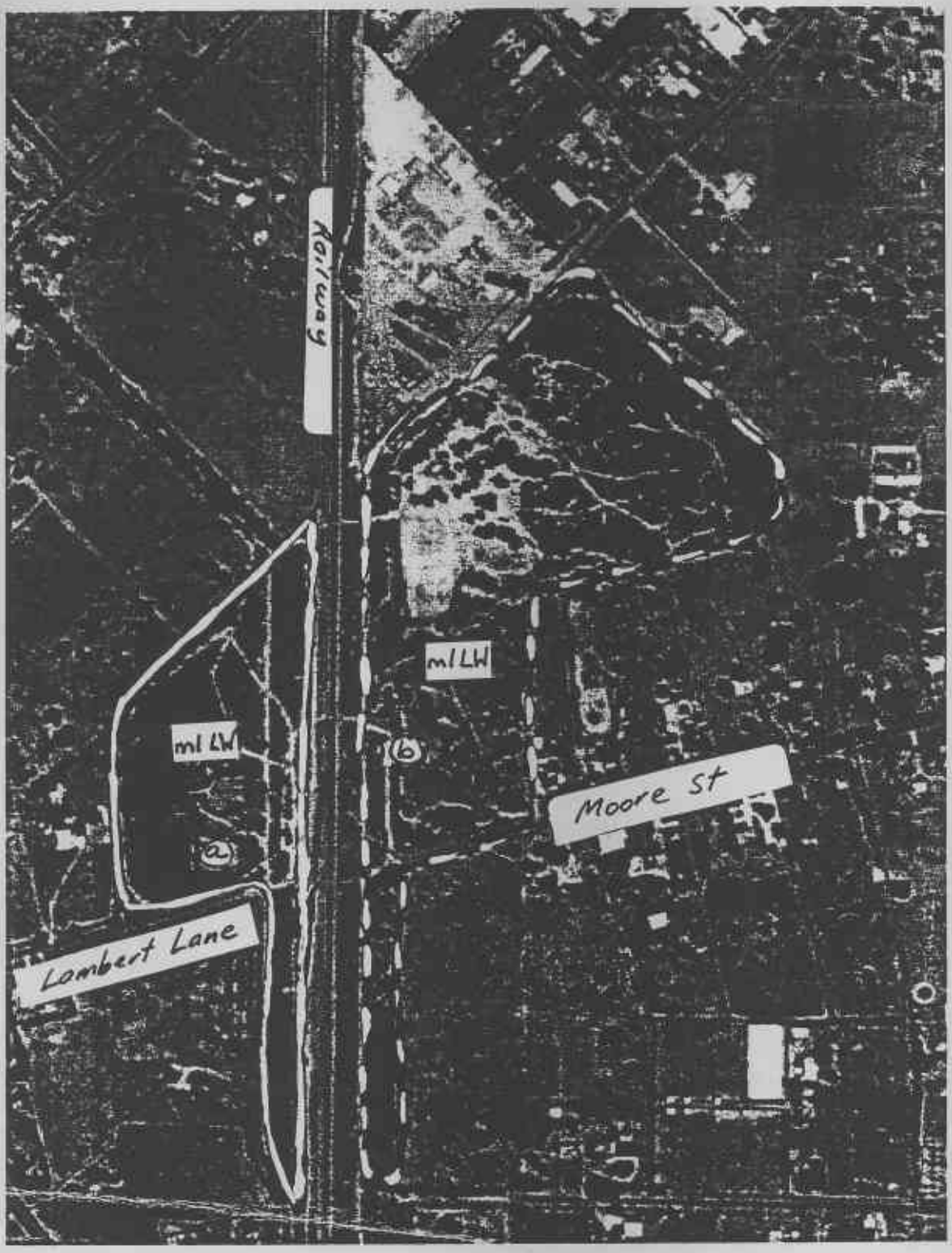
Duckpond and Mundijong Rd intersection, Serpentine - Jarrahdale, approx 3 ha (Location 16) - local government



Vegetation Map Area 2

Bushland between Brand Hwy and southern T/O to GinGin, GinGin, approx 5 ha (Location 127) - private land



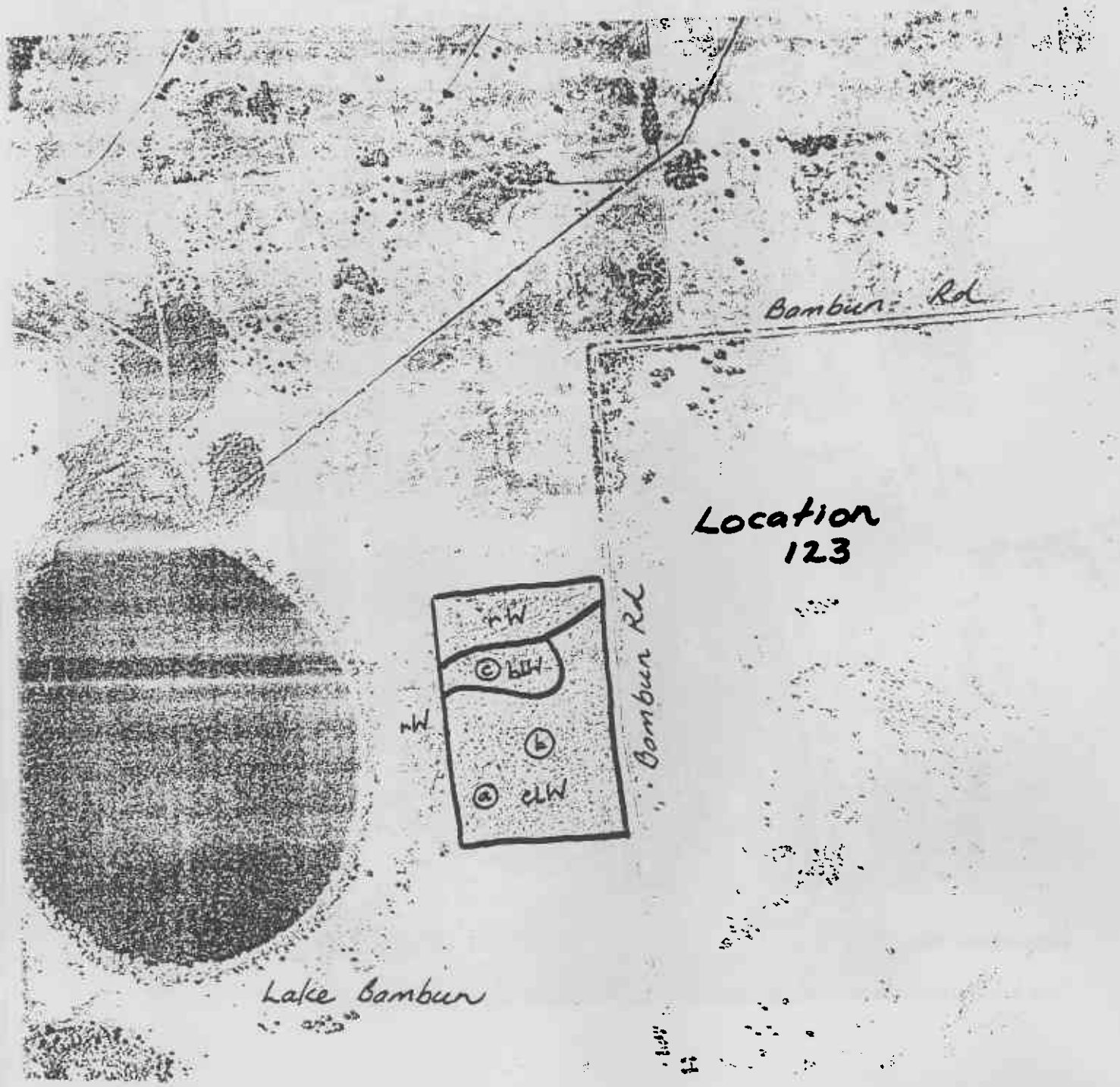


Vegetation Map Area 3

North east of Lambert Lane and the Perth to Bunbury Railway Line, Armadale - Kelmscott, approx 4 ha (Location 5) - local government

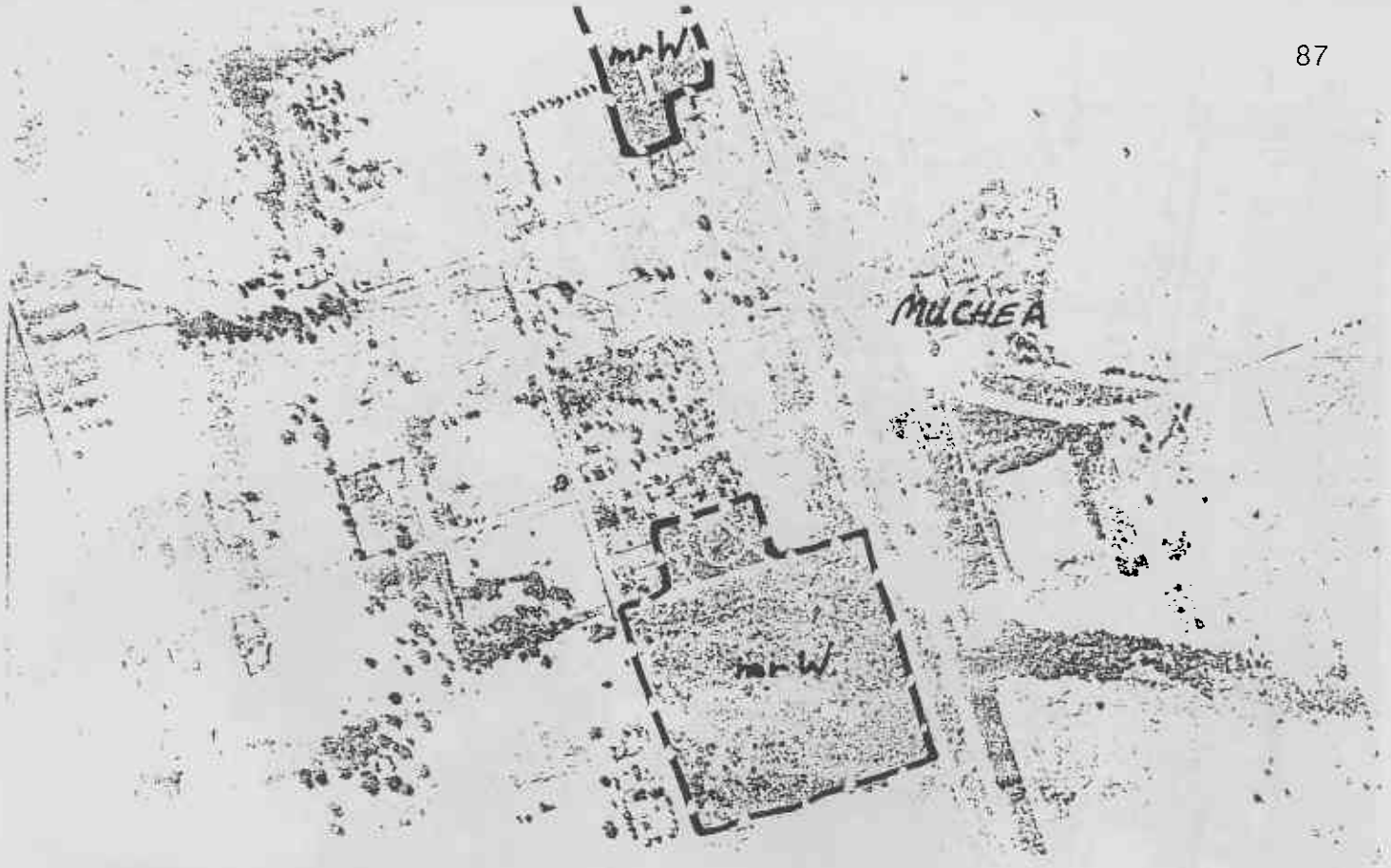
Vegetation Map Area 4

Page Rd, Serpentine Jarrahdale, approx 1 ha (Location 30) - private land



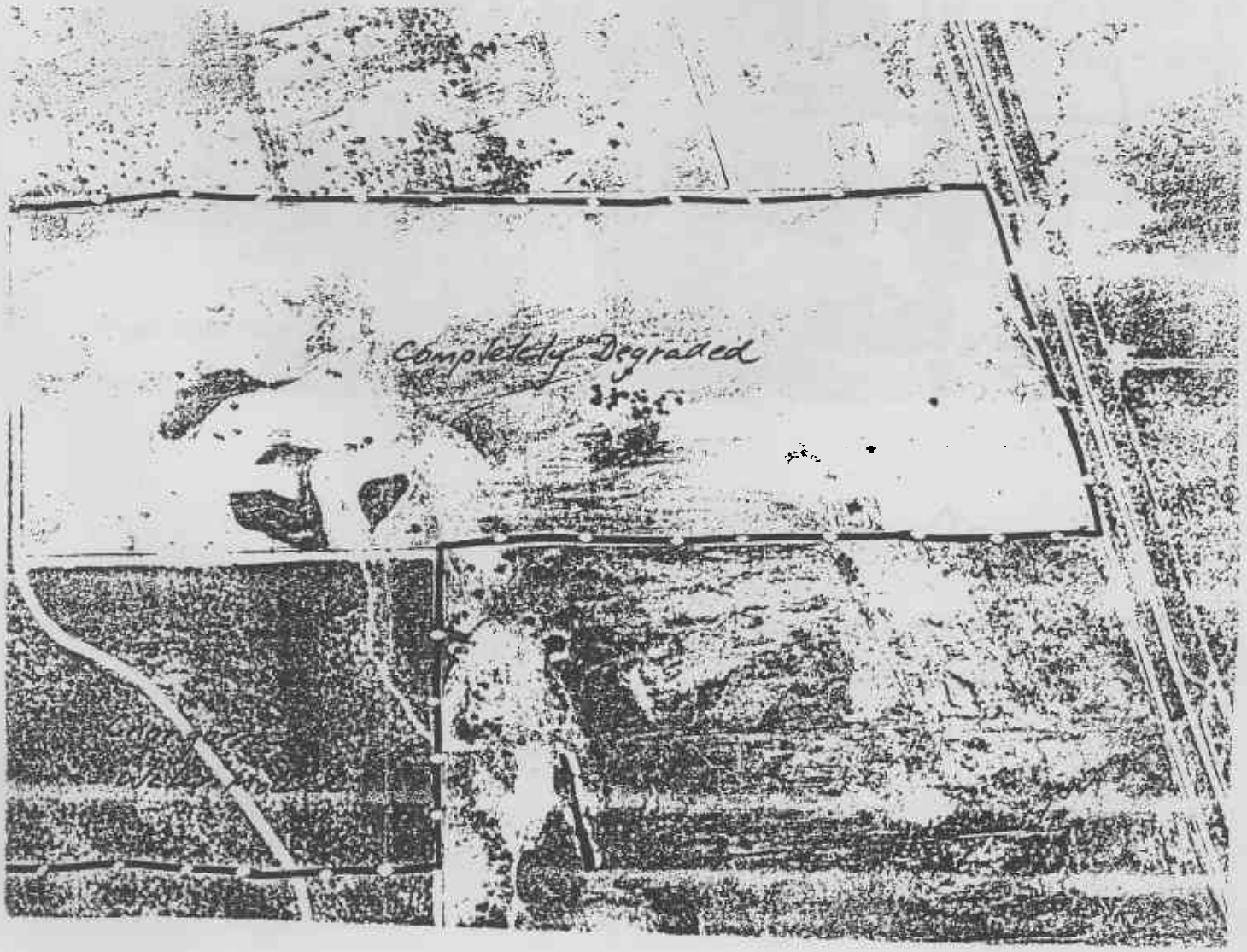
Vegetation Map Area 9

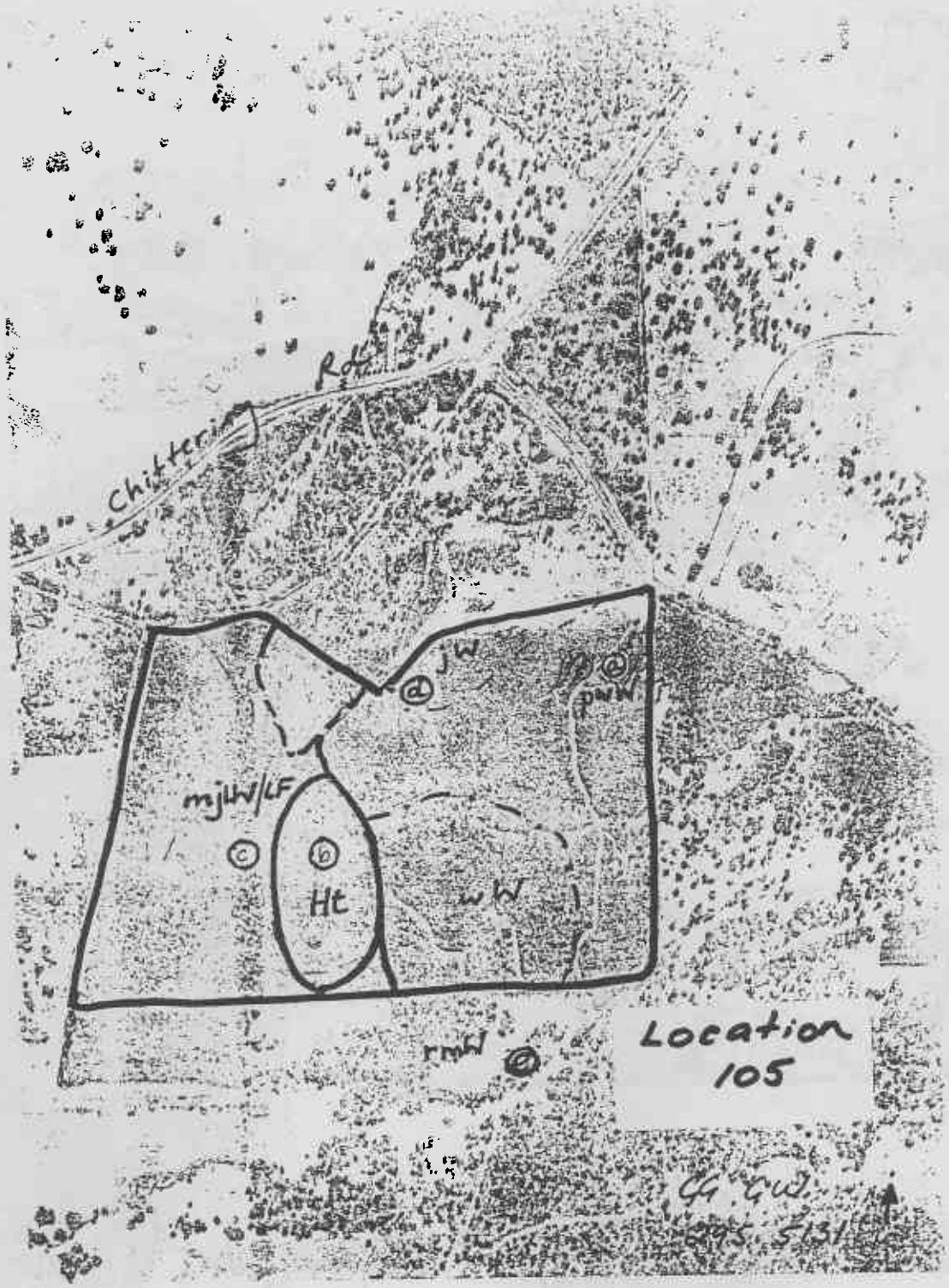
Bambun Rd, east Lake Bambun, Reserve 22831, GinGin, approx 12 ha (Location 123) - local government



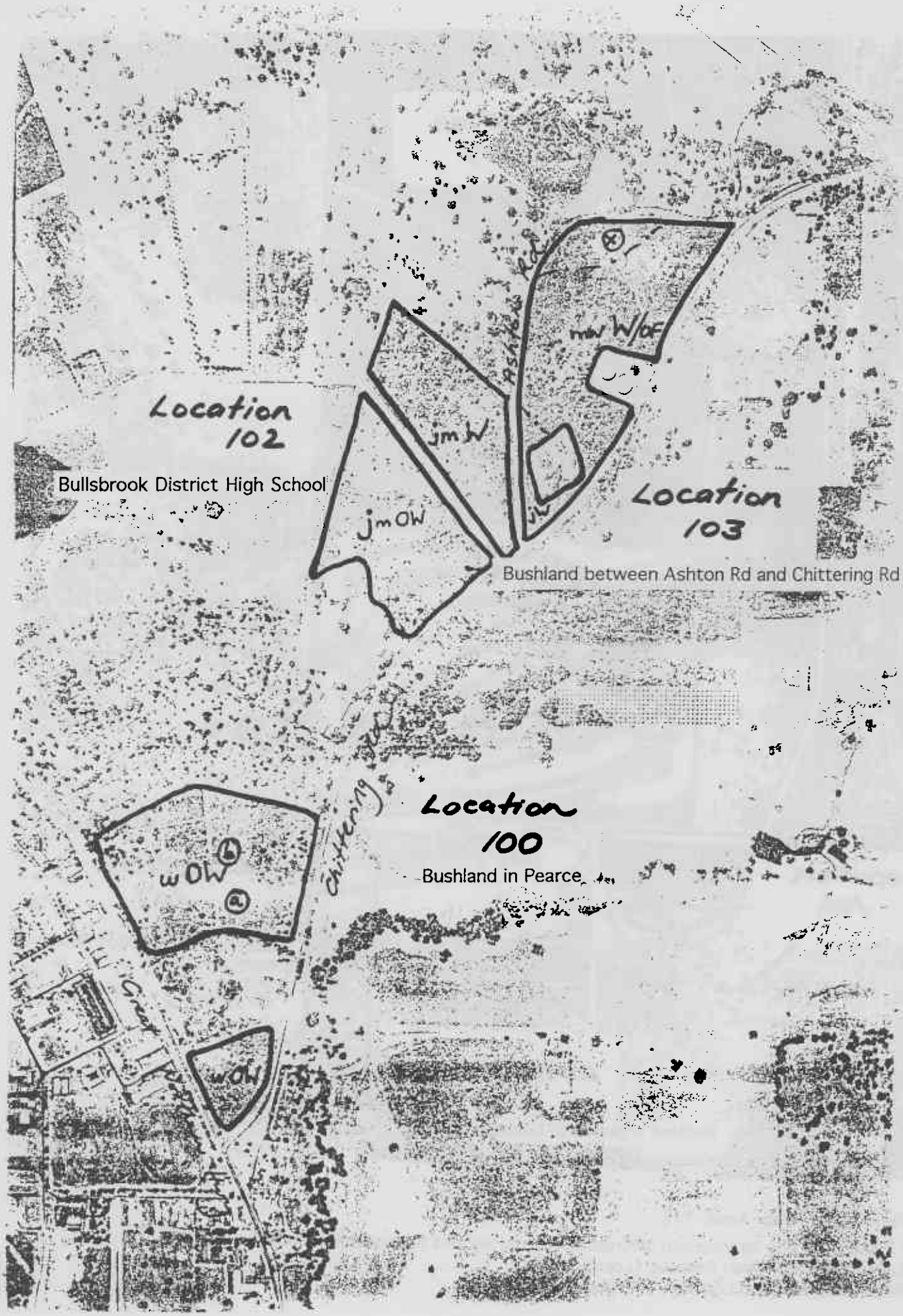
Vegetation Map Area 10

Muchea Townsite, part of System 6 Reserve C 25, Chittering, approx 12 ha (Location 118b)



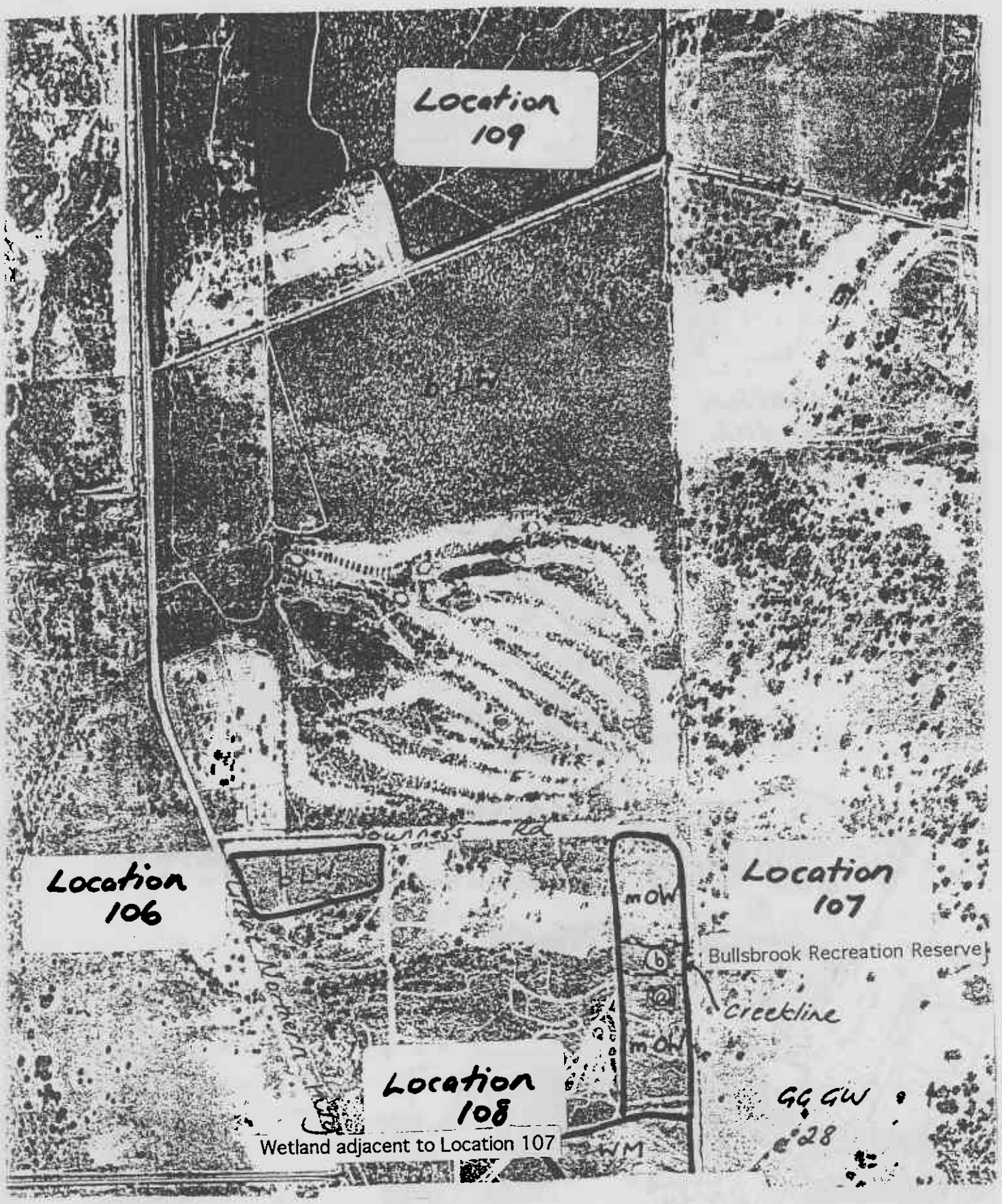


Vegetation Map Area 11a **Bullsbrook Bushland,** Swan Burley Park, 43 ha (Location 105)



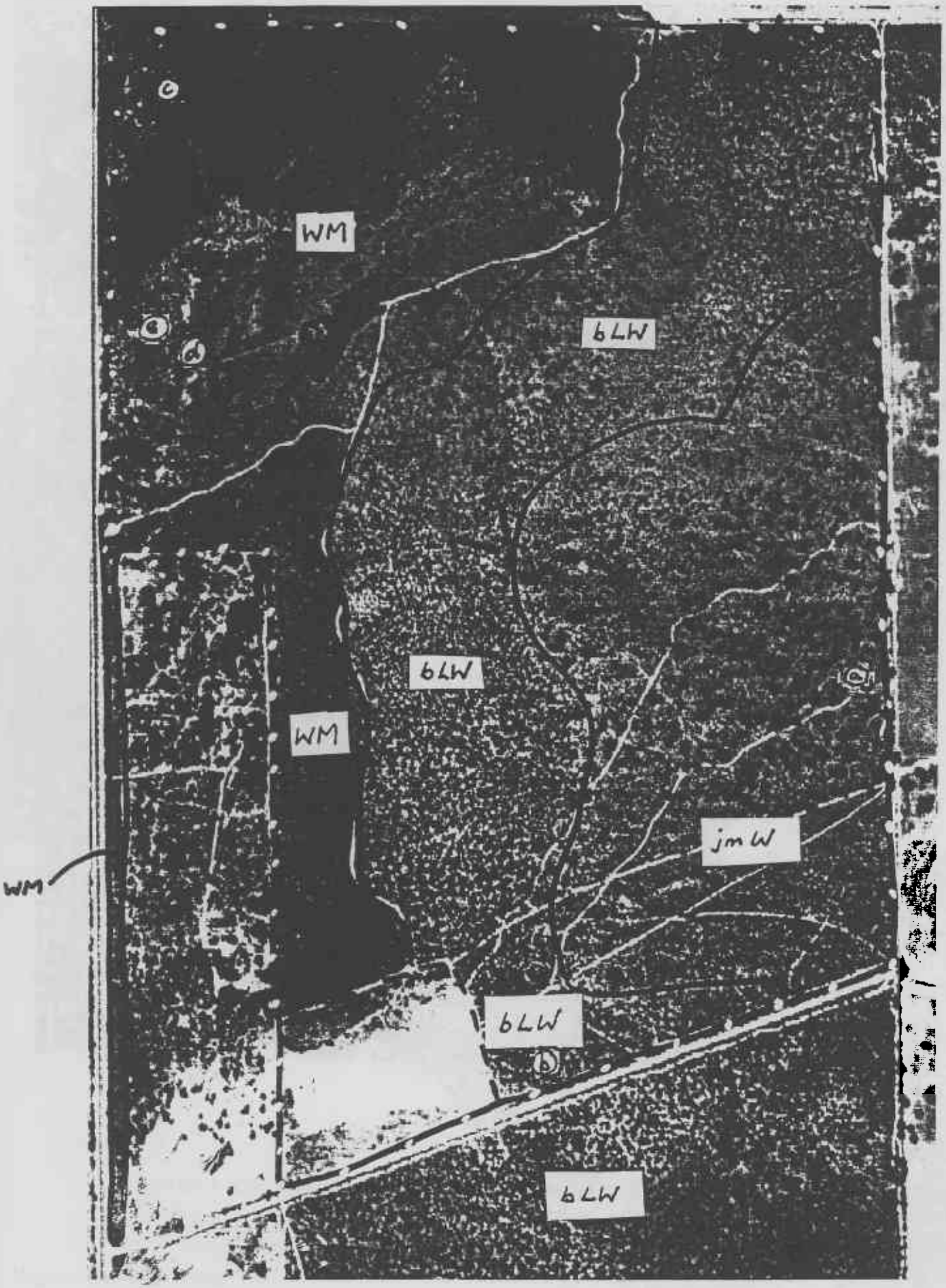
Vegetation Map Area 11b **Bullsbrook Bushland,** Swan

Bushland in Pearce, spanning the area between Great Northern Hwy and Chittering Rd (Location 100)



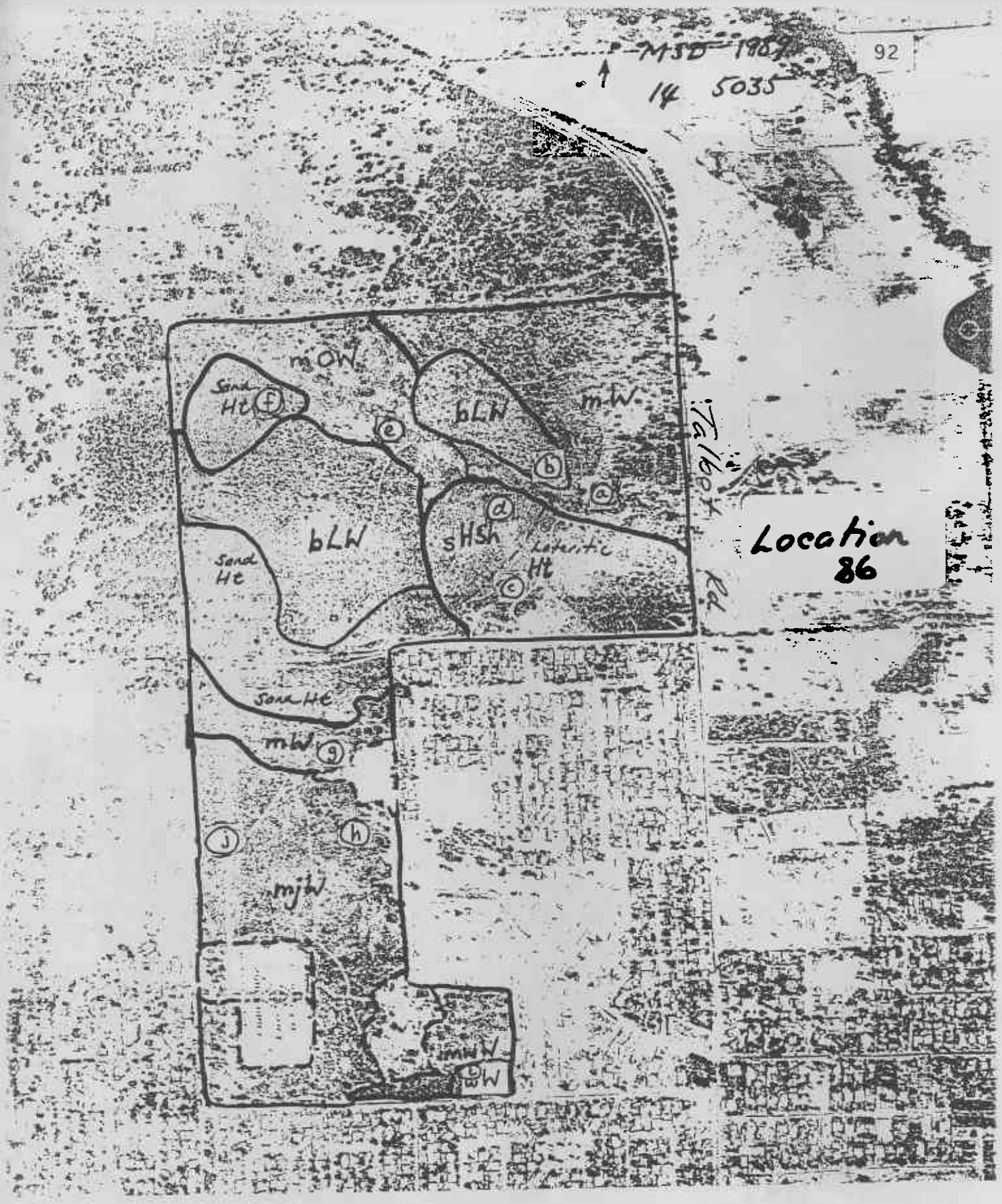
Vegetation Map Area 11c

S E corner of the intersection of Great Northern Hwy and Sounness Rd (Location 106)
Bullsbrook Recreation Reserve (Location 107)
Wetland adjacent to Location 107 (location 108)



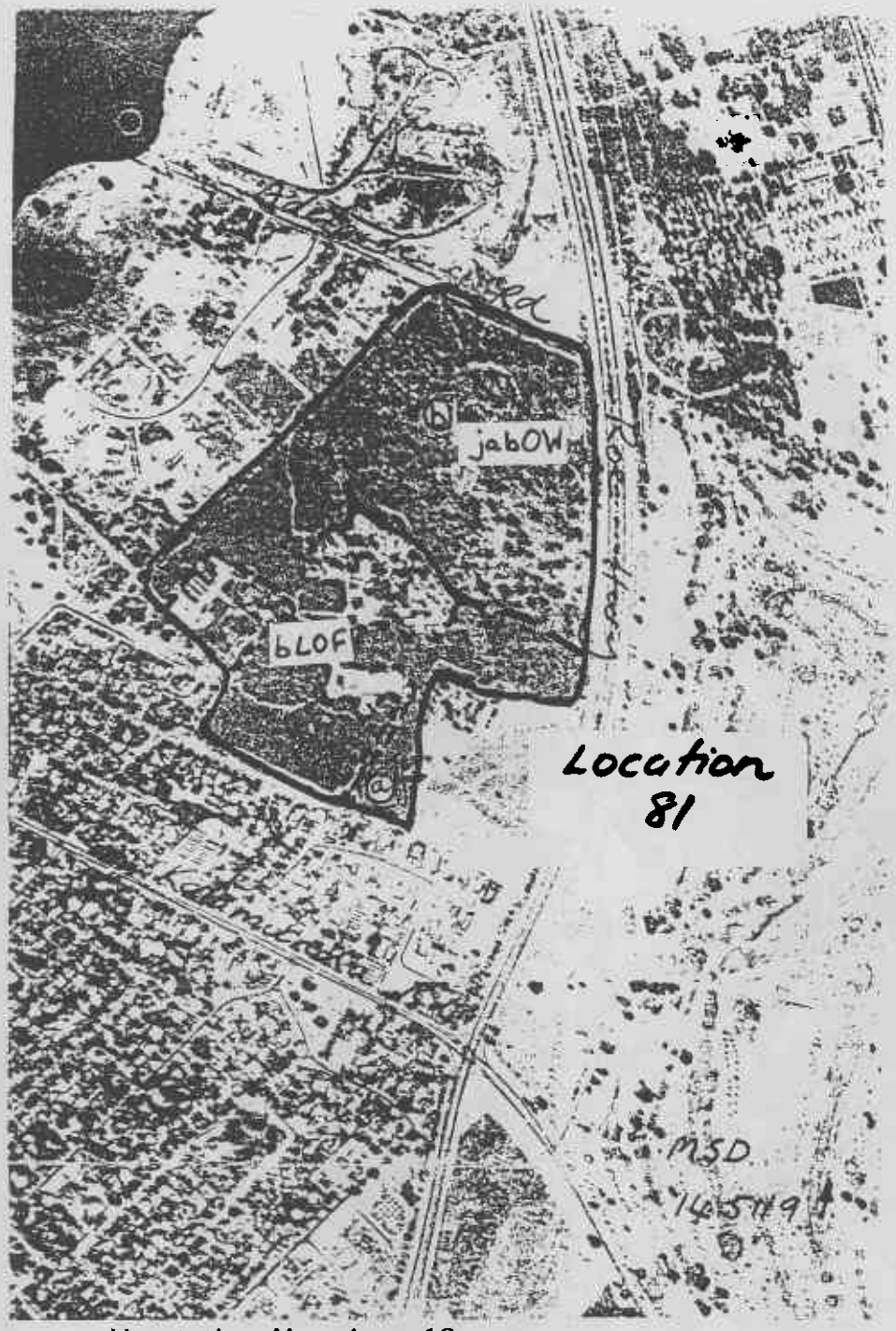
Vegetation Map Area 11d **Bullsbrook Bushland**, Swan

Recreation Reserve, System 6 Reserve M14, 117 ha (Location 109)



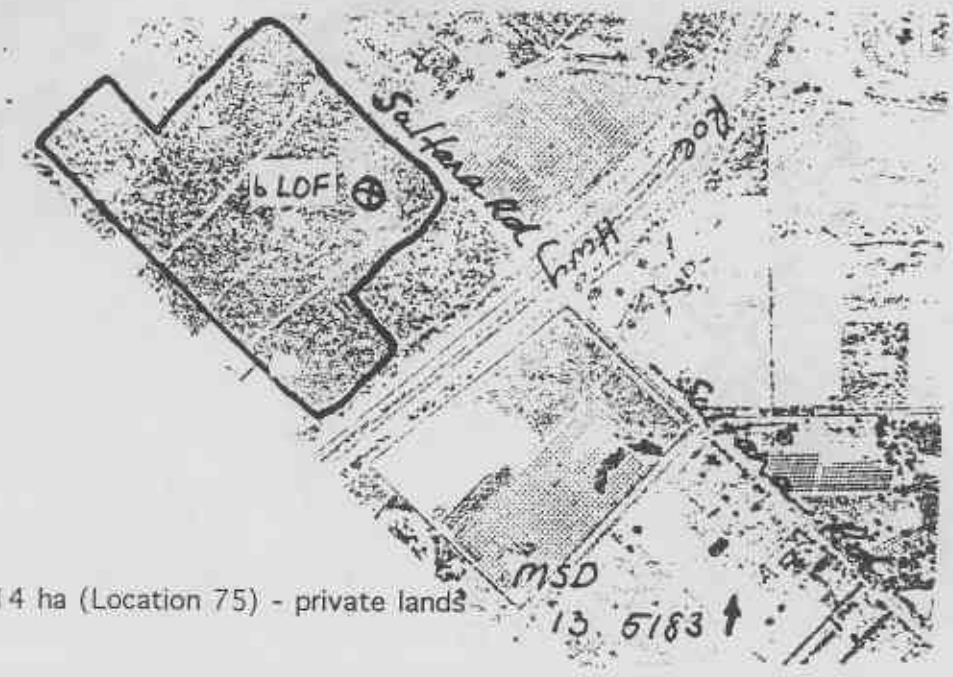
Vegetation Map Area 12 -

Talbot Rd Reserve, Midland, approx 88 ha (Location 86) - local government with a variety of vestings from Cemetery to Recreation.



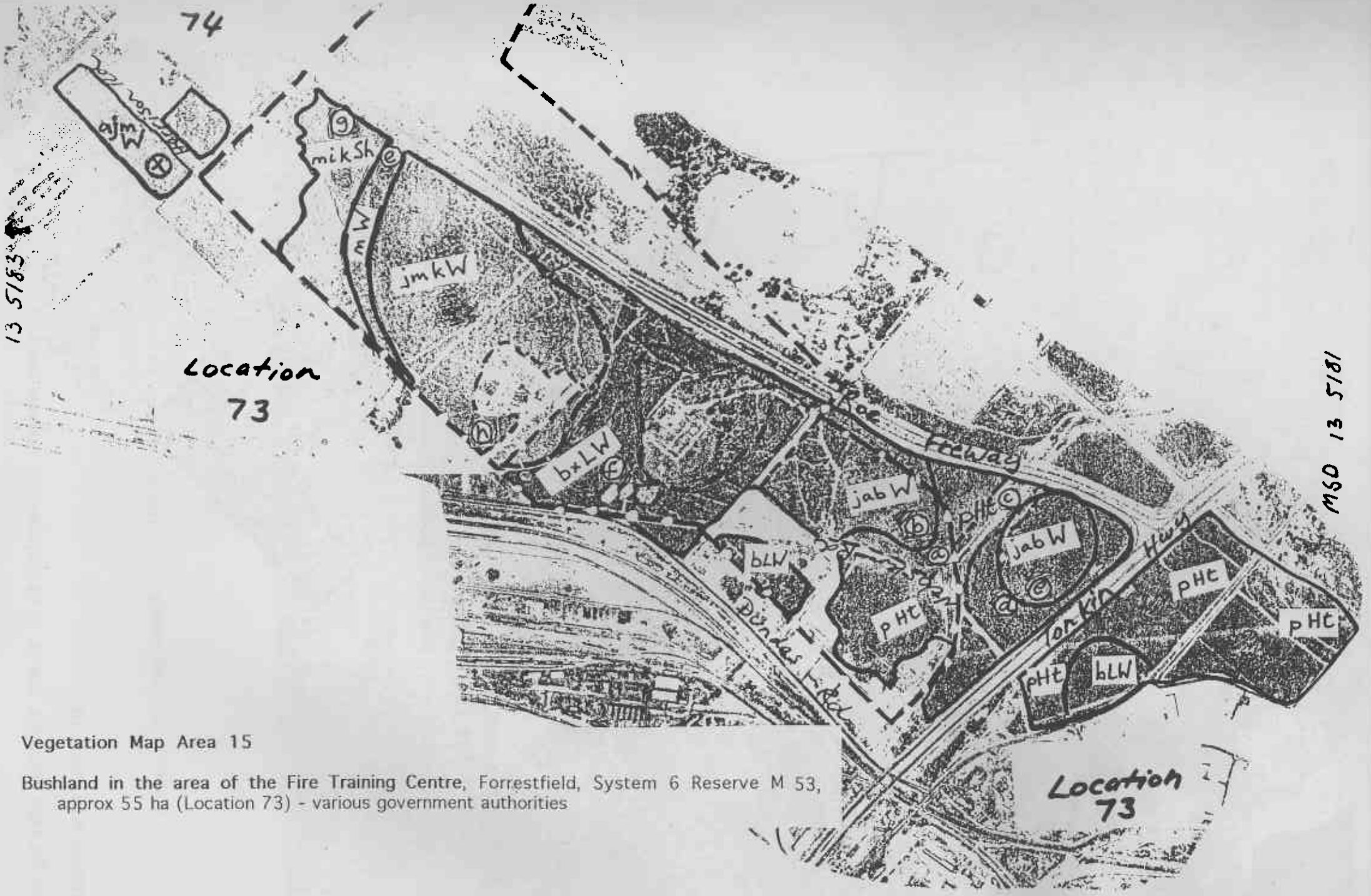
Vegetation Map Area 13

Activ Industries Site, SW intersection Adelaide St And Roe Hwy, High Wycombe, approx 20 ha(Location 81)



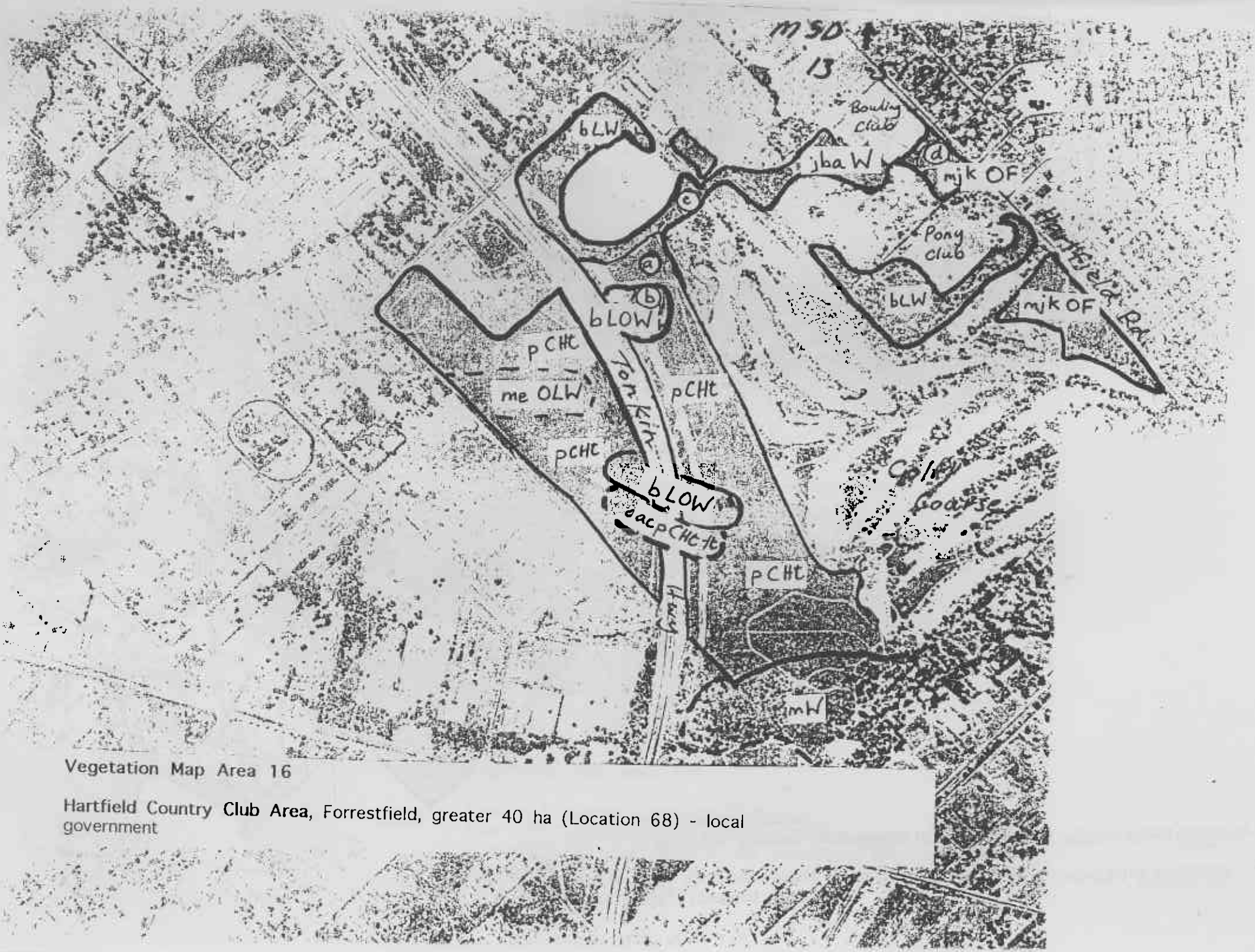
Vegetation Map Area 14

Sultana Rd, High Wycombe, approx 14 ha (Location 75) - private lands



Vegetation Map Area 15

Bushland in the area of the Fire Training Centre, Forrestfield, System 6 Reserve M 53, approx 55 ha (Location 73) - various government authorities

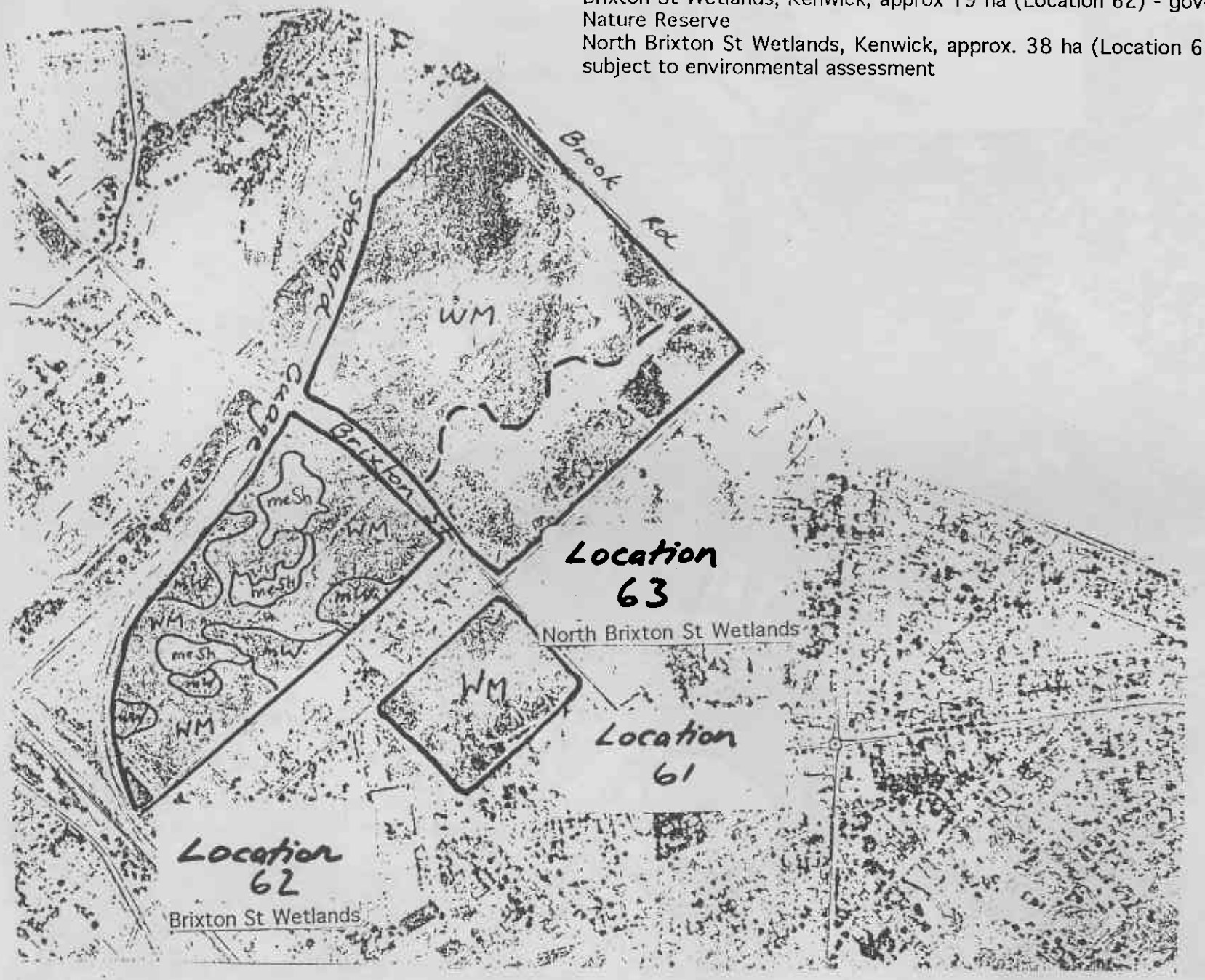


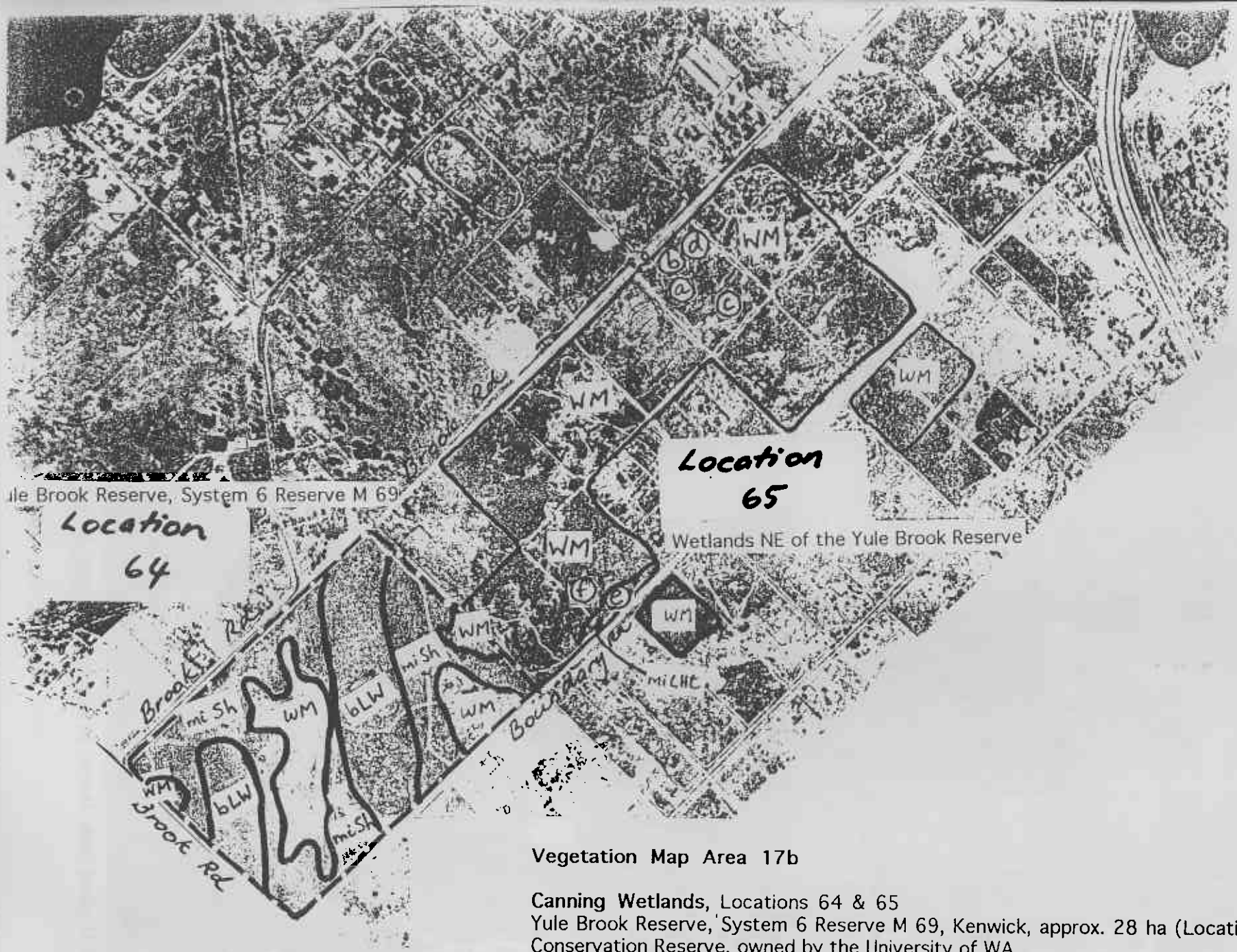
Vegetation Map Area 16

Hartfield Country **Club Area**, Forrestfield, greater 40 ha (Location 68) - local government

Vegetation Map Area 17a

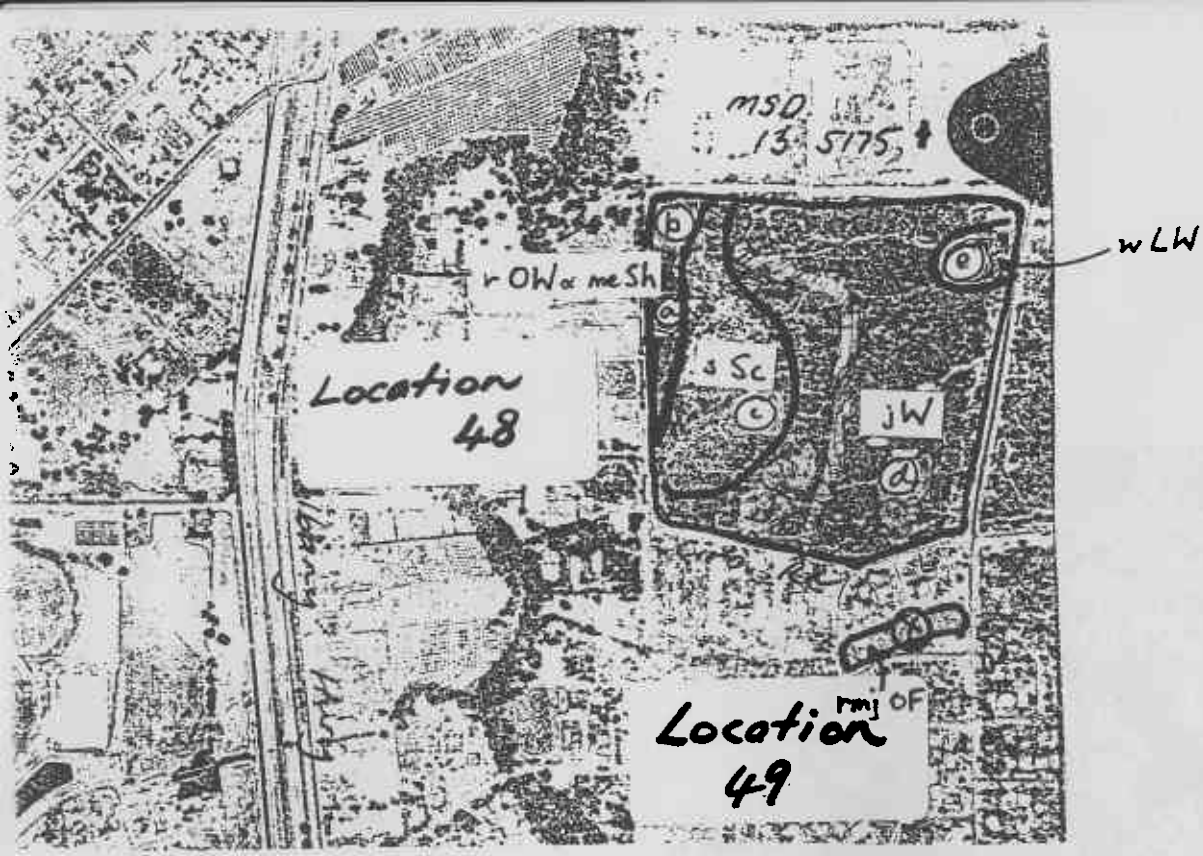
Canning Wetlands, Locations 62 & 63
Brixton St Wetlands, Kenwick, approx 19 ha (Location 62) - government land, proposed Nature Reserve
North Brixton St Wetlands, Kenwick, approx. 38 ha (Location 63) - private land currently subject to environmental assessment





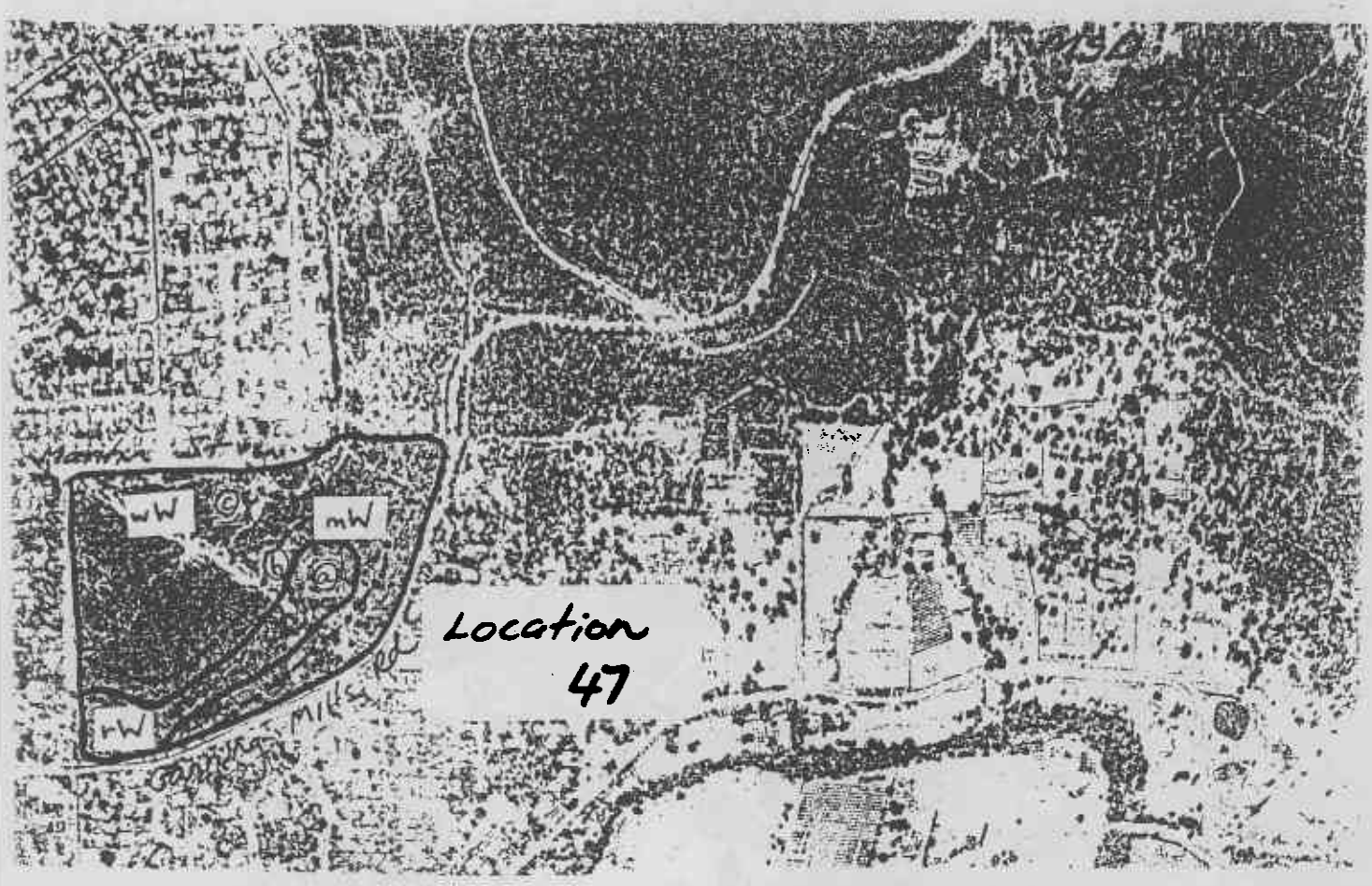
Vegetation Map Area 17b

Canning Wetlands, Locations 64 & 65
Yule Brook Reserve, System 6 Reserve M 69, Kenwick, approx. 28 ha (Location 64) - Flora Conservation Reserve, owned by the University of WA
Wetlands NE of the Yule Brook Reserve between Brook and Boundary Rds, Kenwick, approx. 34 ha (Location 65) - private



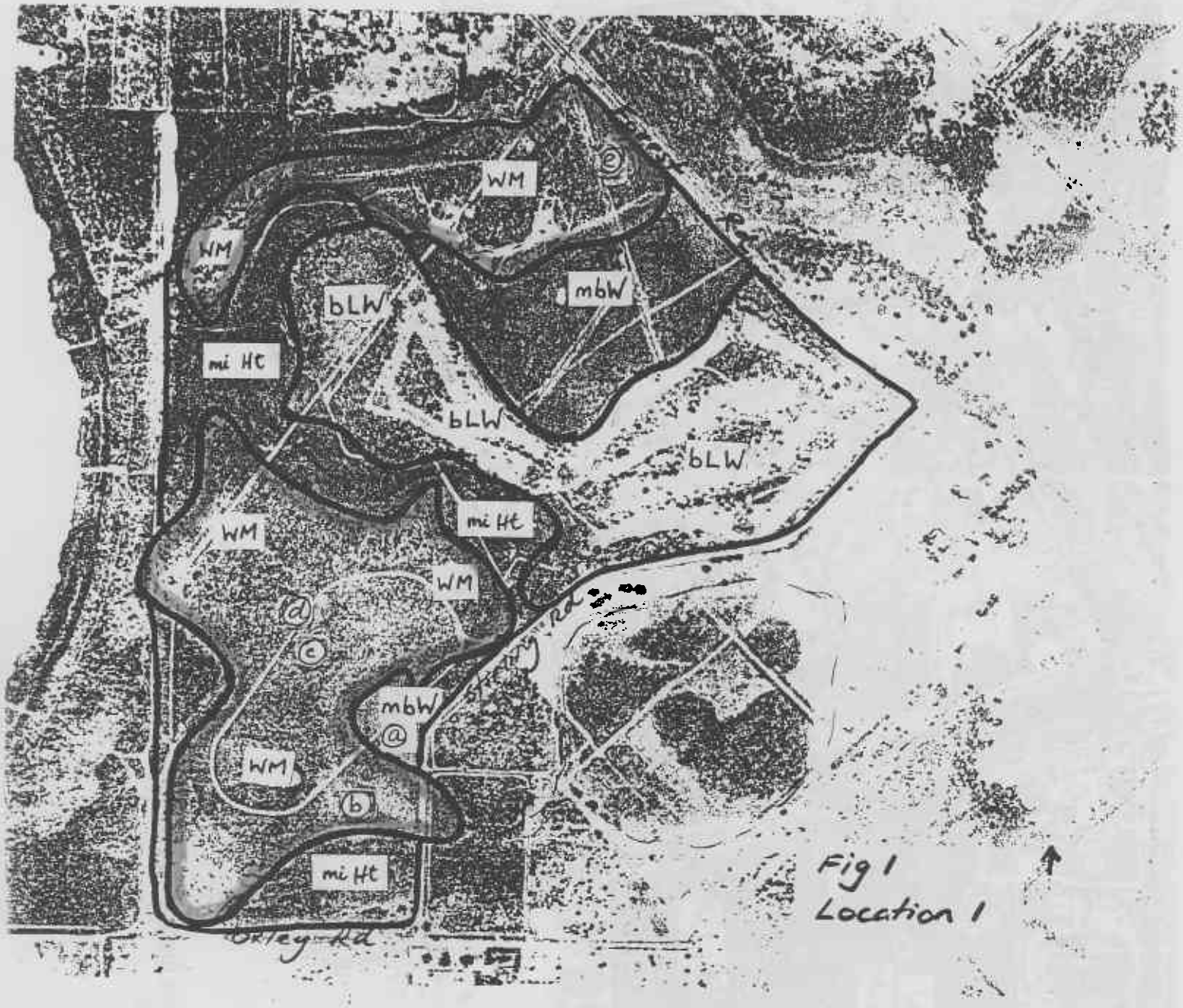
Vegetation Map Area 18

NW junction Connel Ave and Ciro Rd, Kelmscott, approx. 22 ha (Location 48)- local government



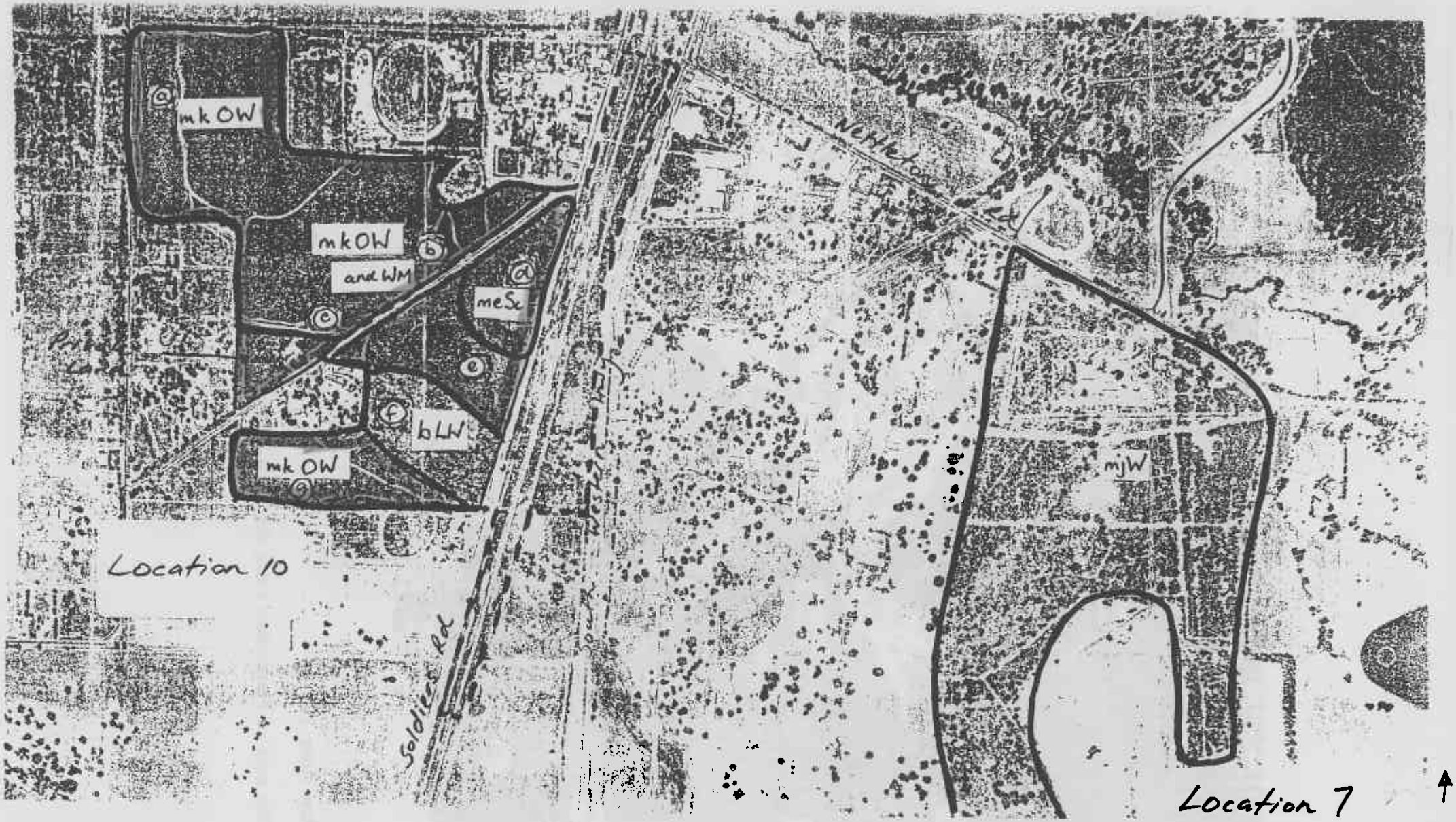
Vegetation Map Area 19

LLoyd Hughes Park, Martin St Kelmscott, approx 17 ha (Location 47) - local government



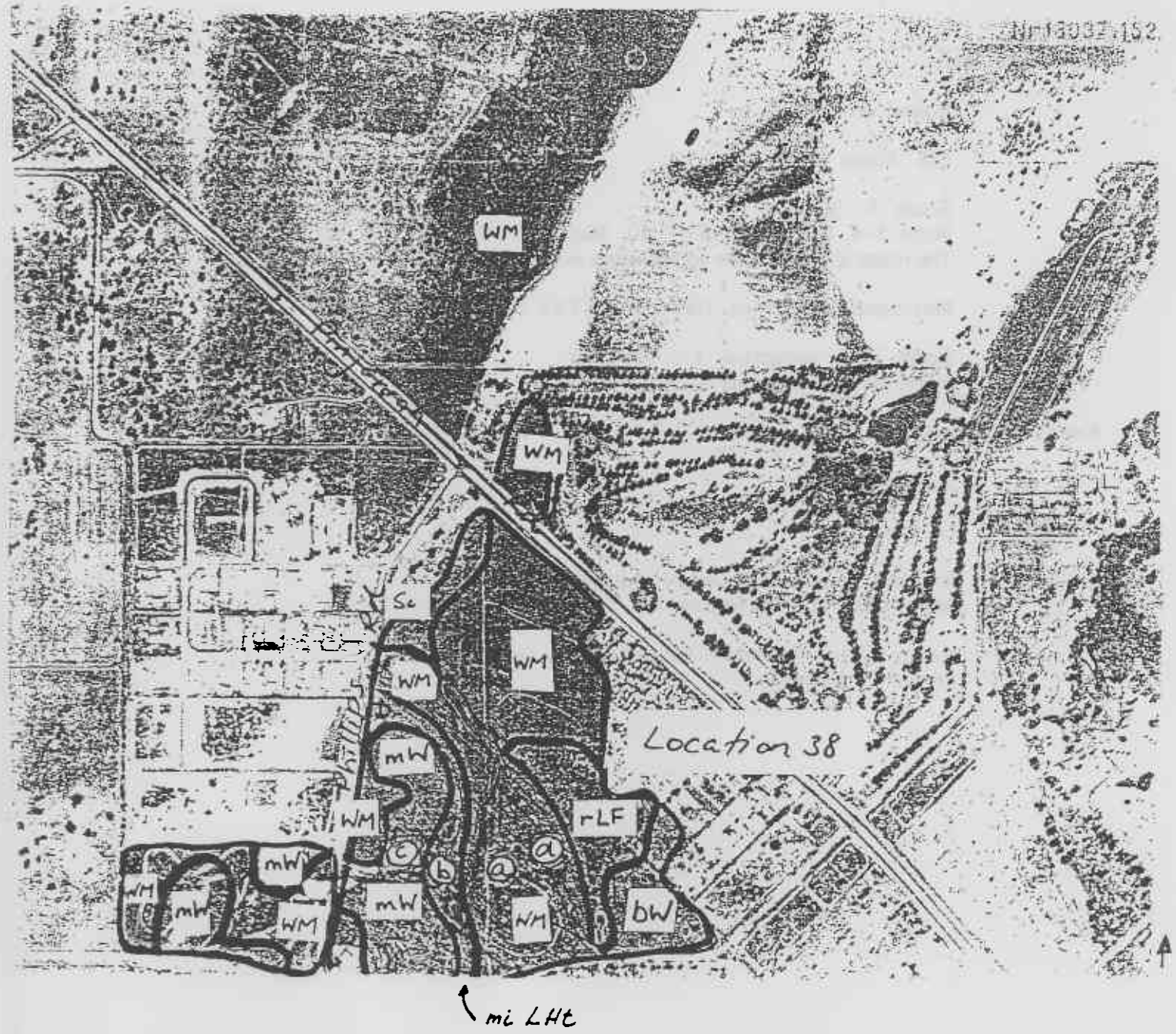
Vegetation Map Area 20

Wetlands to the east of Forrestdale Lake, Armadale - Kelmscott (Location 1) - local government



Vegetation Map Area 21

Brickwood Reserve and adjacent bushlands, Serpentine-Jarrahdale, approx 43 ha (Location 10) - local government



Vegetation Map Area 22

Phillips Rd, Industrial Area west Pinjarra, approx. 38 ha (Location 38) - ?local government, private

Location Maps

Based on the

GIS Maps

Scale 1: 50 000
Maps 1-4, Locations 96 - 140, **Maps 11-15,** Locations 1 - 40.
The maps show cadastre and remnant vegetation as mapped by the GIS Unit.

Metropolitan Street Directory (1992)

Scale 70% reduction 1 : 20 000
Maps 5-10, Locations 41 - 95

Key to Symbols

4 Location Number

■ Location

— Remnant Vegetation Boundary of areas not surveyed but mentioned in the Report

- - - Nature Reserve Boundary, not matched by remnant vegetation boundary

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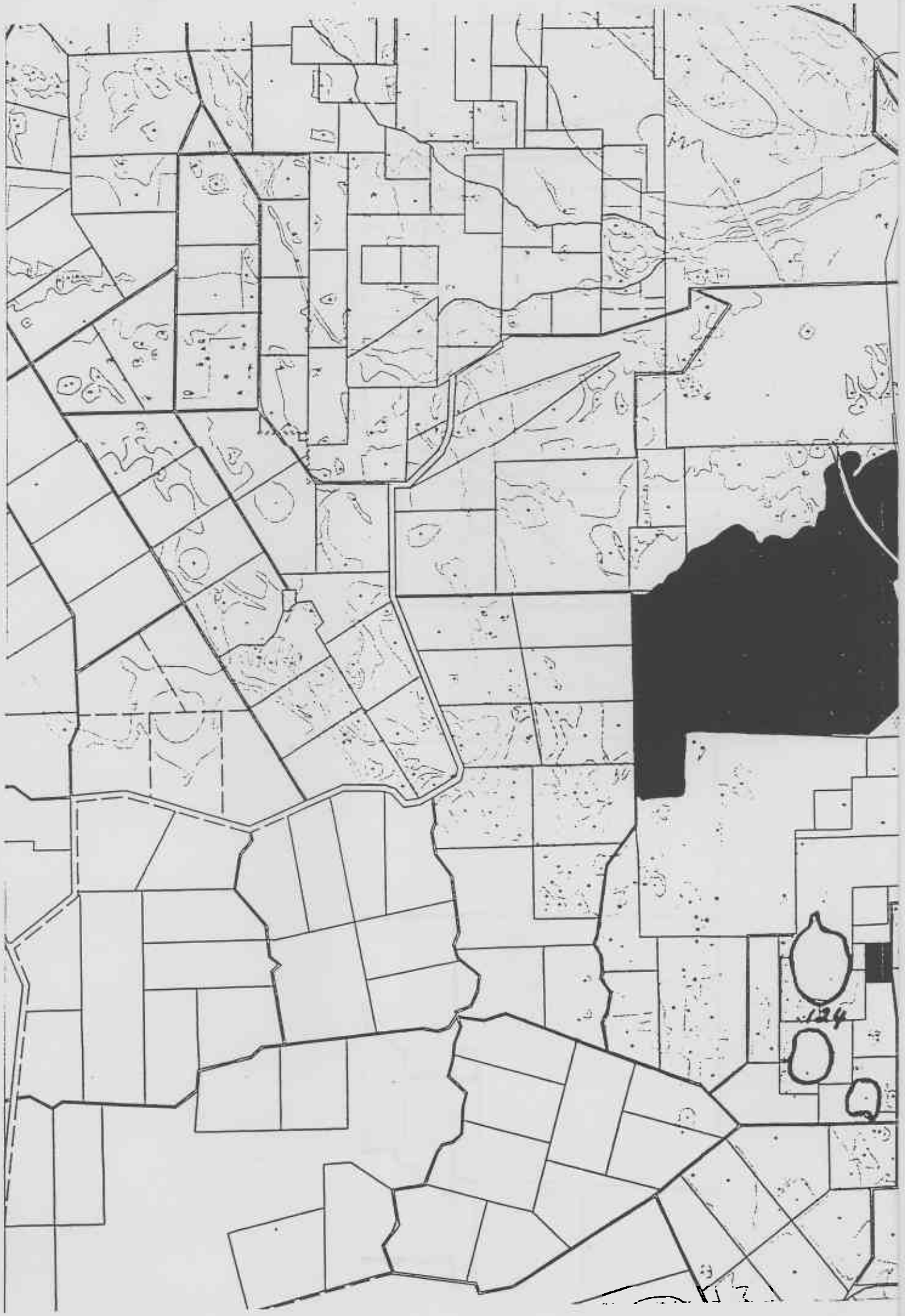
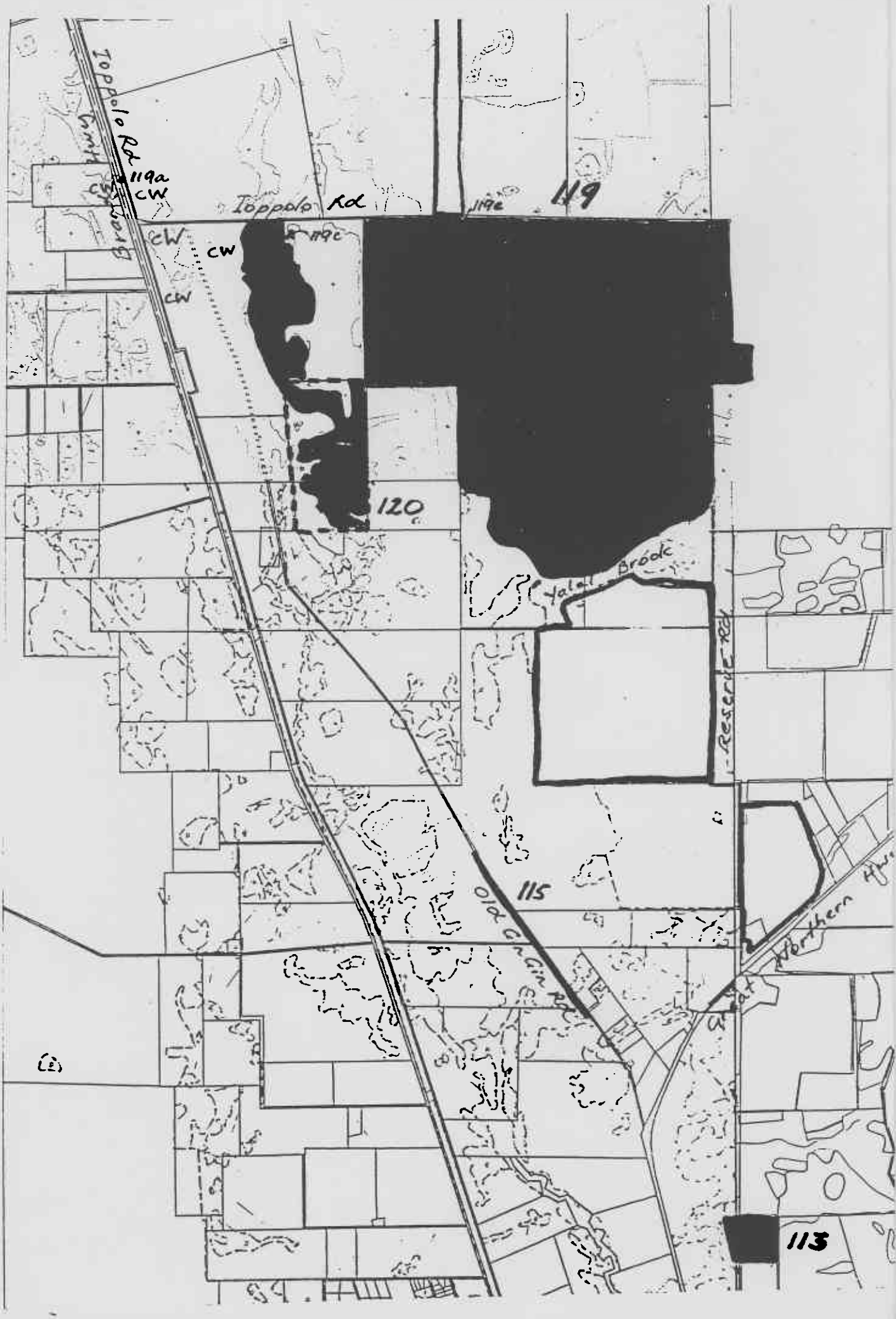
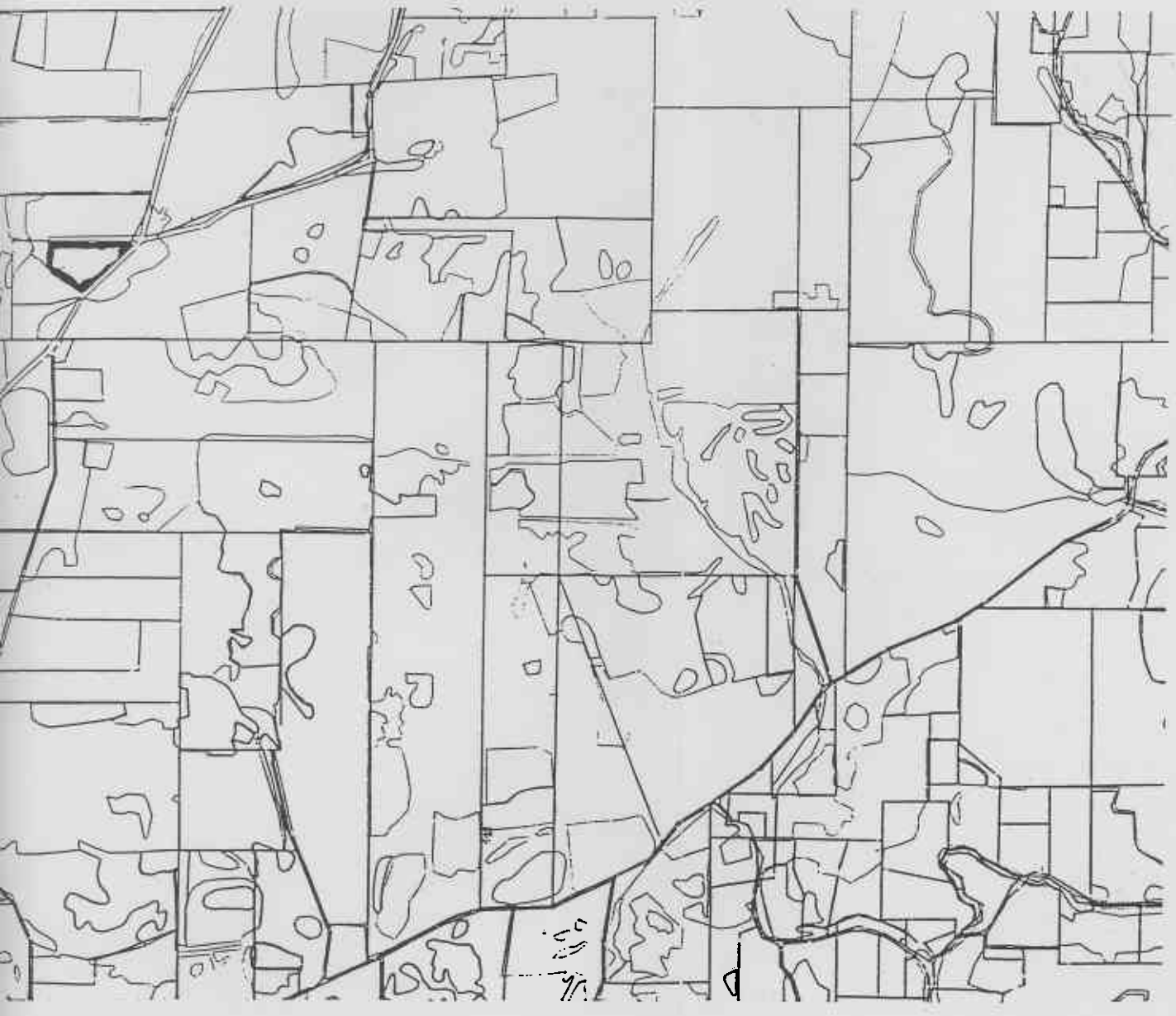


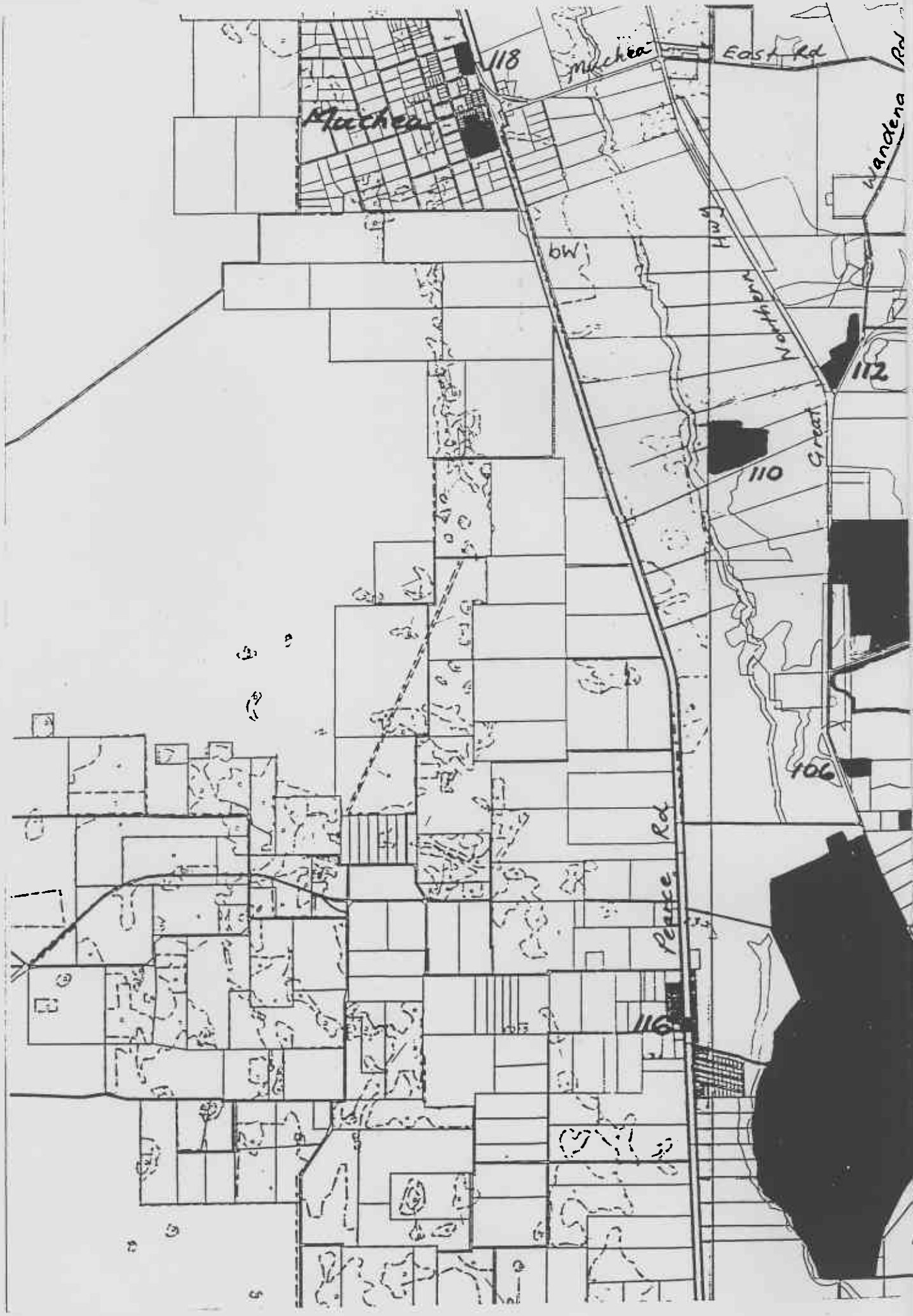
Map 1 GIS 2035 2


Gin Gin
129
128
Lennards Brook
130
Creighton Rd
127
CW
126
Nulla Nulla Brook
Bamban Rd
122
CW
CW
123
125
Brecra Brook
Brecra Rd
121
Air field Rd

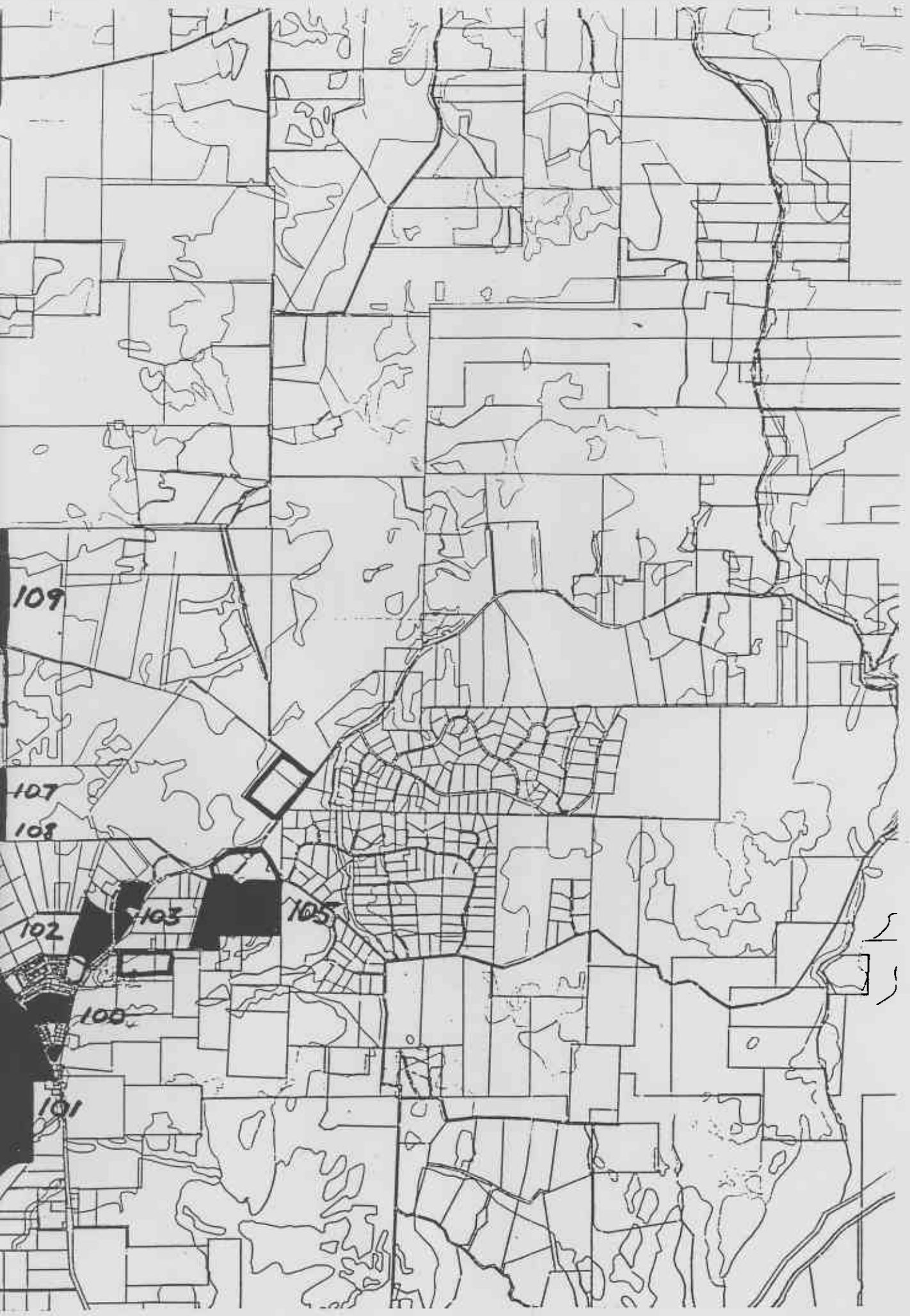


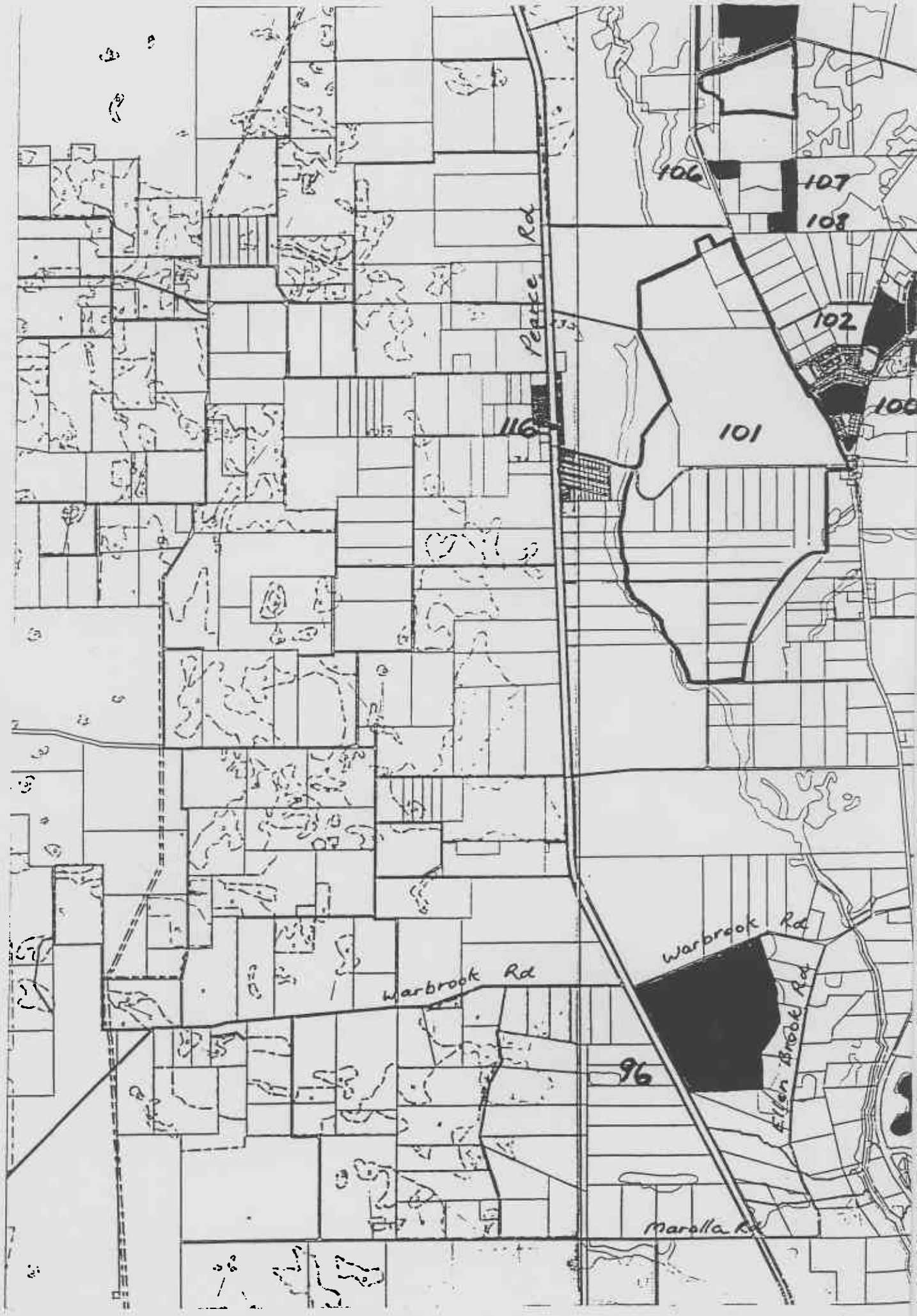
Map 2 Mosaic, GIS 2035 2, 2034 1 & 2134 4.





Map 3 Mosaic, GIS 2034 2 & 2034 1.

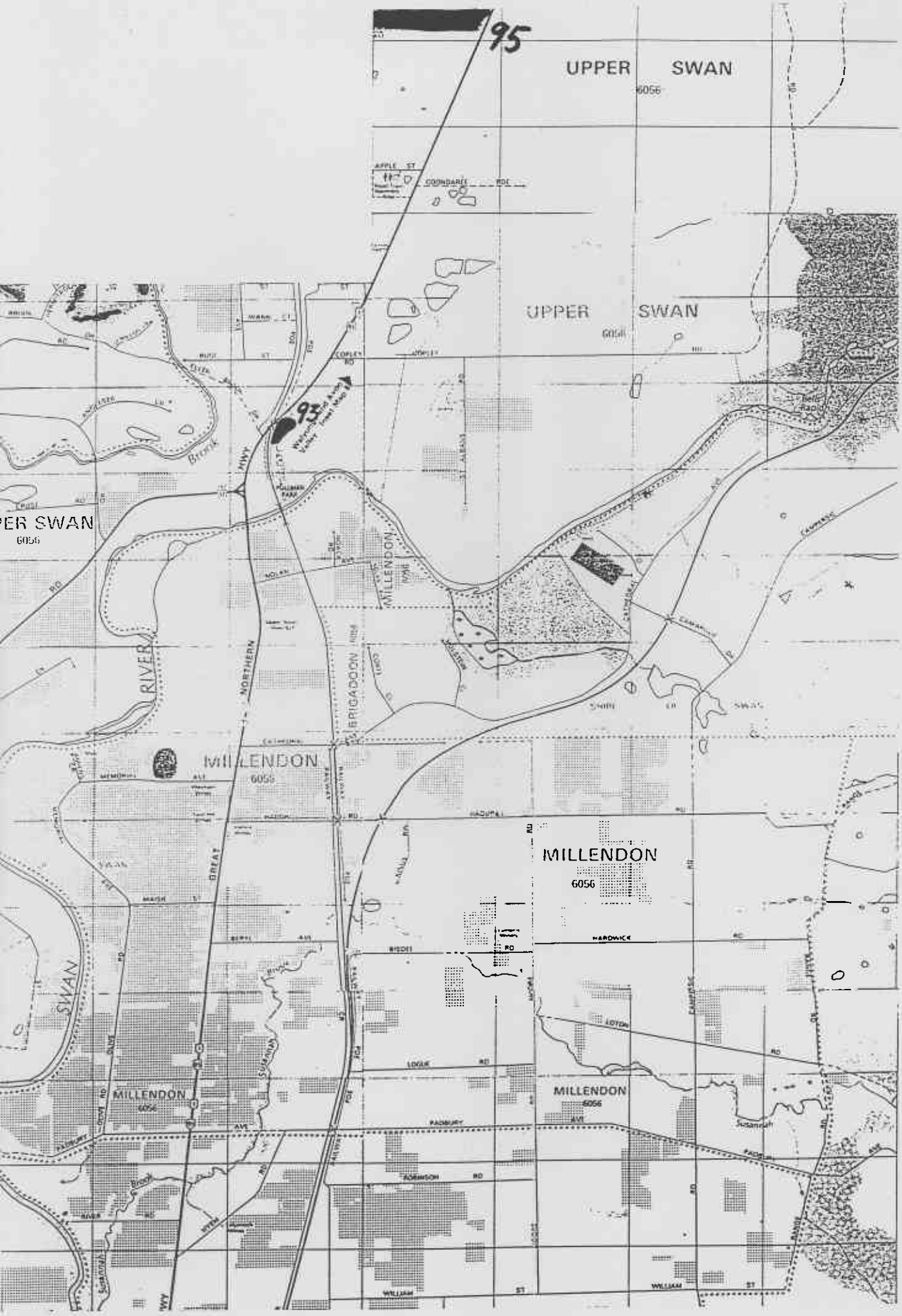

109
107
108
102
103
105
100
101

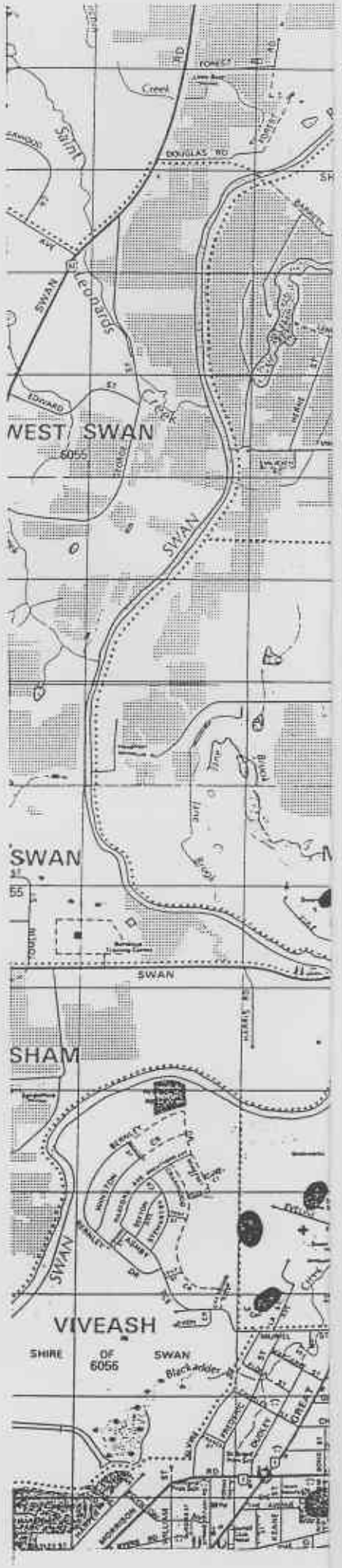


Map 4 Mosaic, GIS 2034 2 & 2034 1.


103
105
98 Wolyunga National Park
97

Map 5 Metropolitan Street Directory

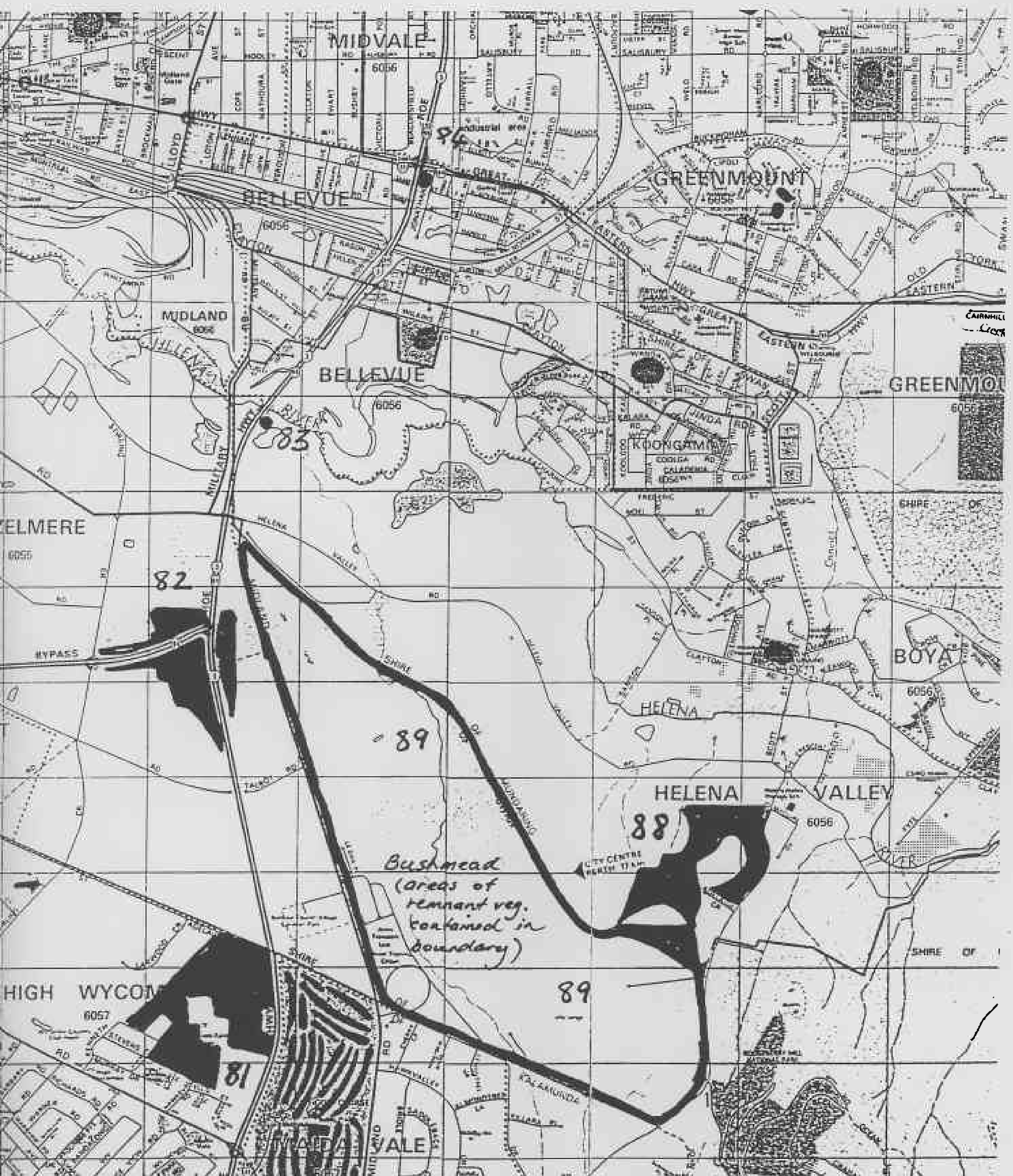

95
UPPER SWAN
6056
APPLE ST
COONDAREE RDE
93
UPPER SWAN
6056
COPLEY RD
HWY
MILLENDON
6056
RIVER
NORTHERN
BRIGADOON
MILLENDON
6056
MILLENDON
6056
HARDWICK
LOTON
LOGUE
SWAN
MILLENDON
6056
MILLENDON
6056
PADBURY
ROBINSON RD
WILLIAM ST

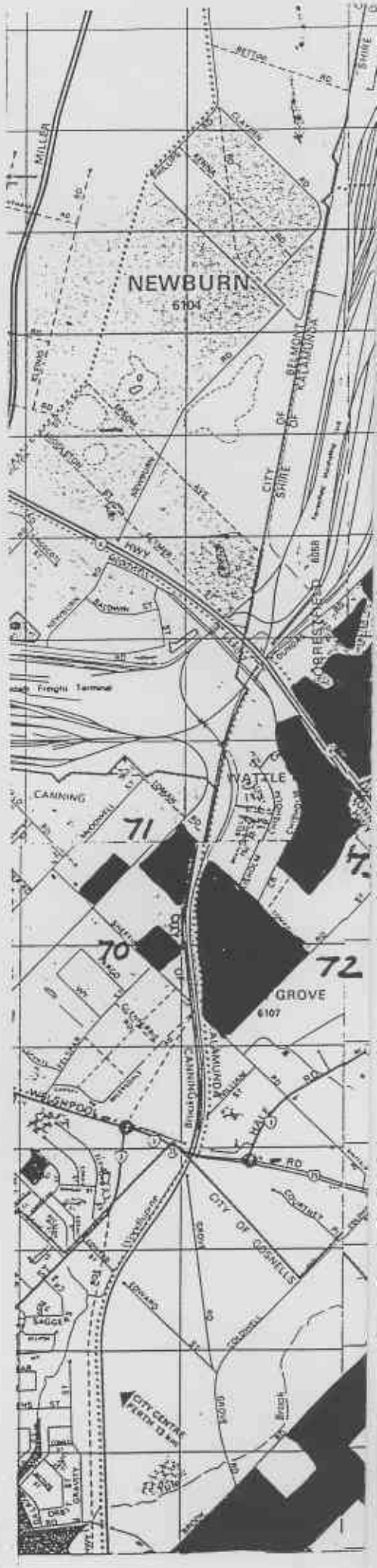


Map 6 Metropolitan Street Directory

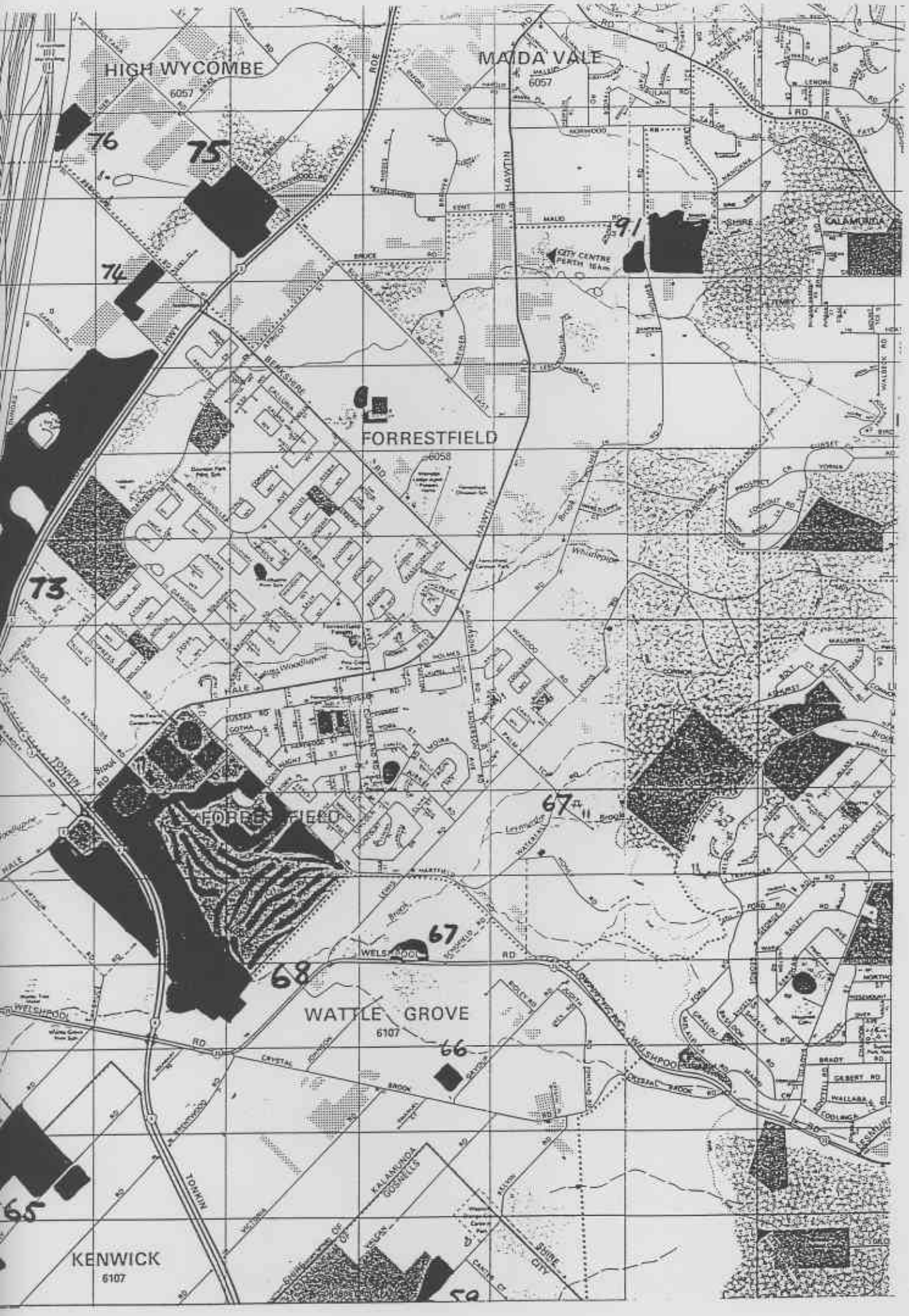

HERNE HILL
6056
MIDDLE SWAN
6056
MIDDLE SWAN
6056
MIDVALE
SWAN VIEW
6056
MIDLAND
6056
SHIRE OF SWAN
SHIRE OF MORRISON
92
85
86
ROE
TOODYAY
TOODYAY RD
MORRISON RD
STOCK RD
LENNARD ST
DAKOVER RD
DALGETY RD
ADAMS RD
WILSON RD
TALBOT RD
MORTIMER RD
PORT RD
NEWMAN RD
GEORGE RD
ALBANY HWY
GREAT NORTHERN HWY
RAILWAY
SWAN RIVER
Creek
CEMETERY
NATIONAL PARK RD
WESTON

Map 7 Metropolitan Street Directory

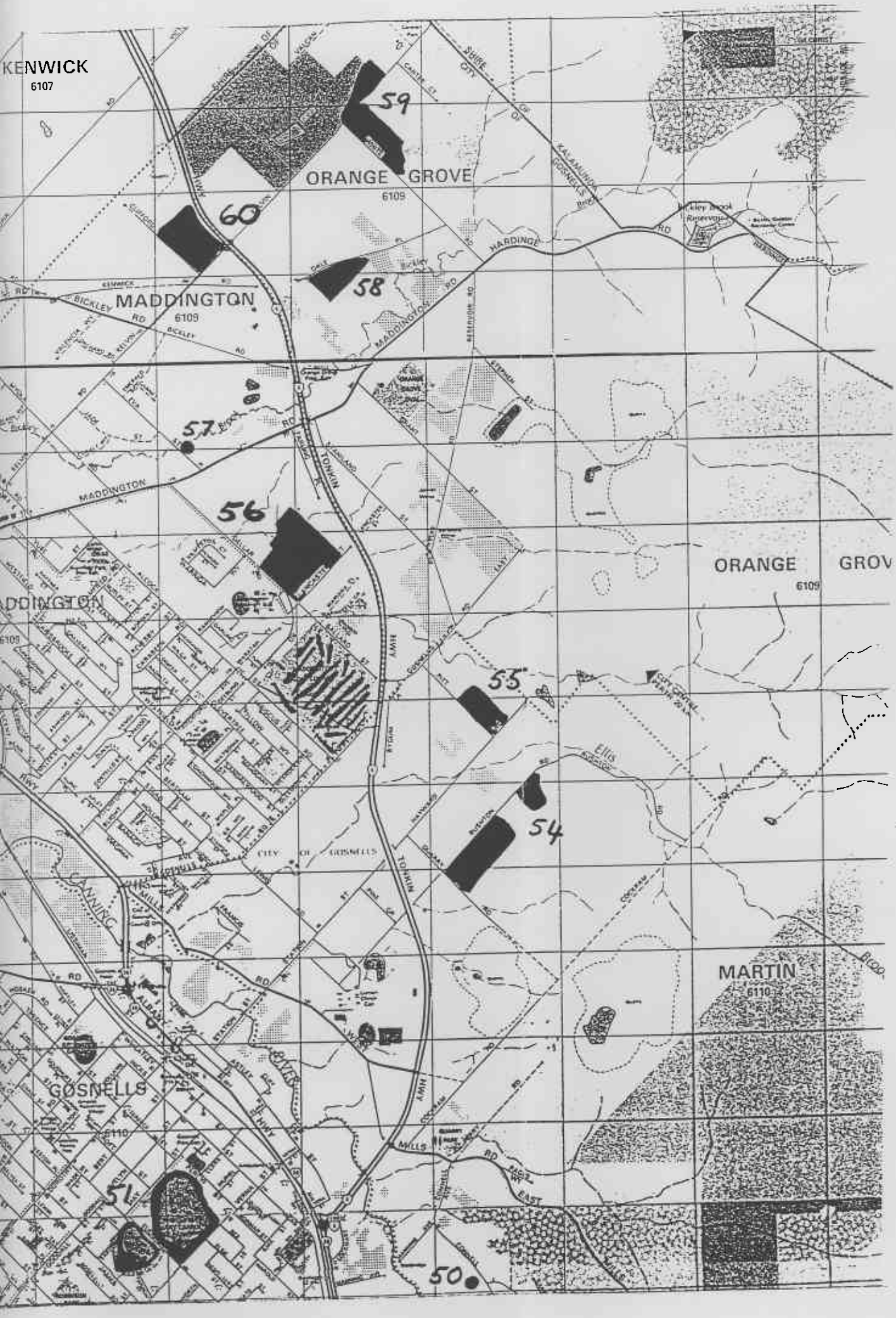

MIDVALE
6056
BELLEVUE
GREENMOUNT
MIDLAND
BELLEVUE
6056
GREENMOU
KOONGAMIA
ELMERE
HELENA VALLEY
6056
BOYA
HIGH WYCOM
6057
MAIDA VALE
GOOSEBERRY HILL
6076
GOOS
Bushmead
(areas of remnant veg. contained in boundary)
84
83
82
89
88
89
81
79
90
78

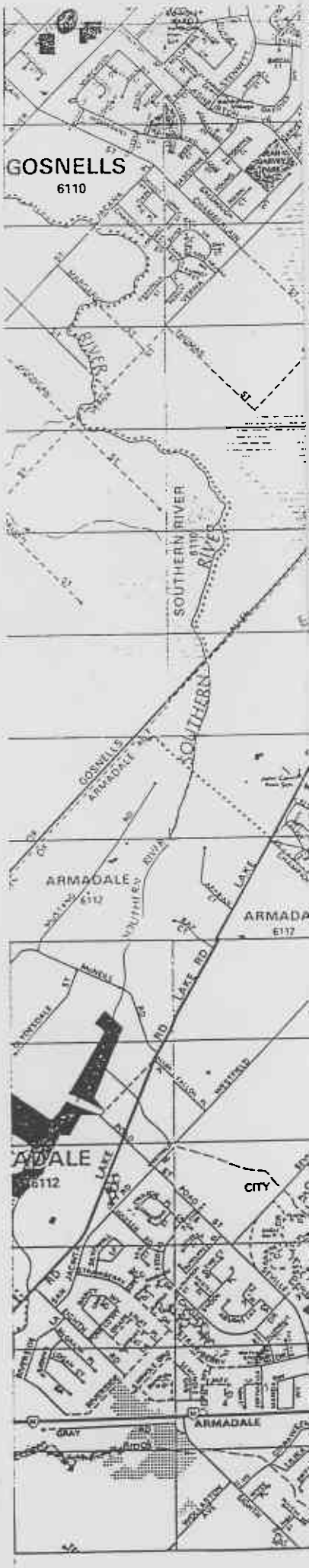


Map 8 Metropolitan Street Directory

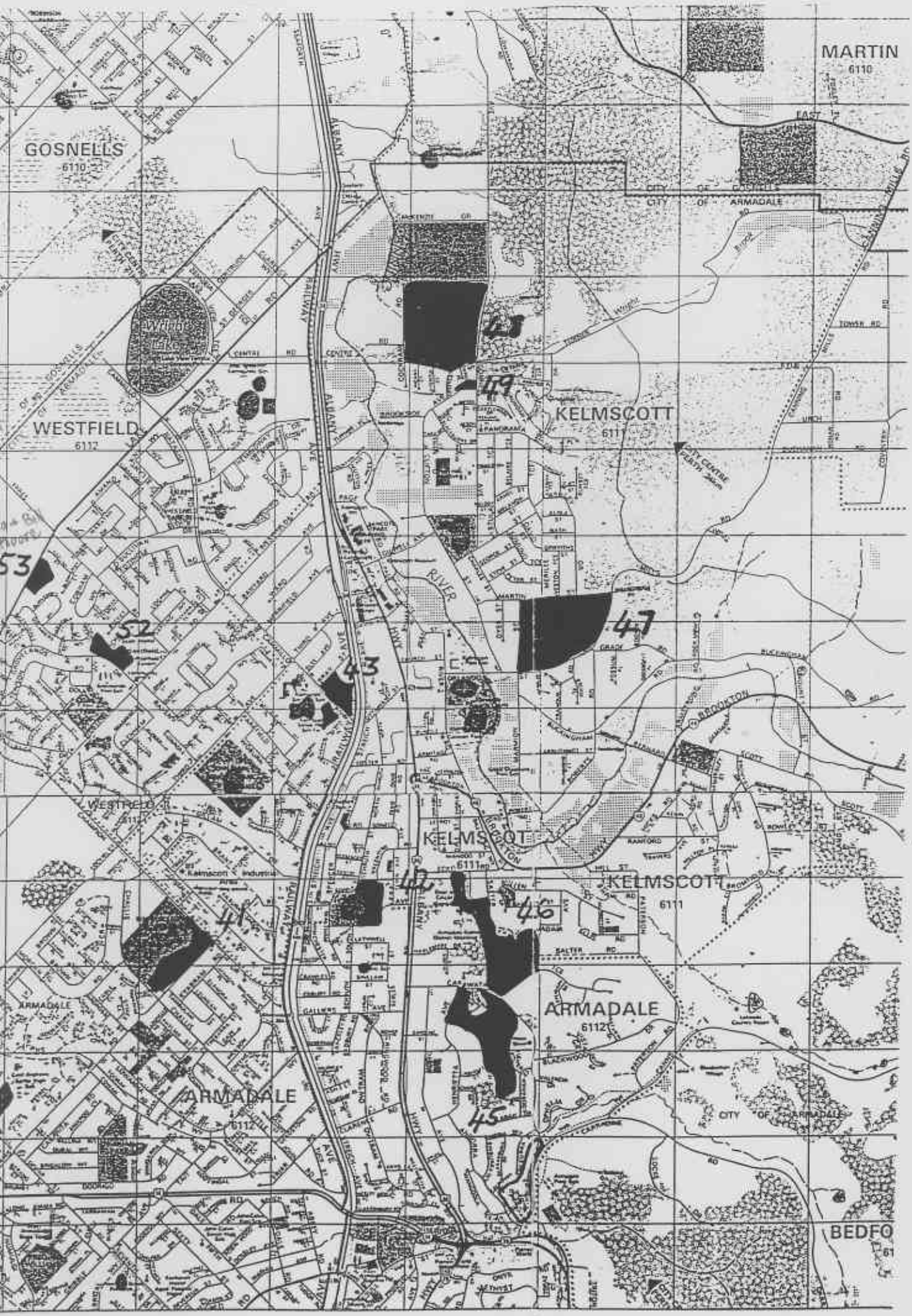

HIGH WYCOMBE
6057
MAIDA VALE
6057
FORRESTFIELD
6058
WATTLE GROVE
6107
KENWICK
6107
76
75
74
73
91
67
68
66
65
HAWTIN
ROE
BERKSHIRE
TONKIN
WELSHPOOL
CRYSTAL BROOK
KALAMUNDA GOSNELLS
SHIRE OF KALAMUNDA
CITY CENTRE PERTH 16km

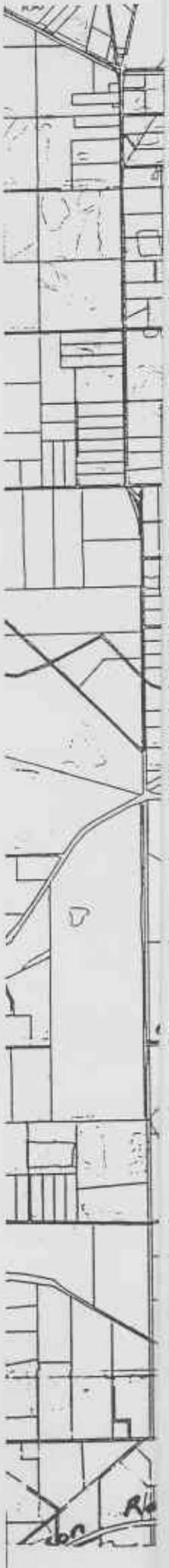
Map 9 Metropolitan Street Directory


KENWICK
6107
ORANGE GROVE
6109
MADDINGTON
6109
ORANGE GROV
6109
MARTIN
6110
GOSNELLS
6110
59
60
58
57
56
55
54
51
50



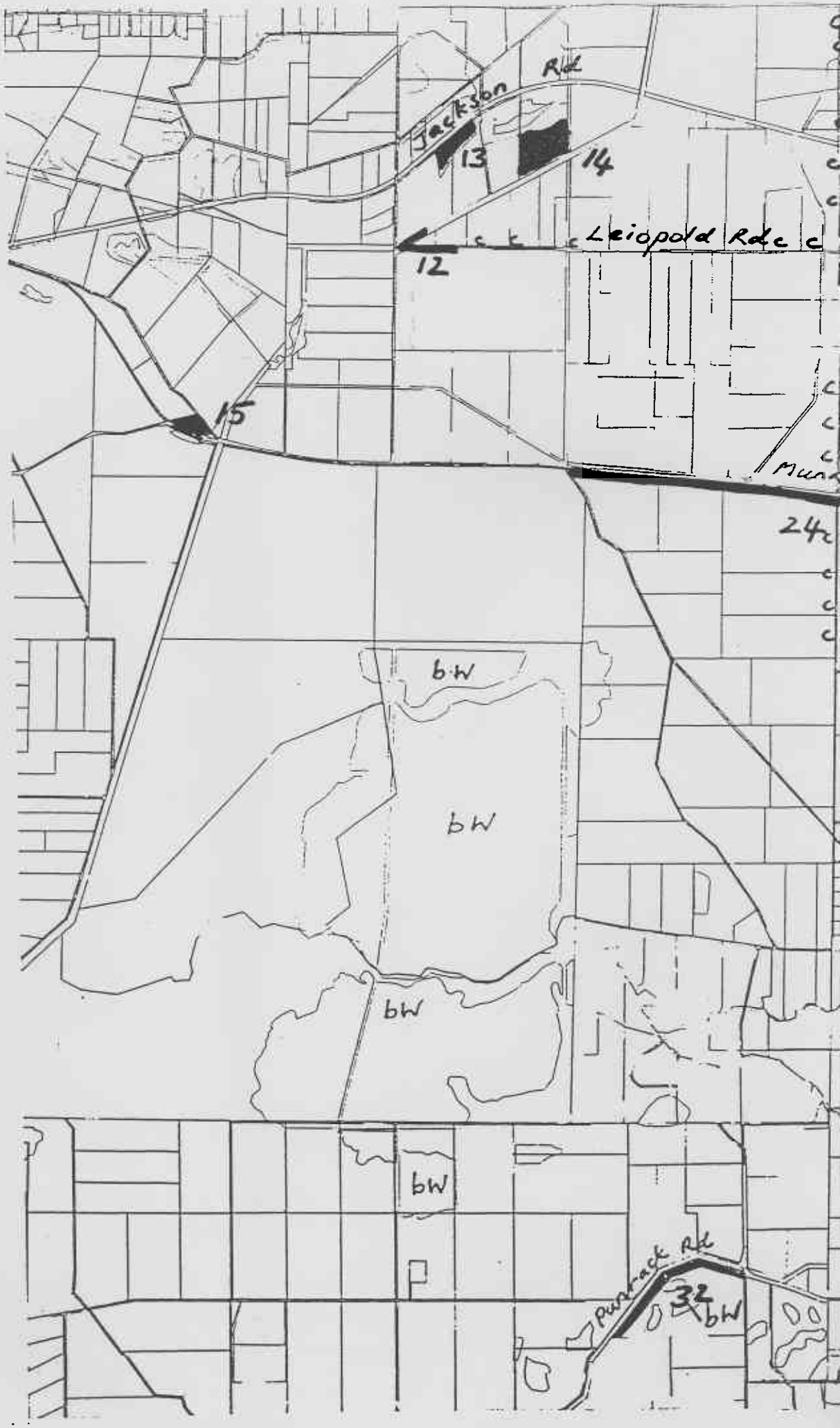
Map 10 Metropolitan Street Directory


MARTIN
6110
GOSNELLS
6110
CITY OF ARMADALE
KELMSCOTT
6111
WESTFIELD
6112
ARMADALE
6112
BEDFO
49
47
43
42
46
41
45
53
52

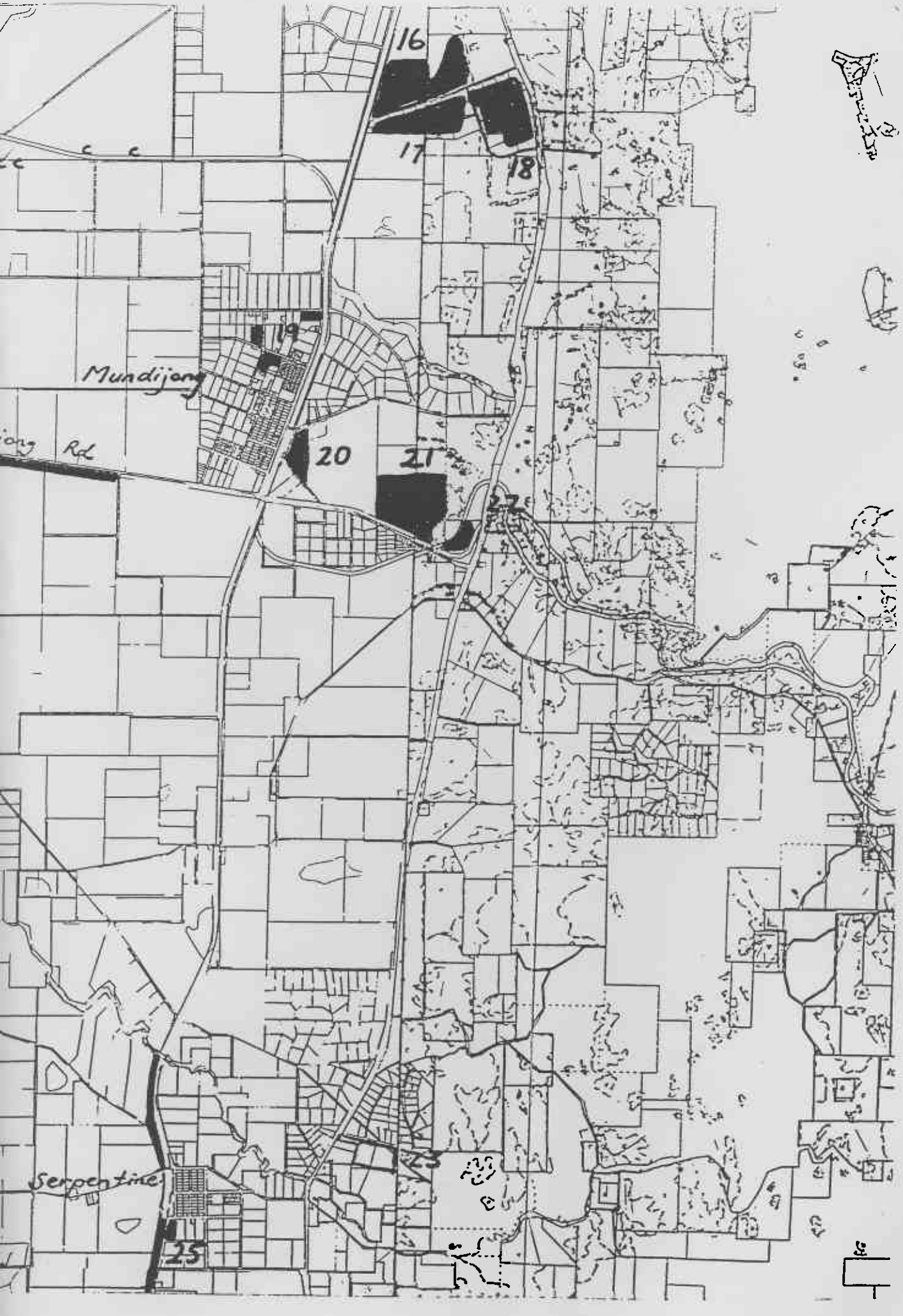


Map11 Mosaic, GIS 2033 1, 2133 4 & 2133 4.


Forrestdale Lake
South western Hwy
Hopkinson Rd
Kargotich Rd
Abernethy Rd
Orton Rd
bW
cW
4th
2
3
4
5
6
7
8
9
10
11
16
44



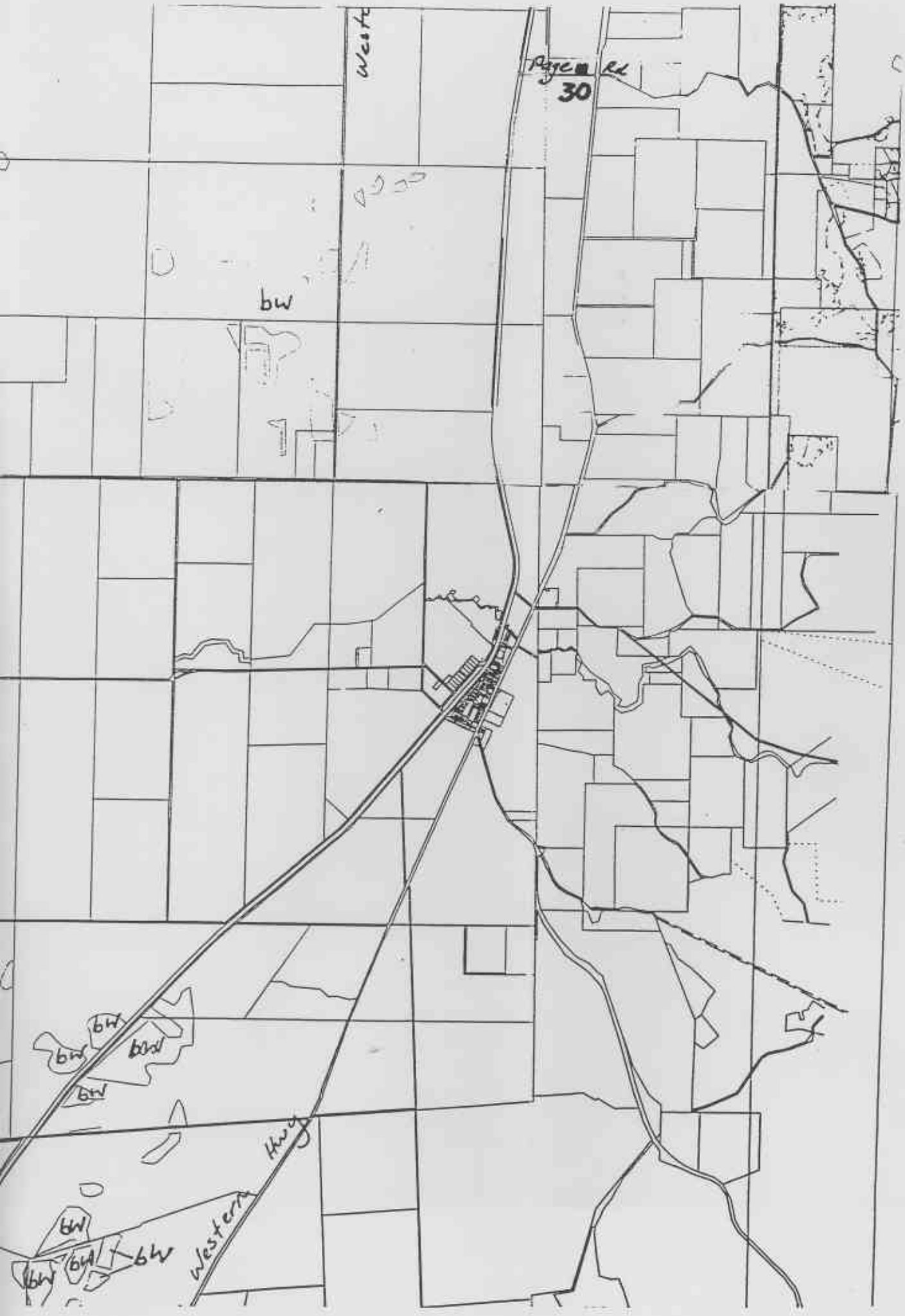
Map 1 2 Mosaic, GIS 2033 1 & 2133 4.

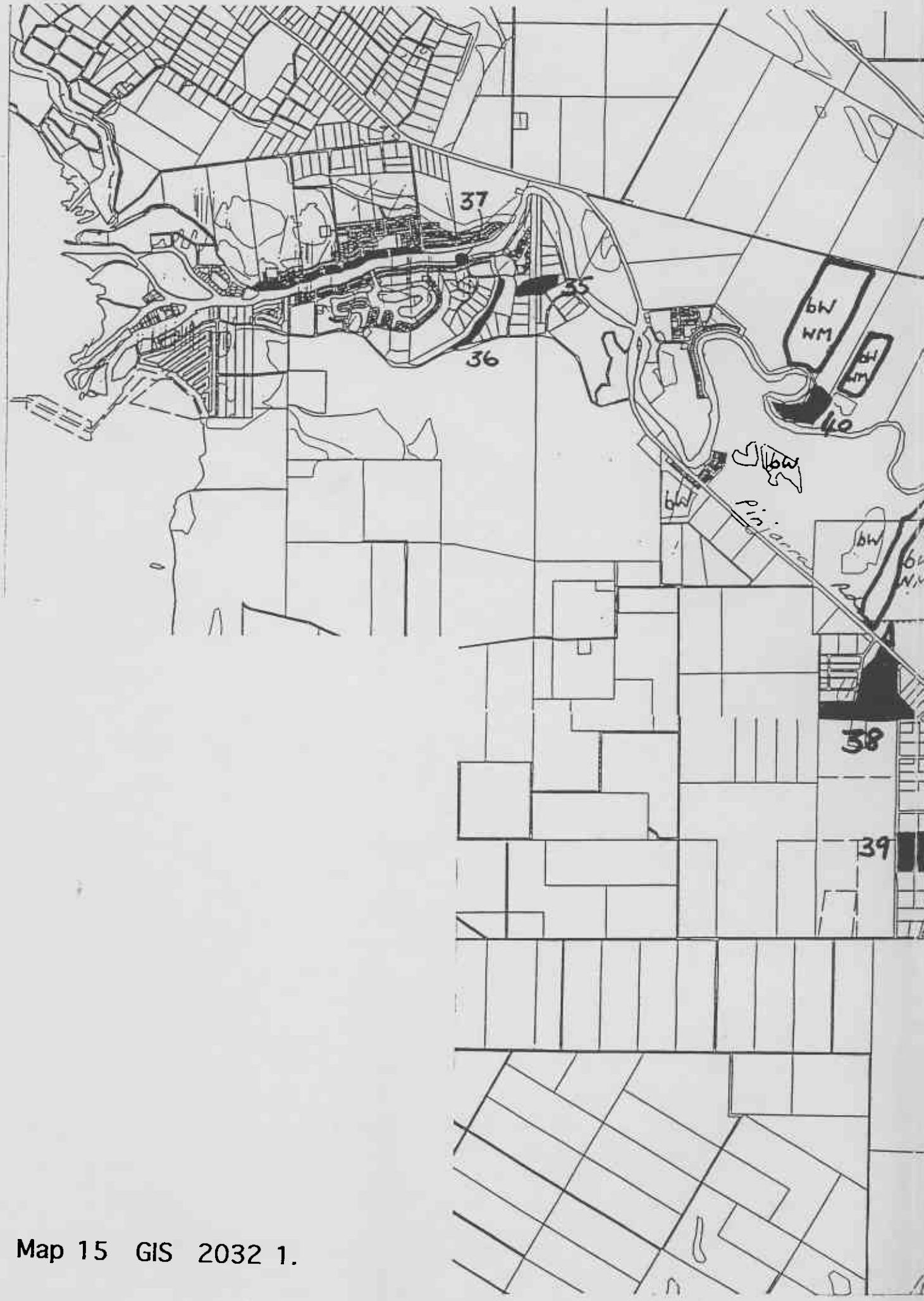

16
17
18
19
Mundijong
Rd
20
21
22
23
Serpentine
25

Map13 Mosaic, GIS 2033 1 & 2133 4.


25
26
29
27
South Western Hwy
Page Rd
30

Map14 Mosaic, GIS 2033 1, 2133 4 & 2032 1.


Page Rd
30
bw
bw
bw
bw
bw
bw
bw
bw
bw
bw
Western Hwy



Map 15 GIS 2032 1.


bw
Railway
South Western Hwy
33
34
Alcoa Rd
Pinjarra