THE WETLANDS OF SYSTEM 6

A report prepared for the

ENVIRONMENTAL PROTECTION AUTHORITY

by

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1. Terms of reference

The terms of reference of this study were as follows:-

(1) Carry out a study of available maps, aerial photographs and other information to compile an inventory of wetlands of the south-west of Western Australia, the exact geographical boundaries of the study area to be determined in consultation with the Director.

(2) Assist as directed in the development of a classification scheme for wetlands in south-western Australia.

(3) Carry out such field inspections of wetlands as may be necessary for the development of a classification scheme as referred to in 2 above.

(4) Compile a list of the wetland reserves in the study area and liaise with the Department of Lands and Surveys to determine the classification, vesting, area and purpose of the wetland reserves, and any other such available information deemed necessary.

(5) Assist as directed in the establishment of a system of collating and recording the data collected.

(6) Assist as directed the Wetlands Advisory Committee in the preparation of a review of the present use and management of the wetland reserves.

(7) Prior to termination of this contract prepare a precis of work undertaken during the period of contractual employment, together with necessary maps, illustrations and documentation

as are necessary to make this a comprehensive report in such a format as will be suitable for production of copies.

2. Scope and methods of the study

This report is limited in geographical scope to that area of land defined as System 6 in the report to the Environmental Protection Authority by the Conservation Through Reserves Committee (1974). This area is presently under consideration by the CTRC; it is generally regarded as containing the most significant wetlands in the State; and it is an area of intensive multiple land use with considerable past and present alteration of the environment.

The definition of wetlands formulated by the Wetlands Advisory Committee of the Environmental Protection Authority has been adopted for the report. This states that wetlands are "Areas of seasonally, intermittently or permanently waterlogged soils or inundated land whether natural or otherwise fresh or saline, e.g. waterlogged soils, ponds, billabongs, lakes, swamps, tidal flats, estuaries, rivers and their tributaries".

In practice the approach to developing a classification scheme and inventory for wetlands has been limited by time restrictions to named wetlands on the following series of maps:

(1) 1:250,000 Army maps for Perth, Pinjarra, Collie and Pemberton.

(2) 1:000,000 Australian Topographic Survey, Bunbury

(3) 1:25,000 Australian Topographic Survey, Muchea NE, Muchea NW, Muchea SE, Muchea SW, Yanchep NE, Yanchep NW.

(4) 80 chain Forestry map series

(5) 80 chain lithos of Lands and Surveys Department

(6) 40 chain lithos of Lands and Surveys Department

Un-named wetlands have not been included in the inventory although they undoubtedly have high collective, and sometimes individual, biological significance. An inventory card has been allotted to each named wetland located by map search and additional information may be added as it becomes available.

This approach also led to the location of all wetlands on reserves and a list of wetlands for each shire within the study area.

The classification scheme is based on that of Bayly and Williams (1973) and available information on the soils and hydrogeology of the area. The extent to which this scheme correlates with vegetative formations is yet to be established by field surveys.

While the study was ongoing it was decided to enlarge its scope by considering the nature and extent of land uses liable to affect wetlands in general (see Terms of reference No. 6). This information greatly increases the usefulness of the study for purposes of determining a representative system of wetland reserves and National Parks, and for devising the basis of a management plan for wetlands within the study area. These

problems are responsibilities of the Wetlands Advisory Committee and the Conservation Through Reserves Committee.

Land use information was collected through requests to Government departments and other bodies. The following departments were approached:

Department of Agriculture

Department of Conservation and Environment

Department of Fisheries and Wildlife

Forests Department

Geological Survey of W.A.

Public Health Department

Department of Lands and Surveys

Metropolitan Water Supply, Sewerage & Drainage Board

Department of Mines

National Parks Authority

Public Works Department

Town Planning Department

A survey of published information pertinent to the study was also carried out.

The report is therefore divided into

- the classification and inventory of wetlands within System 6.
- a consideration of land uses having a direct or indirect effect on wetlands.
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- a series of maps presenting the information contained in A and B.

3. Overview of System 6

The area covered by System 6 is shown in Figure 1 and, in more detail, on other maps in the attached portfolio. It extends from the Moore River in the north to the Blackwood River in the south and basically contains the two broad topographical features of the Darling Range in the east and the coastal plain in the west.

The climate is characterized by a regular winter rainfall and summer drought with 90% of the average annual precipitation during May to October. Figures 2 and 3 show the median annual rainfall and the average winter rainfall excess respectively for much of the area covered by this report (both Figures are taken from CSIRO Report on Ecological effects of Bauxite Mining, 1972). In the long effective summer high temperatures and radiation levels and low humidity cause high evaporation. This weather pattern gives rise to a large number of seasonal wetlands particularly on the coastal plain.

McArthur and Bettenay (1974) comment: "The fluctuation in the rainfall induces a corresponding, though slightly lagging, fluctuation in the water relations of the solum. This is particularly so in the case of flat-lying water-laid deposits. During the winter the soils are heavily leached until saturation is reached, usually in May, and the soil then remains waterlogged until September..... With the onset of high temperatures in November the soil moisture falls rapidly below field capacity in both water-laid and dune soils, and by late summer there is no available water within several feet of the surface." (p. 5).

The Darling Range has both westward and eastward drainage systems, the westward consisting of several medium sized rivers and their tributaries which tend to run either north or south on the coastal plain and enter the sea at only a few points.

System 6 covers an area of 25,470 km^2 or 1.06 per cent of the total area of Western Australia but it contains the greater percentage of the State's population (approximately 75% in the Perth area). It is therefore an area of high land use with alternative uses often competing.

Much of the Darling Range supports dry sclerophyll forest with Jarrah (Eucalyptus marginata) as the dominant species and is the State's principal forestry area. A large area of Low Open Forest to the north of Perth on the coastal plain is being converted to Pine plantations to meet demands for timber. Wetlands surrounding Perth have been extensively developed for market gardens, and the southern coastal plain supports most of the dairy cattle industry. In addition there are a variety of mining activities ranging from major industries involved in the extraction of bauxite and coal in the Darling Range to small companies extracting diatomaceous earth and peat from wetlands on the plain. Most of the major rivers have been dammed to provide water for much of the south-west of the State and bore-fields are being developed to exploit the shallow surface aquifers north and south of Perth to meet the population's inordinately high demands relative to other Australian capital cities.

Finally the area must meet the bulk of the recreational demands for the State's population and should have a system of flora and wildlife reserves to preserve representative samples of vegetative formations and to meet the ecological requirements of fauna.

The introduction of co-ordinated land use management for the area is obviously an urgent necessity.

4. The classification of wetlands

4.1 Limnological classification

The generally accepted limnological classification of wetlands based on operative and formative factors is described in Bayly and Williams (1973).

At the highest level LENTIC (areas of standing water) and LOTIC (areas of running water) environments are distinguished. Lentic environments are further subdivided into lakes (i.e. areas of relatively deep water) and bodies of shallow water. Both of these categories are further subdivided, lakes into tectonic, volcanic, landslide, glacial, solution, fluviatile, wind action or coastline types, with further subdivisions of some types, and shallow water bodies into underground water, springs, waters associated with terrestrial vegetation, puddles, rock pools, and ponds either permanent or temporary.

Lotic environments may be permanent, temporary or episodic and are characterized by unidirectional flow, fluctuation in flow rates, unstable bottom and shoreline areas, linear morphology,

relative shallowness, adaptations of the biota particularly to flow, and greater turbidity, oxygen concentrations and terrestrial and aquatic nutrient interchange than Lotic environments.

This hierarchical classification scheme is represented diagrammatically in Table 1. To determine the applicability of this scheme to System 6 it is necessary to examine the geology and in particular the soils of the area and the hypothesized origins of the overlying wetlands.

4.2 Proposed classification for System 6

Fortunately, several excellent soil studies have been published (McArthur and Bettenay 1960; Mulcahy, Churchward and Dimmock 1972; Bettenay, McArthur and Hingston 1960; McArthur, Bettenay and Hingston 1959) and geological maps with associated notes published by the Geological Survey of W.A. covering part of the system are available. (Maps of Section D of this report relate to the following discussion.)

The geomorphic elements which make up the Swan coastal plain and their constituent soil associations are listed on Table 2 taken from Bettenay, McArthur and Hingston (1960) and are shown on Maps 1, 2, and 3 of Section D.

It is readily apparent that the principal geomorphic elements with respect to lentic wetlands are the Bassendean, Quindalup and Spearwood dune systems and the Pinjarra Plain. In particular a series of depressions lies between the Bassendean

and Spearwood dune systems and a second series between the Spearwood and Quindalup dune systems (McArthur and Bettenay 1960). The former series includes Yeal swamp, and Lakes Pinjar, Coogee and Jandabup to the north of Perth; North Lake, Thompson and Yangebup Lake, and Goegrup Lake between Perth and Mandurah; and Mialla Lagoon and Myalup Swamp between Mandurah and Bunbury. The latter series includes Lakes Cooloongup and Walyungup, Lake Preston and the Leschenault Inlet. In addition there are lentic wetlands that occur within the geomorphic elements rather than between them, e.g. the Yanchep lakes on the Spearwood dune system and numerous small wetlands on the Bassendean dune system including Lake Jandakot.

It is to be expected that the similarities of wetlands within each of these series in terms of origins, nature and perhaps even biota will be greater than similarities across systems. The evidence available supports this expectation. The Yanchep lakes for example are steep sided and are thought to have been formed by the collapse of underground caverns (McArthur and Bettenay 1960), whereas the swamps of the Bassendean dune formation are simply expressions of the extensive surface aquifer typically shallow and containing acid brown water of low salinity (Morgan 1969). Relating these two examples back to the limnological classification, they may be tentatively classified as solution lakes (formed by water dissolving limestone) and wind action-dune-water table lakes respectively, although strictly both are ponds rather than lakes as they contain water shallow enough for rooted vegetation to be established over most of the bottom.

It is therefore probably meaningful to classify the lentic wetlands of the coastal plain on the basis of soil elements and series, i.e. to adopt soil associations as environmental indicators. It is desirable to add to this a geographical division of the plain into north, middle and south, meaning between the Moore River and Perth, from Perth to the Murray-Dandalup Rivers and southwards of the Murray-Dandalup Rivers respectively. This division adds a further dimension of locatability to each classification.

The soils immediately surrounding and on the bottoms of the wetlands themselves are recent and generally consist of peaty sand or sandy peat regardless of the larger soil association on which they are found. This simply reflects the organic nature of their formation. There are some differences, however, as Lakes Cooloongup, Walyungup, Richmond and Munster (Coogee) consist of clay, silt and marl with shell beds and the beds of the Rottnest island lakes are fossiliferous limestone and unlithified shell beds. Limnologically these are athalassic or saline waters. This character therefore offers a further classificatory division.

The basic scheme is shown on Table 3 together with suggested classification symbols. Examples of applied classifications are shown on Table 4. It should be repeated that certain classifications may be related back to the limnological classifications (e.g. all B-B-Qrw are probably wind action-dune-water table ponds) and that these relationships will increase as more information becomes available in the future.

It is the opinion of the authors that both classification schemes should be adopted as the limnological classification is generally accepted and will have wider application as the inventory is extended to cover the whole State and the Soils-Wetland Classification Scheme (SWCS) divides the previous scheme into location and integrated physical sub-units within the study area, allowing refinement of classification, and provides the basis for studying the relationship between soils, vegetative formation and biota.

The soil associations can also be closely related to land use. Table 5 shows the Soil Series that comprise each association, the general nature of the wetlands that occur on these series, and the principal land uses.

The Darling Range was formed by an uplift of the Western Australian Shield probably during the Tertiary. This uplift led to a rejuvenation of drainage patterns running westwards and eastwards of the range and this in turn has contributed to its landforms and soils (Mulcahy, Churchward, Dimmock 1972). The landform-soils classification schemes developed by these authors and their association with wetlands is shown on Table 6. It is to be expected that this soils classification may be extended to the Range in general and therefore the units may be incorporated into the proposed Soils-Wetland Classification Scheme (SWCS) with the same location divisions of North, Middle and South (being a continuation of the Coastal Plain divisions in a due easterly direction). The first hierarchical division

for the SWCS as applied to the entire area of System 6 is therefore the Coastal Plain (CP) and the Darling Range (DR).

In any wetland classification scheme it is essential to separate Lentic (standing water) and Lotic (running water) environments due to their great ecological differences and further any scheme based on narrow location criteria, such as the SWCS, is not appropriate to lotic environments which typically extend over vast areas and therefore cross many divisions. The SWCS thus is applicable to lentic wetlands only and the lotic environments are best classified according to the major river complex to which they belong, i.e. into drainage areas.

On the Coastal Plain ".... drainage is by consequent streams from the Darling Plateau [i.e. the Westward Drainage System of Mulcahy, Churchward, and Dimmock (1972)]. The most important modification to this generalization is that streams when they have entered the Pinjarra Plain, ... are diverted either to the north or south, and, linking up one with the other, enter the sea at only a few points..... In some cases the dunes have diverted the streams, but the most likely explanation is that subsequent streams have formed, and, by headward erosion, have captured weaker consequents..... The rivers of the coastal plain occur either in wide channels with extensive flood plains or in narrow steep-sided, straight channels." (McArthur and Bettenay 1960, p. 14).

The major drainage complexes of System 6 which are all "dendritic" in form are from north to south as follows:

1. Moore complex (M)
2. Swan complex (S)
3. Peel complex (P)
4. Leschenault complex (L)
5. Capel complex (C)
6. Hardy complex (H)

Greater definition within this proposed lotic classification scheme (LCS) can be achieved through the recognition of second order criteria based on principal river components as shown on Table 7. Each tributary may then be classified as Swan-Canning (Sc) or Moore-Gingin (Mg) etc. Further subdivisions can be added as required. The LCS can readily be extended to all lentic environments in the State.

All of these river complexes were originally fresh-water but a few have become relatively saline due to the effects of increased run-off following clearing of natural vegetation. They are both singly and collectively crucial ecological elements of System 6 as well as the major land uses of the area being used for such diverse activities as irrigation and water supply to canoeing and fishing. In a few cases they extend into a series of lakes such as at the lower end of the Serpentine River or contribute to large estuaries such as the Peel inlet, Harvey Estuary and Leschenault inlet which support commercial fishing and crabbing industries as well as providing major potential recreational areas and wildlife reserves.

In conclusion, the entire proposed classification scheme is shown diagrammatically on Figure 4.

4.3 Other classification schemes

The C. S.I.R.O. Division of Land Resources Management have recently outlined a microclassification scheme for wetlands of the south-east corridor of Perth (1976). This scheme has as its greatest units the soil associations within that corridor and recognises types of wetlands within these (Table 8). It therefore corresponds with Levels 6 and 7 of the SWCS proposed above, offering a more detailed alternative at Level 7. The generality of these types to other areas can only be determined by more detailed surveys but this level of classification should be included as Level 7 of the SWCS as that information becomes available.

Riggert (1966) also developed a classification scheme for the Swan coastal plain based on the system developed by the Wetlands Classification Committee of the United States Fish and Wildlife Service (1953). The hierarchical criteria of this scheme are location, water quality and water depth (Table 9). Riggert further divides this into three geographical zones (A, B, C) and drainable/non-drainable, describing the nature and area of wetland types within each with particular reference to waterfowl (Table 10). The geographical zones are:

A - 31°30'S to 32°16'45" S; area 2,317.5 km^2

B - 32°16'45"S to 33°6'S; area 2,821.5 km^2

C - 33°6'S to 33°45'S; area 2,684.3 km^2

According to this study wetlands of the Swan coastal plain cover a maximum winter area of 645.58 km^2 or 13.4% of the total land area although reservoirs, sounds and bays constitute 237.1 km^2 of this or 4.91% of the total land area.

Although this classification system is conceptually simple and could be applied beyond System 6, the authors consider the SWCS is preferable as it is based on a more fundamental environmental indicator. The SWCS is immediately applicable to System 6 and will be applicable to other areas as information on their soils becomes available. Through field surveys the system may be interrelated with 'higher' order elements of the ecosystem such as vegetation, water depth and salinity etc. Further the U.S. system does not permit as many levels of classification as the SWCS and its use would therefore increase the probability of any survey omitting particular types of ecosystems from especial consideration.

If the information contained in the Wetlands inventory is stored in computer form it would eventually be possible to devise classification schemes based on any combination of the recorded data and it would be possible to correlate various criteria with the aim of establishing an ecologically 'meaningful' classification scheme. It is necessary at this stage to select criteria for which definite information exists and this is the case for soils within System 6.

Numerical classifications of vegetation have also been widely used to classify and define ecosystems (Bunce 1973; Goodall 1954) and have been applied to the Northern Jarrah Forest within System 6 (Havel 1975a, 1975b, 1975c). Despite some theoretical limitations the application of this type of vegetation classification to the wetlands within the study area

would identify the majority of vegetation types. Such information is essential if a truly representative system of wetland flora reserves is to be established. Moreover the relationship between soil and vegetation types and thus the ecological validity, of the SWCS could be investigated. Some information on the vegetation of particular wetlands within System 6 is already available. McCoomb and McCoomb (1967) studied the vegetation of Loch McNess; Bowman et al. (1976) that of the Cockburn Lakes (North, Bibra, South Rush, Little Rush, Yangebup, Kogolup, Thompson, and Banganup) and Meagher and Le Provost (1976) that of a section of the Canning River.

It is therefore recommended that the possibility of site-vegetation mapping of the wetlands be seriously considered by the Department of Conservation and Environment and the Wetlands Advisory Committee.

5. The Wetland Inventory for System 6

The Wetland Inventory was compiled by searching the series of maps listed in the Scope and Methods section of this report. A record card (Figure 5) was commenced for each named wetland, together with location data, soil type and classification. Other information was recorded when available (e.g. information on Reserves was available from the Fisheries and Wildlife Department) but field surveys will be necessary to complete almost all cards.

The inventory located a total of 149 named lentic and 327 named lotic wetlands. Every named wetland has been classified

in either the SWCS or LCS as far as is possible with existing information and details of the classifications are given on Tables 11 and 12 respectively.

Two hundred and fifty-one wetlands are either wholly or partly within reserves. These are indicated by an asterisk on Tables 11 and 12 and details of their location, reserve number and purpose are given in Table 13. Table 14 gives the location by Shires of all non-reserved wetlands and Table 15 lists all reserves both with and without wetlands within System 6. This latter table is presented as it may be useful in the overall CTRC planning for System 6.

Many of these reserves contain only small un-named creeks or swamps, few contain major wetlands and there are only 12 national parks and 43 flora and fauna reserves containing wetlands (Tables 16 and 17).

Wetland areas within System 6 that are considered particularly desirable for vesting as national parks by the National Parks Authority are as follows:-

1. Julimar Forest - between Avon Valley and the Bindoon-Toodyay Road. This area provides many attractive spots in the wandoo woodland for discreet camping. Should the Army vacate the area of Julimar Forest north of the Bindoon-Toodyay Road this too could be added.

2. Helena Valley - which has been under consideration for some years.

3. Areas about the Brunswick and Lunsburgh Rivers apparently under the control of Worsley Timber Co. There is fine valley scenery and magnificent stands of Jarrah, Marri and Blackbutt.

4. The Collie River valley from Wellington Dam down to Reserve 25973, including Mt. Lennard.

5. Leschenault Inlet and Peninsula, including the swamps at the head of the inlet, have a National Park potential, but this is severely marred by the La Porte pipeline across the inlet and the disposal ponds in the sand hills of the peninsula.

Collectively, National Parks must meet a multiplicity of demands including passive and active recreation and flora and fauna conservation. Large wetland areas are particularly suitable for these purposes. They all present management problems largely arising from staff shortages in the National Parks Board particularly fire management programmes and supervision of the public.

Flora and fauna reserves have been declared as suitable land becomes available rather than according to a systematic plan to adequately meet the needs of flora and fauna conservation and associated human activities. Very little biological information is available for any reserve even in the basic form of inventories. Management plans, although required by the Fauna Conservation Act, are totally lacking. As in the case for National Parks, shortage of staff is the principal reason for this.

ADDENDUM TO SECTION 5

Advice received from the PWD (18 August 1976) indicates that it has no proposed usage or requirements for the following reserves, all of which are not vested:

7504	Karakin Lakes, 9 miles SE of Lancelin - 583 ha.
19203	19 miles north of Boyup Brook
16907	Nine Mile Lake - Murray Shire, east of the Harvey Estuary

In addition, that department may not object to changes in the purpose of Water reserve 10687 (Red Lake), 7 miles NW of Harvey provided that this entails no interference with the Harvey drain that traverses this reserve. Furthermore no objection is likely to any proposed change in the purpose of Water reserve 15515 to Water and the Conservation of Flora and Wildlife, provided that the vesting remains with the Minister for Water Supplies.

Wetland reserves are generally subject to a number of pressures particularly damage from stock, as they are often unfenced, fire (mainly inappropriate control burning), drainage, and mining claims. Information on these problems is available on Table 17 and in the Wetland reserve file submitted with this report.

It should be readily apparent from perusal of the information presented that wetland reserves and National Parks within System 6 and staff to manage them are inadequate. There is an urgent need for research to determine -

(a) the variety and distribution of wetland vegetative formations;

(b) the requirements of aquatic fauna;

(c) management plans for wetland reserves.

Only with such information can a representative system of reserves be secured.

6. Land uses and their effects on wetlands

6.1 Introduction

The non-continuous distribution of wetland ecosystems poses particular problems in decision-making aimed at establishing a representative system of reserves and parks for fauna, flora and recreation.

It is doubtful whether a system of relatively large reserves will adequately meet the needs of flora and especially fauna which is widely dispersed. On the other hand a network of small reserves

would be difficult to manage. The continuing reduction in wetland areas through drainage, direct clearing, mining, fire, sanitary landfill and stock damage, highlights the urgency of forming wetland preservation regulations and wetland conservation priority zones for effective conservation.

Riggert (1966) found that "....in the area from Yanchep to Rockingham 49 per cent (13,154 acres) of all wetlands had been drained by 1966; from Rockingham to Harvey 31 per cent; from Harvey to Dunsborough 96 per cent." (from Seddon 1972, p. 226). Since 1966 these facts have been widely quoted but no active conservation scheme has been implemented and it must be concluded that the rate of destruction has continued unabated if not increased.

These 'on-site' problems are further aggravated by activities removed from wetlands which indirectly cause changes to these eco-systems and sometimes their devastation. The use of fertilisers in agriculture and manure from grazing stock can lead to local eutrophication, land clearing can increase salinity and the extraction of groundwaters from surface aquifers can lower the water table and thus the levels of wetlands.

In this Section the authors attempt an outline of these diverse activities and a summary of existing available information on the wetlands they are affecting or may affect. It is essential that the implications of this Section for the establishment of effective reserves and parks be fully understood as they pose fundamental and considerable management problems.

The lack of ecological knowledge and consideration of ecological factors in planning, as illustrated by the following quotes, is alarming, "The Board [MWSSDB] was aware of proposals to mine diatomite on the coastal plain.....This mining is not expected to affect groundwater levels as such, although dredging of lakes and swamps is likely to increase their free water surface area. In areas where exploitation of the unconfined aquifer may cause water level declines the deepening of these lakes may ensure their permanence. In general there appears to be no conflict between diatomite mining and development of the groundwater and there may in fact be advantages in terms of a reduced impact on some lakes." * and "I would suggest that in the touristic or other development of this area [i.e. Peel-Harvey System] the swamp lands can be dredged and reclaimed. This provides deeper water, which is available through droughts, and areas where vegetation can prosper. I am sure the bird population would thank man for such thoughtfulness. The swans, ducks and pelicans and other aquatic birds using Lake Monger and many other metropolitan improved swamps have a look of gratitude on their faces, because of the lawns and trees that attract visitors, even brides on their wedding day". (Silvester 1975).

6.2 Effects of agriculture

The Swan Coastal Plain has been intensively developed for agriculture, principally the production of beef and dairy cattle but also intensive small scale development such as market gardening and citrus growing.

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* Quote from a letter from an officer of MWSSDB to the Director of Fisheries and Wildlife, 1975.

Agricultural development has caused changes to wetlands through drainage, clearing, salinity, fire, stock damage, and eutrophication. The extents of all of these factors apart from drainage are undocumented but it is apparent that they are widespread.

Wetlands are often used as summer pasture for the grazing of stock, usually having been planted with an introduced pasture grass such as Paspalum vaginatum. Many wetland flora and fauna reserves remain unfenced and suffer considerable and continuous damage through grazing and trampling. An example is Wellering swamp which once supported one of the few Straw-necked Ibis nesting colonies in the State but has failed to recover from an intense fire in the early 1960s due to heavy stock effects.

Random burning to reduce suspected fire hazards but with total ignorance and/or disregard of ecological effects is often an annual practice particularly in rural shires where it may be encouraged by the local authorities. Although wetlands were undoubtedly adapted to periodic burning before European settlement the effect of regular burning as an additional pressure on ecosystems much reduced in area has not been assessed and may be deleterious. There is some evidence that too frequent burning of the Jarrah forest, for example, is assisting the spread of Jarrah dieback (Phytophthora cinnamomi) (Shea 1975).

The fire hazard is often overcome by simply clearing the indigenous vegetation, thereby eliminating the potential of a wetland to provide nesting sites and shelter for waterfowl.

Clearing in catchment areas may also affect wetlands by increasing the run-off into drainage channels. This results in both an increase in water salinity (Shea et al. 1975; Peck and Hurle 1973; Peck et al. 1973; Havel 1975) and altered flooding regimes (Tingay et al. 1977). Increased salinity may cause the death of freshwater vegetation and altered flooding regimes may severely affect the productivity of waterfowl populations. The former effects are readily apparent but identification of the latter often depends on intensive ecological studies of fauna.

In some areas the organic soils on the beds of wetlands are intensively used for the cultivation of vegetables, particularly potatoes (e.g. Benger swamp). Apart from drainage, these activities result in direct mechanical damage and also the introduction of insecticides, herbicides and fungicides in large quantities into the ecosystem. In addition, superphosphate is generally applied and quantities are inevitably carried into lentic wetlands where it stimulates the growth of aquatic plants and this may lead to eutrophication and/or algal blooms. Given the right conditions the latter may result in 'botulism' in waterfowl and odour problems. The problems of eutrophication and botulism are causing continuing concern in the southern metropolitan 'Cockburn' lakes (Bowman et al. op. cit.).

Large scale drainage is under the control of the Metropolitan Water Supply, Sewerage and Drainage Board (MWSSDB) within the metropolitan area and the Public Works Board beyond this area to

the south. North of the metropolitan area drains have been installed privately. As mentioned in the introduction to this Section, drainage both of lentic wetlands and major diversions of lotic wetlands is extensive on the Swan Coastal Plain and both authorities have documented this in map form (see Maps 25-43). It can be seen from these maps that very few wetlands particularly to the south of Perth are not affected either directly or indirectly by drainage. Actual named wetlands directly affected are listed on Table 18.

In general, the effects of drainage are to reduce seasonal water levels of lentic wetlands and to increase those of lotic wetlands although the reverse may occur particularly in the short term. In ecological terms the productivity of wetlands is dependent on an annual succession of water levels (often termed water regime or flooding patterns) and alteration of this succession will naturally cause changes to these ecosystems. These changes are almost totally undocumented but many must be deleterious (Tingay and Tingay 1976; Tingay et al. 1977). In the management of wetland reserves it may be difficult or undesirable to restore original water regimes and the controls offered by drainage, pressure gates etc., may be utilised as positive management tools. This is being done at Benger swamp and the Broadwater lake at Busselton through the co-operation of the Public Works and the Fisheries and Wildlife Departments and is planned for the 'Cockburn' lakes south of Perth.

Within the Darling Range agriculture is not as extensive as

it is on the Coastal Plain due to the extent of the State Forests but it does pose a particular localised threat to wetlands as clearing within catchment areas increases the salinity of streams, rivers and reservoirs (Peck et al. 1973). This problem is severe in the catchment area of the Wellington reservoir which supplies water to the principal dairy industry centres of the State and is increasing in the Mundaring Weir catchment area which supplies water to the Goldfields.

A report on the economic benefits derived from agricultural exploitation of wetlands within System 6 is currently being prepared by an officer of the Department of Agriculture (Malcolm 1976).

6.3 Effects of mining

Extractive industries that are affecting or potentially may affect wetlands within System 6 involve the mining of bauxite, coal, tin, heavy mineral sands, limestone, clay and peat. Effects may either be through direct disturbance or by pollution via surface run-off and leachates.

Bauxite mining leases held by Pacminex, Alcoa and Alwest cover most of System 6, particularly on the Darling Plateau (Figure 4, taken from CSIRO Report on the ecological effects of bauxite mining (1972); and Maps 44-45 in the map folio). Actual and proposed open-cut extraction sites are at Jarrahdale, Pinjarra and south of Boddington (Mt. Saddleback). Mt. Saddleback is adjacent to System 6 but mostly within System 4. The ecological

effects of the actual mining operation and the results of re-vegetation attempts are currently under study by the Mines Department, Forests Department and CSIRO Division of Land Resources Management (CSIRO Report 1972; Hewett 1975; Havel 1975d).

Pollution during processing of bauxite, particularly from the associated red mud lakes*, may also affect wetlands by contamination of shallow aquifers. The existing red mud lakes at Kwinana are leaking into the aquifer (Hansard 1976, p. 106). They are also positioned in line with the string of wetlands known as the Cockburn Lakes and are in themselves a considerable hazard to waterfowl, particularly in summer (213 strikes were recorded in the period, 1968-1974).

New red mud lakes are to be sited on the Large Eye and Small Eye swamps in the same area. These swamps will consequently be totally destroyed - a typical example of the low priority given to wetland resources. The proposed Pacminex alumina refinery is positioned on top of the Bassendean soil association, north of Perth, where, because of the porous nature of the sandy soils, pollution control will be more difficult and costly. There will be risk to the underground water supply to Perth (see Section 6.4) as well as to adjacent wetlands. These include Lake Chandala, the last major nesting colony of Straw-necked Ibis (Threskiornis spinicollis) in Western Australia (Tingay and Tingay 1976).

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* Large open pits about 1 km square, lined with clay, containing a highly concentrated caustic solution recycled in the separation of bauxite from the ore waste which precipitates to the bed of the pit.

Other large areas of the Darling Plateau lie within existing mining claims (Map 44), for stone near Toodyay, vanadium at Wundowie, coal at Collie and tin at Greenbushes. All of these industries involve open-cut mining as does or will the extraction of heavy mineral sands in the Capel and Waroona areas and limestone and sand north and south of Perth. The extraction of peat from organic deposits on the beds of lakes and swamps does not occur on a large scale in System 6 but deposits of diatomaceous earth are exploited.

Wetlands within existing and proposed mining areas and those which could be affected by the development of mineral resources are shown on a map in the Folio compiled and made available by the Geological Survey of Western Australia. Table 19 lists all named lentic wetlands within System 6 which have existing or expired mining claims within their boundaries collated from 40 chain lithos supplied by the Mines Department of W.A. and included with this report. It should be noted that the existence of a mining claim does not necessarily imply the existence of a resource that will be extracted or that will be worth extracting but claims may be taken, in the absence of other information, as indicators of the location of potential resources.

Actual mining on wetland reserves is proposed for Lake Gnangara subject to the satisfaction of conditions laid down by the Fisheries and Wildlife Department. However these conditions are aimed at maintaining the appearance and gross ecological

features of the lake rather than at ensuring that the lake's productivity is unaffected. No management plan is in existence and no baseline studies of the present productivity have been instigated.

6.4 Water supply and wetlands

The effects of water supply on other forms of land use in the South-west are well documented, principally in a recent article by Havel (1975d).

Water supply is the responsibility of the Metropolitan Water Supply, Sewerage and Drainage Board (MWSSDB) within the metropolitan area of Perth, and the Public Works Department (PWD) beyond this area. Demand for water has been met in the past by damming rivers within the Darling Plateau but more recently by extraction of groundwater from shallow aquifers underlying the Bassendean soil association north and south of Perth (Sadler 1975; Sadler and Field 1975).

The damming of a river drastically alters its ecology. Reservoirs are typically large deep bodies of water similar to true lakes and similarly are of low productivity (Bayly and Williams 1973, p. 217). Downstream water flows extending to estuaries are also affected, particularly in dry seasons. Havel (1975d) points out that "Although the area of land actually drowned by the dams is still only a small proportion (less than 1%) of the total forested area in the region, the impact is made serious by its selective nature. The vegetation types most

affected .... [details given] ... are restricted in occurrence to valleys ..." (p. 115). This problem is further aggravated by agricultural development in the more westerly sections of the river valleys. The effects on fauna are probably a reduction of habitat for birds, particularly passerines that prefer dense vegetation, but possibly a favourable habitat for the freshwater crayfish or Marron (Cherax teniumanus), the indigenous Catfish (Tandanus bostocki), the Oblong Turtle (Chelodina oblonga) and the introduced trout (Salmo trutta). Effects on recreation based on wetlands are also considerable as most activities are prohibited in catchment areas.

Details of existing and possible sites of dams together with catchment areas are shown on Maps 51 and 52 supplied by the PWD and MWSSDB. More detailed information of catchments is shown on Figure 5 taken from Havel (1975d). Table 20 (adapted from Table V, Havel) lists the lotic wetlands affected or likely to be affected. Further information on dam sites is available in Gordon (1965), Wyatt and Swarbrick (1965) and Wyatt and Swarbrick (1966).

The shallow unconfined aquifers underlying the Bassendean association north and south of Perth are known as the Gnangara and Jandakot mounds respectively. Their location is largely defined by the Gnangara and Jandakot Underground Water Pollution Control Zones shown on Maps 53 and 54 supplied by the MWSSDB, and the location of borefields are shown as collector main routes. The Mirrabooka and part of the Wanneroo fields are extant and,

at the time of writing of this report, were working at full capacity (West Australian, 3 August 1976). Other details of shallow groundwater resources are given in Morgan (1969) and Bestow (1971).

The effect of extraction of water from these bores is a general lowering of the water table over a wide area, "...within 100 metres of any production well the drawdown may be in excess of five metres, within 1 kilometre of any line of wells the drawdown may be as much as 3 metres and within 2 kilometres the drawdown may be as much as 2 metres. However, these estimates must be regarded as tentative and order of magnitude estimates only."*

As the lakes adjacent to the borefields are simply expressions of the shallow-aquifer the effects of extraction on lake levels and on vegetation may be considerable. Bestow (1971) comments, "The drastic lowering of the water table by abstraction will lessen the availability of groundwater to the present plant populations which in consequence, will be reduced." (p. 1). Aplin (1975) elaborates, "Variations of the water table level could ... cause a shift in the continuum from the moist phase to the xeric phase or vice-versa. The compound effects .... could include massive invasion of alien plant species, biological pollution of swamps and lakes and general degradation of the native vegetation." Havel (1975d) states that "... mature, large trees whose root systems generally have difficulty in adjusting to a new situation

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* Quote from a letter dated 18.11.75 to the Director of the Fisheries and Wildlife Department from an officer of the MWSSDB.

and taking up adequate water to meet transpirational demands of large crowns [are likely to be affected]. Around the lakes the likely effects would be replacement of Scirpus validus and Baumea articulata by Lepidosperma. On the seasonal swamps a corresponding change would be the replacement of the Leptospermum ellipticum-Regelia ciliata-Hypocalymna angustifolium type by the Adenanthos obovata-Dasypogon bromeliaefolius-Xanthorrea preissii type and the replacement of the latter type on the sites it previously occupied by the Leucopogon conostephioides-Scholtzia involucrata-Eremea pauciflora type. Similarly, it is probable that the drying lake margins in the Spearwood [our italics] Dune System would be invaded by trees occupying adjacent, seasonally-dry ground, especially Eucalyptus rudis and Melaleuca rhaphiophylla. In the former, seasonal swamps of the Bassendean Dune System, the low woodland of Banksia littoralis and Melaleuca preissiana would be displaced by a taller woodland of Banksia ilicifolia, Eucalyptus marginata and E. calophylla, which would lose the sites they previously occupied to Banksia attenuata, B. menziesii and Eucalyptus todtiana. Presumably the change-over in the sedge and shrub storey would be completed more rapidly than the corresponding change in the tree storey.

Such a view may, however, be too simplistic. A high groundwater table results, over a sufficiently long period, in a build up of organic matter in the topsoil, and this, as well as the direct effect of the groundwater table, accounts for the variation in the vegetation. A lowering of the water table will not automatically reduce the organic matter content of the soil. It may,

on the other hand, accelerate the removal of the organic matter by recurrent fires, which have been partially excluded from the swamps by the proximity of water to the surface." (pp.100-101). The Director of the Geological Survey has indicated that the effects on vegetation may not be so widespread although no substantive ecological evidence has been published to support this. "The assertion ... that the extent and location of the effect of MWB pumpage on vegetation is largely unpredictable but may be considerable, is also not a true statement of the situation. It is believed that drawdown effects will be widespread, but will only be large in the immediate vicinity of the borefields where there may be some effects on the vegetation and wetlands."*

The effect on fauna is likely to be more rapid and drastic (Havel 1975d) with "....a decline in the waterfowl populations, especially those species which are dependent upon freshwater areas for food." (Riggert 1975). The lakes likely to be affected are critical as summer drought refuges for waterfowl, being some of the few permanent freshwater lakes in the South-west.

In terms of management proposals to avoid these ill-effects, it has been suggested that lake levels could be maintained by pumping groundwater into them (Sadler 1975). However, the cost of such schemes has not been estimated and no guarantees have been given that they will be installed. Moreover it is not known whether the groundwater will fulfil the same ecological role and

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* Quote from letter to Director of Fisheries and Wildlife from the Director of the Geological Survey of W.A. dated July 1, 1976.

whether it will maintain the same levels of productivity. There is no baseline information available on productivity and even flora and fauna inventories are very scarce.

A more positive and satisfactory approach to the problem has been suggested by Williamson and Cole (1975), who point out that water resources can be extended (i.e. demand for water) if there is improvement in the efficiency of water use particularly in garden planning and management. This may be effected by publicity campaigns and pricing policies, both of which are environmentally long overdue.

In its submission to the CTRC on System 6 the Mines Department states "It may not be possible to preserve wetlands in some areas likely to be developed as water supply areas ... In pumped areas, widespread lowering of the water table can be expected, but it should be possible to arrange pumping layouts and extraction rates so that individual wetlands need not be unduly damaged or interfered with." (our emphasis). The uncertainty is continued by the MWSSDB: "At this stage it is difficult to predict with any certainty, or in any detail the likely effect of exploitation of the unconfined groundwater by the Yeal and Barragoon Groundwater Schemes on the water table. Aquifer simulation studies of this effect are under way, but are still at a preliminary stage."* The existing groundwater extraction schemes may therefore be

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* Quote from a letter from an officer of MWSSDB to the Director of Fisheries and Wildlife, 1975.

considered as large scale environmental experiments for which the ecological and even the hydrogeological outcomes are unknown.

Only recently has the MWSSDB sought ecological advice and monitoring of extraction effects from the Fisheries and Wildlife Department. It is apparent that a major co-ordinated research programme, probably beyond the present means of the Fisheries and Wildlife Department, is needed to obtain this information. The preparation of a full Environmental Impact Statement on this issue is needed and further development of the borefields should be postponed until this has been completed. "A major research effort is needed to determine the best solutions to the problems of optimum utilisation of groundwater resources of the Swan Coastal Plain." (Williamson and Cole 1975).

This situation has arisen as the objectives of government departments are narrowly defined and therefore their scope for co-ordinated management is limited. The EPA, through the Department of Conservation and Environment, could fulfil a significant role as a co-ordinator in land use management in this respect. The information readily supplied for this study by all departments approached indicates ready co-operation.

Wetlands likely to be affected by existing and proposed schemes are shown on Table 21. These include a large number of

the significant lentic wetlands of System 6 as well as a considerable number of unnamed swamps including those of Melaleuca Park (Havel, pers. comm.).

6.5 The effects of urban and industrial development

The greater percentage of the State's population lives within System 6 principally in the metropolitan area of Perth and the few secondary towns of Bunbury, Collie, Mandurah and Pinjarra. Continuing urban growth within these centres affects wetlands by direct urban development, industrial pollution, reclamation by rubbish dumping, insect control programmes and increased recreational demands. However, urbanisation may improve the management and human value of some wetlands currently neglected and abused.

Fortunately, growth is increasingly planned, and the Town Planning Authority (TPA) and Metropolitan Regional Planning Authority (MRPA) are becoming more aware of the conservation and aesthetic value of wetlands left in their natural state. An example of this is the West Murray Town Planning Scheme which covers the southern reaches of the Serpentine River including Goegrup Lake and the eastern side of Peel Inlet (Maps 55-60 in Folio). Specific wetland environmental policies included in this report are:

(1) Improved means of effluent disposal to minimise the pollution of waterways.

(2) The reservation of foreshores and of all lakes and sizeable swamps wherever practicable.

(3) The exclusion of residential and tourist development from the vicinity of fish breeding grounds and significant wildfowl habitats.

(4) The minimal use of chemical sprays in small holding areas.

(5) The retention of trees and natural bushland wherever possible.

(6) The landscaping of appropriate areas.

(7) Setbacks for development near natural waterways.

(8) The exclusion of extractive industry from the vicinity of waterways.

This area is also included in the large-scale preliminary planning study for the future development of the Peel-Harvey-Clifton-Preston-Leschenault complex of wetlands (Peel-Preston Study, Town Planning Department, 1976) which recognises their outstanding conservation value and seeks to consolidate and extend this, and has been the subject of a seminar held by the University of Western Australia Country Extension Service at Mandurah, April 1975.

Within the metropolitan area growth is being channeled into a series of 'corridors' stretching to the north-west, south-west, south-east and east of Perth. These all include wetlands and the north-west and south-west in particular include the important Wanneroo and Cockburn systems of lakes which are currently subject to other pressures of agriculture, water supply and mining. It has been suggested that the Cockburn lakes should be set aside as

a multipurpose reserve or National Park (Bowman et al. 1976) and it would be logical and desirable to develop a matching reserve around the Wanneroo lakes to the north of the city. Perth has few natural features of outstanding value apart from the Swan River complex, the above-mentioned lake systems and the coastline, and the latter has already been ecologically devastated (Meagher and Le Provost 1976b). It would be tragic if these lakes were to continue to be neglected and if they were to result in another Cockburn Sound.

Specific design concepts have been drawn up by the Town Planning Authority for Lakes Cooloongup and Walyungup (1971) south of Perth and Lake Joondalup (MRPA Report, June 1976) north of Perth which are zoned as regional open space. Follow-up hydro-geological and ecological studies of the former lakes have been completed or are in progress (Layton Groundwater Consultants Report, 1976) and the original design concept will be reviewed taking these reports into account. They should also be required for Lake Joondalup and any other developments affecting important wetlands.

The extent of industrial pollution of wetlands within System 6 is largely unknown apart from the monitoring and ecological studies of pollution in the Leschenault Inlet by Laporte Titanium (Aust.) Ltd. (Meagher and Le Provost 1975) and indications that discharge from adjacent wool-scouring works have contributed to the eutrophication of Lake Yangebup.* The high level of nutrients

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* Information on the quantities and nature of industrial liquid wastes disposed of in the Perth Metropolitan Region is available in The Metropolitan Refuse Disposal Planning Committee Report (1974).

in this lake may, however, play an important role in the supply of food during summer to certain species of waterfowl as continuing studies are indicating that it is a critical summer refuge (Viol, pers. comm.).

Sanitary landfill within the Perth metropolitan area has been well documented in The Metropolitan Refuse Disposal Planning Committee Report (1974) (see Table 22 adapted from that report) and non-metropolitan sites affecting wetlands are indicated on Table 13.

Strictly speaking these sites constitute rubbish dumps rather than sanitary land-fill as the latter requires compaction and baling which is seldom practised in W.A. These procedures not only maximise the amount of fill possible per unit area but also minimise the possibility of pollution by leachates and by wind dispersion. A Waste Disposal Authority as the above-mentioned report concludes, is required to co-ordinate waste disposal in the metropolitan area, to ensure maximum use of desirable non-wetland sites and to achieve the economies of scale required for efficient and environmentally suitable methods including recycling. The Department of Public Health current policy is to recommend against land-fill in wetland sites (Zehnder, pers. comm.).

6.6 Forestry and wetlands

The principal State Forests within System 6 occupy the Darling Plateau, an area of principally lotic wetlands with a few associated lentic wetlands, mainly shallow swamps.

Forestry activities are aimed at maintaining the ecology of lotic wetlands and moreover of minimising disturbance as far as is possible within their catchment areas which occupy most of the western portion of the Range. These procedures are adopted to minimise the spread of die-back disease which affects the principal hardwood species, Jarrah (Eucalyptus marginata) and to check salinity within streams and reserv irs due to excessive run-off and also represent recognition of the conservation and potential recreational value of these areas (Shea et al. 1975; Havel 1975d; Peck et al. op. cit.). Furthermore, most of the lentic wetlands within these State Forests are to be recommended for reservation as Forestry reserves in the Forests Department's submission on System 6 and future management will be aimed at their particular flora and fauna (Havel, pers. comm.).

Other State Forests occur between Mandurah and Bunbury and north of Perth in the Gnangara Underground Water Pollution Control Zone (cf. 6.4 above) (State Forest No. 65). Neither appear to present particular problems to wetlands although State Forest No. 65 is extensively developed for pine plantations. However pines do not grow well in waterlogged soils so wetland areas are not directly affected and although pines require phosphatic fertilizers (Hopkins 1960) they apparently utilize most of the dose applied thus minimizing run-off and the possibility of eutrophication in adjacent wetlands. However, the destruction of wetlands by extraction of groundwater in this area may make them suitable for pine plantations which the Forests Department may consider beneficial (Havel 1975, p. 105) but it is hardly

desirable from an ecological viewpoint. It also appears that pines require more water and allow less run-off than the native vegetation and this may affect the hydrology of adjacent wetlands (Havel 1968; Butcher and Havel 1975).

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BIBLIOGRAPHY

APLIN, T. E. H. 1975. Consequences of variations of the water table level on the vegetation and flora of the Swan Coastal Plain. Working Papers of the Symposium on the Groundwater Resources of the Swan Coastal Plain, Murdoch University.

BAYLY, I. A. E. and WILLIAMS, W. D. 1973. Inland Waters and their Ecology. Longman: Victoria.

BESTOW, T. T. 1971. The water balance in the North Gnangara area. Geol. Survey of W. A. Record No. 1970/21.

BETTENAY, E., McARTHUR, W. M., and HINGSTON, F. J. 1960. The Soil Associations of Part of the Swan Coastal Plain, Western Australia. CSIRO Soils & Land Use Series No. 35.

BOWMAN, M., CHAMBERS, M., DUNLOP, N., HART, L., HOGAN, T., LIEVENSE, D., MAISEY, K. 1976. The Cockburn Wetlands - An Environmental Study, Murdoch University.

BUTCHER, T. B. and HAVEL, J. J. 1975. Influence of moisture relationships on thinning practice. In: Proc. Regional Symposium of the International Union of Forest Research Organisations on Economics and Harvesting of Thinning, Canberra, A.C.T., in prep.

C.S.I.R.O. 1972. Ecological Effects of Bauxite Mining in the Darling Range of Western Australia, CSIRO, Canberra.

CONSERVATION THROUGH RESERVES COMMITTEE. 1974. Conservation Reserves in Western Australia. Report to the Environmental Protection Authority, Perth.

ENVIRONMENTAL RESOURCES OF AUSTRALIA. 1972. Waterfowl occurrence Kwinana Tailing Ponds, Perth. Unpublished report.

GOODALL, D. W. 1954. Objective methods for the classification of vegetation. III. An essay in the use of factor analysis. Aust. J. Bot., 2: 304-324.

GORDON, F. R. 1965. A Geological Comparison of the Wungong Brook Dam Sites. Geol. Survey of W.A. Record No. 1965/21.

HANSARD (Parliamentary Debates). 1976. Twenty-eighth Parliament, Third Session.

HAVEL, J. J. 1968. The Potential of the Northern Swan Coastal Plain for Pinus pinaster Ait. Plantations. Forests Dept. W.A. Bull. No. 76.

HAVEL, J. J. 1975a. Site Vegetation Mapping in the Northern Jarrah Forest. I. Definition of Site-vegetation Types. Forests Dept. W.A. Bull. No. 86.

HAVEL, J. J. 1975b. Site Vegetation Mapping in the Northern Jarrah Forest. II. Location and Mapping of Site-Vegetation Types. Forests Dept. W.A. Bull. No. 87.

HAVEL, J. J. 1975c. Site Vegetation Mapping in the Northern Jarrah Forest. III. Relationship of Site-Vegetation Types to Land Utilization. Forests Dept. W.A. Bull. in prep.

HAVEL, J. J. 1975d. The Effects of Water Supply for the City Perth, Western Australia, on other forms of Land Use. Landscape Planning 2: 75-132.

HEWETT, P. N. 1975. Mining in State Forest - A Situation Report, Autumn 1975. Forests Dept. of W.A. Research Paper No. 17.

HONEY, F. R. and HICK, P. T. 1976. Classification of the Wetlands of the South East Corridor. CSIRO Div. Land Res. Mgmt. Report, unpublished

HOPKINS, E. R. 1960. Variation in the Growth Rate and Quality of Pinus pinaster Ait. in Western Australia. Forests Dept. of W.A. Bull. No. 67.

LAYTON GROUNDWATER CONSULTANTS 1976. The Lakes Regional Open Space. Preliminary Report on Geological/Hydrological Study for Rockingham Shire Council, Perth.

MALCOLM, J. 1976. [A Report on the economic aspects of agriculture and wetlands]. Dept. of Agriculture: in prep.

McARTHUR, W. M. and BETTENAY, E. 1960. The development and distribution of soils on the Swan Coastal Plain. CSIRO Aust. Soil Publ. No. 16, Melbourne.

McARTHUR, W. M. and BETTENAY, E. 1975. The Swan Coastal Plain - Soils & Geography. Working Papers for the Symposium on Groundwater Resources of the Swan Coastal Plain, Murdoch University.

McARTHUR, W. M., BETTENAY, E., and HINGSTON, F. J. 1959. The soils and irrigation potential of the Pinjarra-Waroona area, Western Australia. CSIRO Aust. Soil Publ. No. 16, Melbourne.

McCOOMB, J. A. and McCOOMB, A. J. 1967. A preliminary account of the vegetation of Loch McNess, a swamp and fen formation in Western Australia. J. R. Soc. W.A. 50(4): 105-112.

MEAGHER, T. and LE PROVOST, I. 1975. Effluent and Ecology. A Study of the Coastal Environment at Bunbury. Report prepared for Laporte (Aust.) Pty. Ltd.

MEAGHER, T. and LE PROVOST, I. 1976a. The Ecology of the Canning River Wetlands. Report prepared for the Town of Canning.

MEAGHER, T. and LE PROVOST, I. 1976b. Eutrophication of Cockburn Sound. A Report prepared for W. D. Scott & Co., Perth.

METROPOLITAN REFUSE DISPOSAL PLANNING COMMITTEE 1974. A Report on Community Waste in Perth Metropolitan Region. Public Health Department, Western Australia.

METROPOLITAN REGION PLANNING AUTHORITY 1976. Lake Joondalup Design Concept, Perth, June 1976.

MORGAN, K. H. 1969. Hydrogeology of the Swan Coastal Plain, Kwinana-Pinjarra area. Geol. Survey of W.A. Record No. 1969/11.

MULCAHY, M. J., CHURCHWARD, H. M. and DIMMOCK, G. M. 1972. Landforms and Soils on an Uplifted Peneplain in the Darling Range, Western Australia. Aust. J. Soil Res. 10: 1-14.

PECK, A. J. and HURLE, D. H. 1973. Chloride balance of some farmed and forested catchments in South Western Australia. Water Resour. Res. 9(3): 648-657.

PECK, A. J., WILLIAMSON, D. R., BETTENAY, E., and DIMMOCK, G. M. 1973. Salt and water balances of some catchments in the south-west coast drainage division. Proc. Hydrol. Symp. Nat. Commonw. Hydrol. Inst. Eng. Aust., Perth, W.A., 1-4.

RIGGERT, T. L. 1966. Wetlands of Western Australia, 1964-66. Department of Fisheries and Fauna, Perth, W.A.

RIGGERT, T. L. 1975. Consequences of variations of the water table - wildlife. Working Papers for the Symposium on the Groundwater Resources of the Swan Coastal Plain, Murdoch University.

SADLER, B. S. 1975. Water resource and land use problems in Western Australia. U.S.-Australia Range Science Workshop - Watershed Management on Range and Forest Lands. Boise, Idaho.

SADLER, B. S. and FIELD, C. A. R. 1975. Population and Water needs - Water supply and alternate sources. Working Papers for the Symposium on the Groundwater Resources of the Swan Coastal Plain, Murdoch University

SEDDON, G. 1972. Sense of Place. University of W.A. Press, Nedlands, W.A.

SHEA, S. R. 1975. Preliminary Investigations of the Environment of the Northern Jarrah Forest in relation to pathogenicity and survival of Phytophthora cinnamomi. Forests Dept. W.A. Bull. No. 85.

SHEA, S. R., HATCH, A. B., HAVEL, J. J. and RITSON, P. 1975. The effect of changes in forest structure and composition on water quality and yield from the northern jarrah forest. In: Proc. Symp. on Managing Terrestrial Ecosystems, Brisbane. Ecol. Soc. Aust., 58-73.

SILVESTER, R. 1975. The Possibilities of Environmental Engineering. Seminar on the Peel-Preston Lakelands, Mandurah. University of W.A.

TINGAY, A. and TINGAY, S. R. 1976. Report on Lake Chandala with recommendations of its importance as a fauna reserve. Dept. Fisheries and Wildlife, Perth, W.A. Unpublished internal report.

TINGAY, A., TINGAY, S. R. and GOODSELL, J. 1977. Report of a management programme for Black Swans in South-western Australia. Emu (in prep.).

TOWN PLANNING DEPARTMENT 1971. Report on a Design Study for "The Lakes" Regional Open Space Rockingham, Perth, W.A.

TOWN PLANNING DEPARTMENT 1976. Peel-Preston Planning Study. Perth, W.A.

TOWN PLANNING DEPARTMENT 1976. West Murray Town Planning Scheme, Shire of Murray. Perth, W.A.

UNIVERSITY OF WESTERN AUSTRALIA COUNTRY EXTENSION SERVICE. 1975. The Peel-Preston Lakelands. Policy, Planning and Public Opinion. Seminar held at the Brighton Hotel, Mandurah, April 23 & 24.

USHER, M. B. 1973. Biological Management and Conservation. Ecological Theory, Application and Planning. Chapman & Hall: London.

WILLIAMSON, D. R. and COLE, K. 1975. Management of urban water needs in relation to groundwater resources. Working Papers for the Symposium on the Groundwater Resources of the Swan Coastal Plain, Murdoch University, W.A.

WYATT, J. D. and SWARBRICK, E. E. 1965. Engineering Geology of the South Dandalup Dam site - Preliminary investigations. Geol. Survey of W.A. Record No. 1965/22.

WYATT, J. D. and SWARBRICK, E. E. 1966. Geological investigation of the proposed Harvey Dam site. Geol. Survey of W.A. Record No. 1965/26.

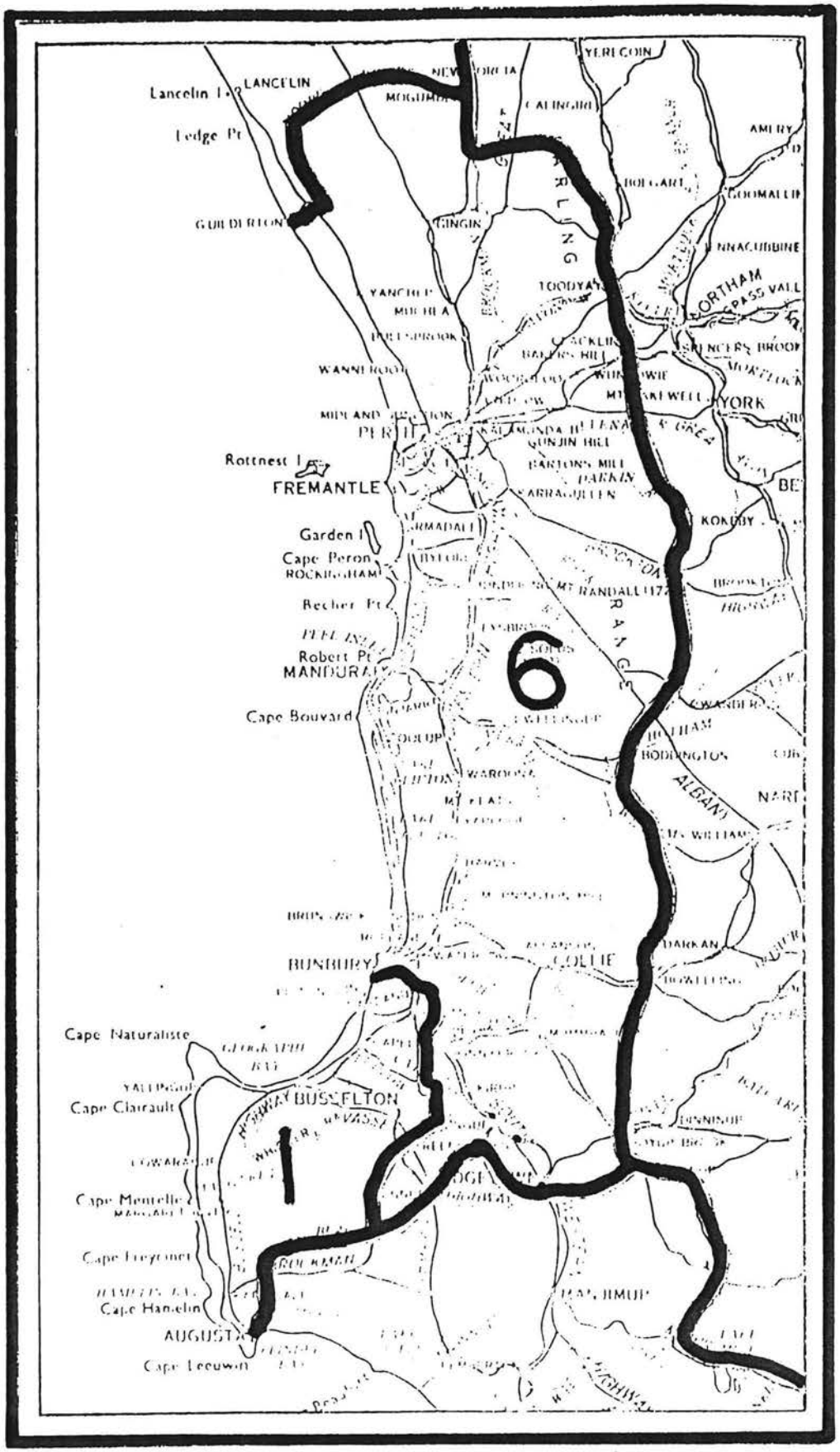

Fig. 1. Area map for System 6

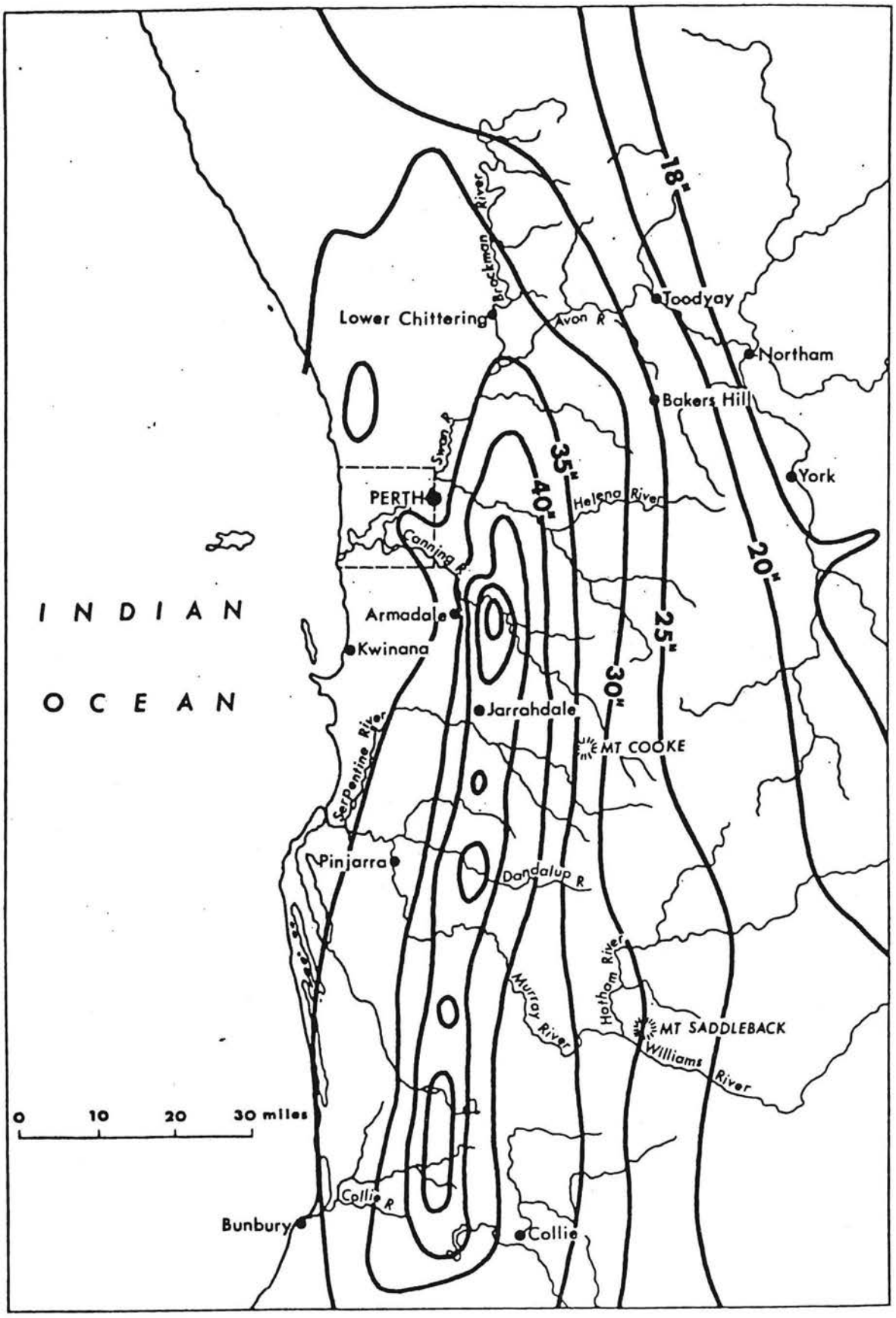

FIGURE 2 - Median annual rainfall in the Darling Range of Western Australia

Taken from CSIRO Report on the effects of Bauxite Mining in the Darling Range (1972).

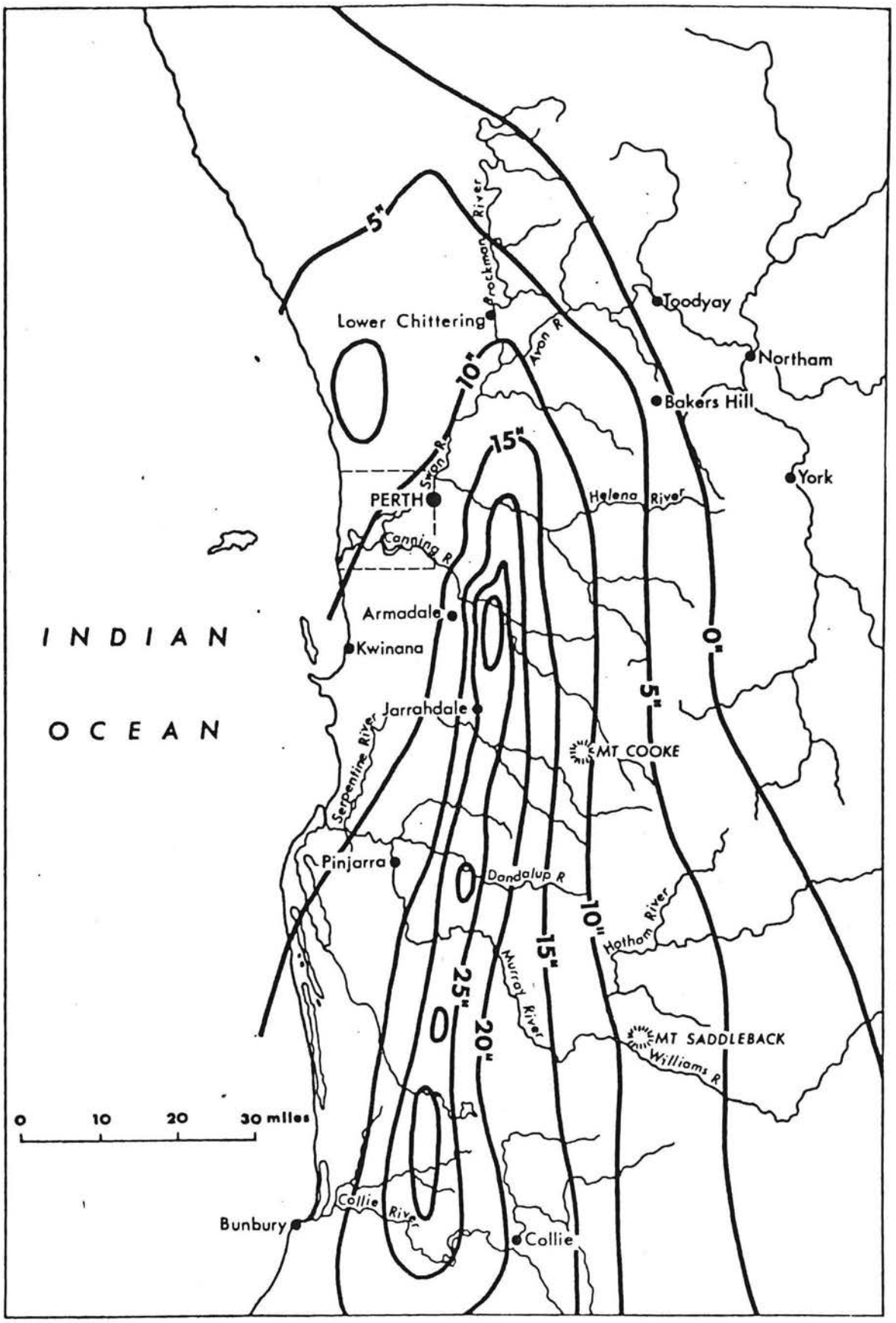

FIGURE 3 - Average Winter rainfall excess in the Darling Range of Western Australia

Taken from CSIRO Report on the effects of Bauxite Mining in the Darling Range (1972).

FIGURE 4: Proposed Wetland Classification Scheme for System 6

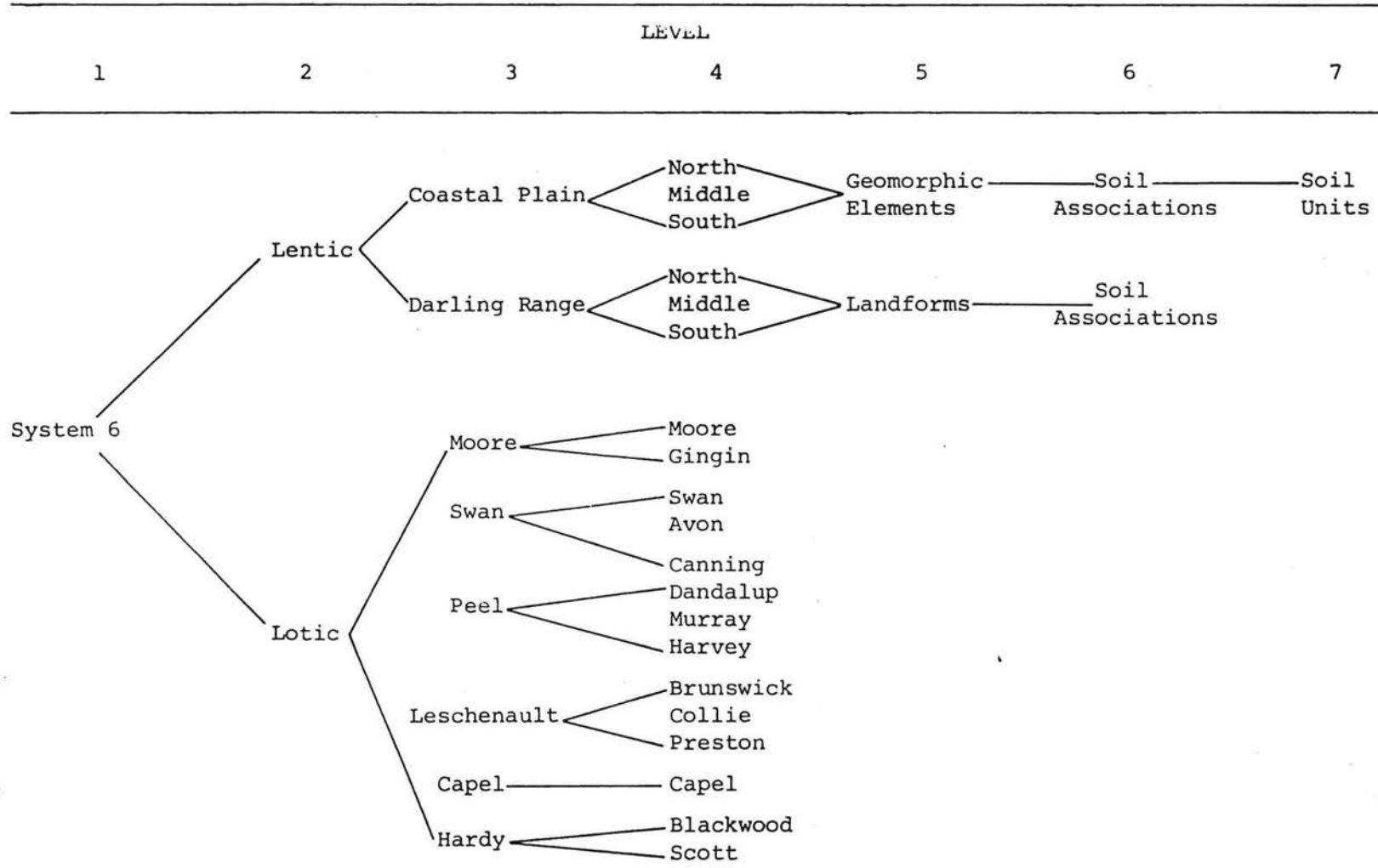

FIGURE 5

W.A. WETLANDS INVENTORY - SYSTEM 6

(Soils Wetland Classification Scheme)

1. LOCATION DATA:

   Name:

   Location:

   Maps:

   Status:

2. PHYSICAL DATA:

Area:	Mean depth:	Max. depth:
Volume:	Max. length:	Mean width:
Max. width:	Shoreline devpt:	Volume devpt:

3. GEOLOGICAL DATA:

   Soil types:

   Water source:

   Classification:

4. WATER DATA:

   Permanence:

   Water quality:

5. VEGETATION DATA:

   Vegetative cover (%):

   Vegetative formations:

6. HUMAN USE DATA:

7. SPECIAL FEATURES:

FIGURE 6

W.A. WETLANDS INVENTORY

LOTIC CLASSIFICATION SCHEME

SYSTEM:

Name:

Classification:

Maps:

Physical data: Length: Permanence:

Vol. : Water quality:

Vegetation:

Human Use: Reservoirs:

Reserves:

Freehold:

Other:

Recreation:

Associated wetlands:

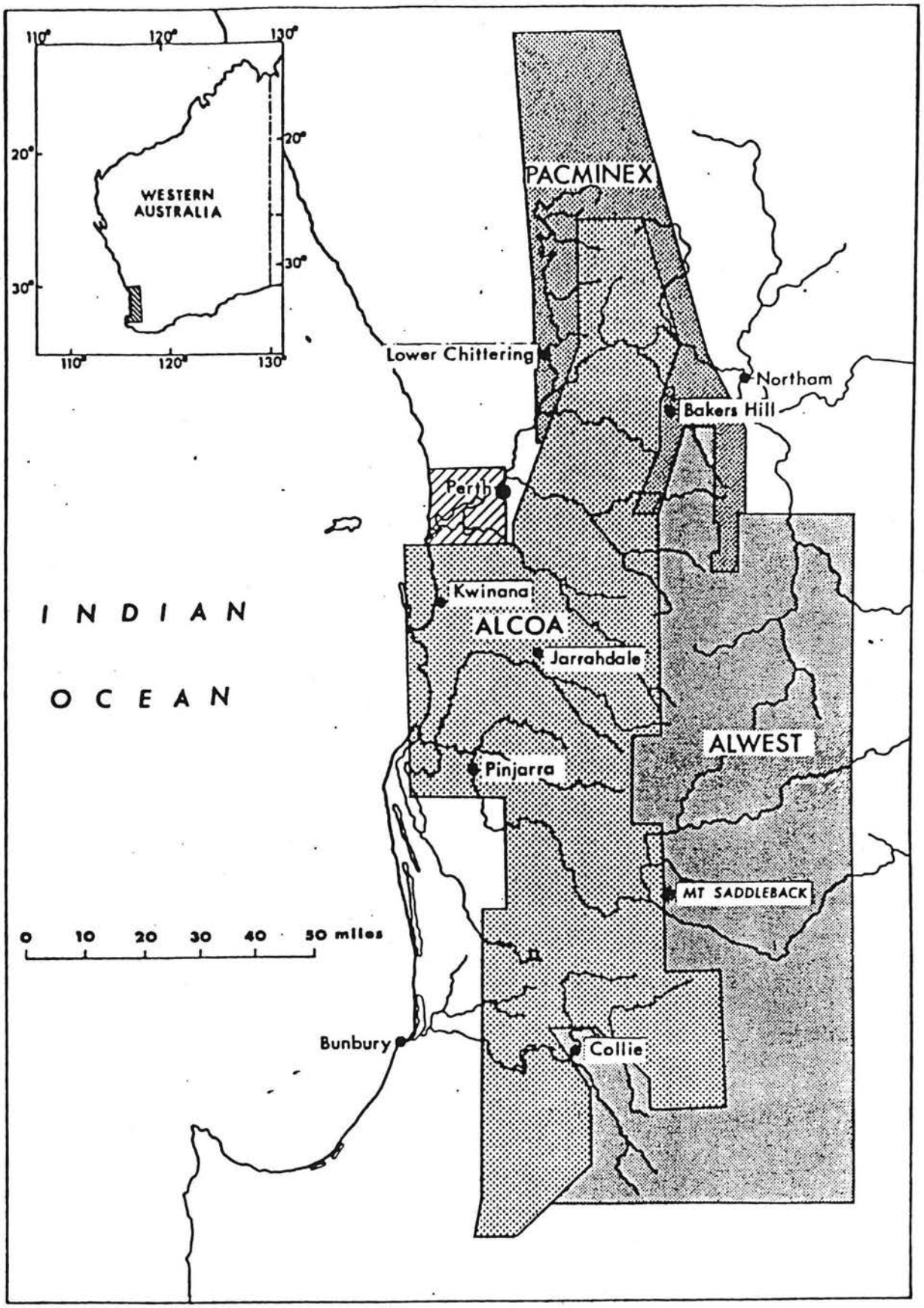

Figure 4. Bauxite Mining leases in System 6.
Taken from CSIRO Report on the Ecological effects of Bauxite mining in the Darling Range (1972).

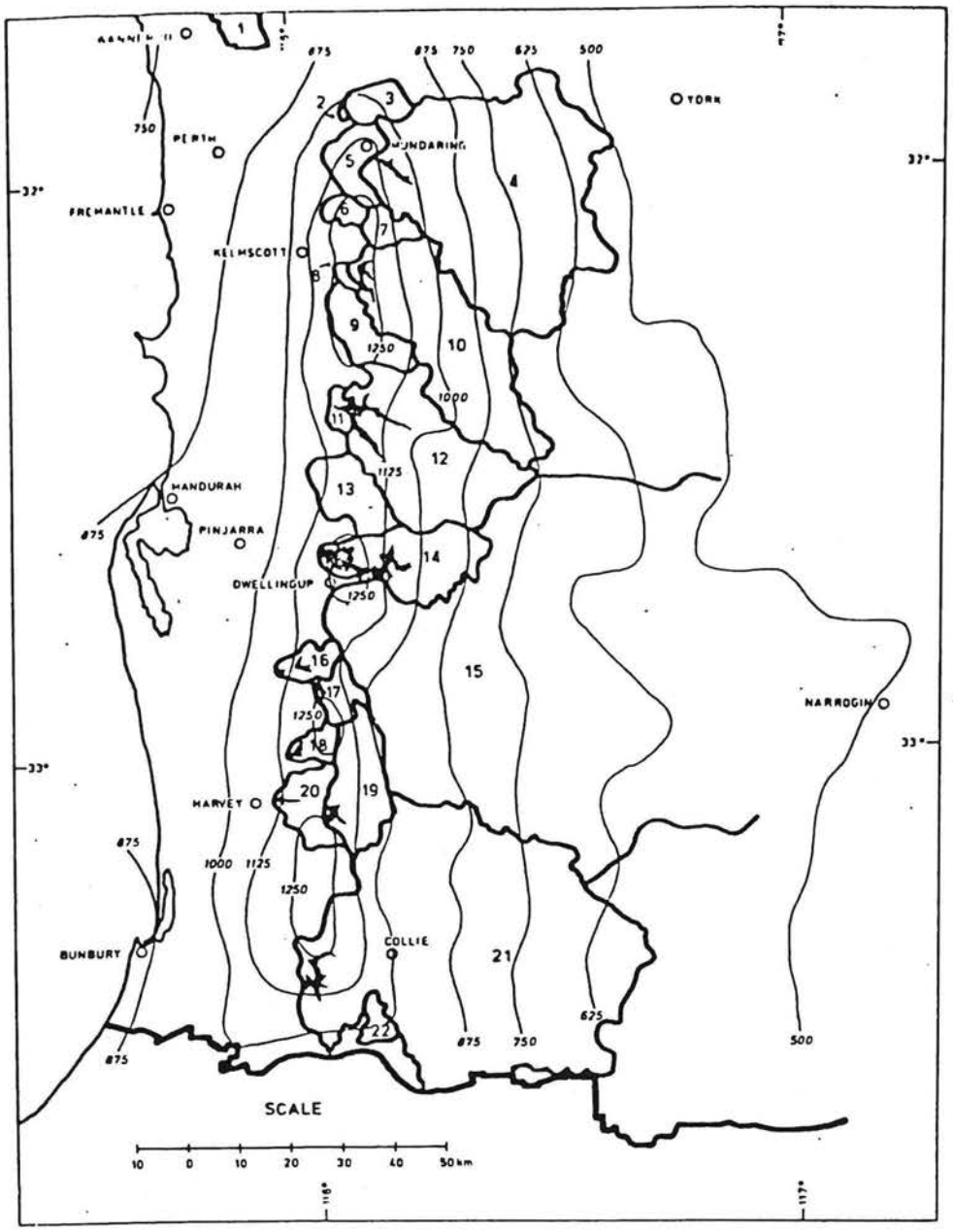

Figure 5. Location of catchments on the western margin of the Great Plateau in relation to average annual rainfall. (Catchments: 4 and 5: Helena River; 6: Victoria; 8: Churchmans Brook; 9: Wungong Brook; 10: Canning River; 11 and 12: Serpentine River; 13: North Dandalup; 14: South Dandalup River; 15: Murray River; 16-21: catchments supplying agricultural irrigation on the coastal plain south of Perth).

Taken from Havel (1975d).

TABLE 1: Limnological classification of wetlands

Division 1	2	3	4	5
(1) LENTIC	(1) LAKES (either open with a surface outlet or closed)	(1) Tectonic		
		(2) Volcanic	(1) Maars (eruption)	
			(2) Crater lakes	
			(3) Calderas (subsidence)	
			(4) Collapse of lava flows	
			(5) Volcanic damming)	
		(3) Landslide		
		(4) Glacial activity	(1) Kettle (melting ice blocks)	
			(2) Cirques (ice action)	
			(3) Morainic damming	
		(5) Solution		
		(6) Fluviatile	(1) Lateral	
			(2) Oxbow	
		(7) Wind action	(1) Dune	(1) Dune barrage
				(2) Inorganic bottoms
				(3) Organic bottoms
				(4) Water table
			(2) Deflation	
		(8) Coastline		
	(2) OTHER	(1) Underground		
		(2) Springs		
		(3) Terrestrial vegetation		
		(4) Puddles		
		(5) Rock pools		
		(6) Ponds	(1) Permanent	
			(2) Temporary	
(2) LOTIC	(1) Permanent			
	(2) Intermittent			
	(3) Episodic			

TABLE 2: Soil associations of the Swan coastal plain*

Geomorphic Element	Soil Association	Area (ac)	% of Total
Ridge Hill shelf	Forrestfield	56,200	3.5
Pinjarra plain	Guildford	224,700	14.0
	Abba	131,500	8.2
	Beermullah	15,300	1.0
	Dardanup	20,400	1.3
	Swan	42,100	2.6
	Cannington	38,300	2.4
	Serpentine River	54,900	3.4
Bassendean dune system	Southern River	130,300	8.1
	Bassendean	386,900	24.1
Spearwood dune system	Karrakatta	121,300	7.6
	Cottesloe	152,000	9.5
	Yoongarillup	11,500	0.7
Quindalup dune system	Quindalup	86,800	5.4
Miscellaneous	Herdsman	14,000	0.9
	Vasse	43,400	2.7
	Lakes, swamps, inlets, etc.	74,000	4.6
		1,603,600	100.0

* From Bettenay, E., McArthur, W. M., and Hingston, F. J. (1960).

TABLE 3: Scheme and Symbols for the classification of lentic wetlands by soils

Location	Geomorphic Element	Soil Association	Soil Unit
North (N)	Quindalup dune (Q)	Quindalup (Q)	Peat (Qrw)
Middle (M)	Spearwood dune (S)	Karrakatta (K)	Clay, silt, marl with shell beds (Qrg)
South (S)		Cottesloe (Ct)	Alluvium: clay, sand, loam (Qra)
	Bassendean dune (B)	Bassendean (B)	Fossiliferous limestone and unlithified shell beds (Qro)
		Southern River (SR)	
	Pinjarra Plain (PP)	Guildford (G)	
		Abba (A)	
		Beermullah (Bm)	
		Dardanup (D)	
		Swan (S)	
		Cannington (Ca)	
		Serpentine River (Sp)	
	Ridge Hill Shelf (RH)	Forrestfield (F)	
	Quindalup-Spearwood* (Q/S)	Quindalup-Cottesloe (Q/Ct)	
	Quindalup-Bassendean (Q/B)	Quindalup-Southern River (Q/SR)	
	Spearwood-Bassendean (S/B)	Karrakatta-Bassendean (K/B)	

* Three examples of overlap systems are given to show symbolic notation. Many such overlaps of the basic elements and associations exist.

TABLE 4: Selected examples of wetlands classified by soil type

Wetland	Area	Geomorphic Element	Soil Association	Soil Unit	Code
Loch McNess	North	Spearwood	Cottesloe	Peat	N-S-Ct-Qrw
Lake Jandabup	North	Spearwood-Bassendean	Karrakatta-Bassendean	Peat	N-S/B-K/B-Qrw
Yangebup Lake	Middle	Spearwood-Bassendean	Karrakatta-Bassendean	Peat	M-S/B-K/B-Qrw
Cooloongup Lake	Middle	Quindalup-Spearwood	Quindalup-Cottesloe	Clay, silt, marl with shell beds	M-Q/S-Q/Ct-Qrg
Jandakot Lake	Middle	Bassendean	Southern River	Peat	M-B-SR-Qrw
Lake Preston	South	Quindalup-Spearwood	Quindalup-Cottesloe	Clay, silt, marl	S-Q/S-Q/Ct-Qrg
Benger Swamp	South	Pinjarra Plain	Cannington-Serpentine River	Peat	S-PP-Ca/Sp-Qrw

TABLE 5: The occurrence of wetlands and land use of soil associations*

Soil Association	Soil Series	Great Soil Group	Wetlands	Land Use
Forrestfield	Gwindinup	Podzol	Lotic† only	Pasture
	Isandra	Yellow podzolic		Pasture
	Lotons	Residual laterite		Pasture and vines
Guildford	Bellevue	Yellow podzolic		Brick-making
	Boyanup	Yellow podzolic		Brick-making
	Coolup	Meadow podzolic		almost
	Crooked Brook	Meadow podzolic	numerous small seasonal swamps) Lotic	totally
	Cruse	Meadow podzolic		cleared
	Farrbridge	Meadow podzolic		for pasture;
	Herne	Meadow podzolic		some
	Maylields	Lateritic podzolic		irrigated
	Oakley	Podzol		
	Sheron	Meadow podzolic		
Abba	Abba	Meadow podzolic	numerous small seasonal swamps) Lotic	Grazing of annual grass
	Busselton	Meadow podzolic		
	Trigwell	Lateritic podzolic		and clover pastures
Dardanup	Dardanup	Undifferentiated alluvium	lotic only	Irrigated pastures, beans, peas, potatoes and other green vegetables
	Harvey	Undifferentiated alluvium		
Beermullah	-	Sandy and solonetzic soils	small saline wetlands and lotic wetlands	low agricultural value, some pasture
Swan	Andrew	Brown podzolic	Lotic	Intensive agriculture, citrus crops, apples, pears, vegetables
	Belhus	Red podzolic		
	Blythewood	Red podzolic		
	Pyrton	Undifferentiated alluvium		
	River 1	Undifferentiated alluvium		
	Swan	Red podzolic		
	Marybrook	Red podzolic		
Cannington	Greenlands	Grey and brown soils of heavy texture	Lotic	Agricultural lime, pasture
Serpentine River	Benger	Grey and brown soils of heavy texture	Numerous seasonal swamps, some large) Lotic e.g. Benger	Vegetables (particularly potatoes), increasing use as pasture as drainage is extended
	Cokelup	" "		
	Manjerstein	" "		
	Turkey Flat	" "		
	Wellesley	" "		
Southern River	Gavin	Humus podzol	Numerous sandy and clayey swamp flats) Lotic	Peat and associated agriculture, otherwise sporadic agriculture due to diverse nature of soils
	Muchea	Humus podzol		
	Swamp 2	-		
Bassendean	Gavin	Humus podzol	Sandy swamps	Light clearing, semi-improved pasture, sand, mineral sands, diatomaceous earth, pine plantations, natural forests
	Muchea	Humus podzol		
	Jandakot	Iron organic podzol		
	Joel	Groundwater podzol		
	Ludlow	Podzol		
Karrakatta	Karrakatta	Podzol	Swamps often permanent particularly at overlap with Bassendean association + Lotic	Largely uncleared; pine plantations; tuart and jarrah forestry; some grazing; vines and vegetables
	Wonnerup	Podzol		
Cottesloe	Spearwood	Podzol	Some lakes and swamps + Lotic	Market gardening with heavy fertilization; quarries, some pastures
Quindalup	Quindalup	Undifferentiated sand	Separated from Spearwood Dune System by inlets, estuaries and swamps	Low agricultural value, mineral sands
Herdsman	Herdsman	Peat	Swamp soils within the Karrakatta, Cottesloe and Bassendean associations	Summer production of vegetables and pasture
	Bjookenbooroo	Peat		
	Joondanna	Peat		
Vasse	Stirling	Undifferentiated alluvium	Very wet areas in winter associated with estuaries and relatively saline wetlands	Some pasture

* Adapted from Table 2 of McArthur, Bettenay and Kingston (1960)

† Lotic denotes rivers & streams pass thru association

TABLE 6: Landforms, soils and associated wetlands of the Darling Range[1]

Landform	Soil Association	Nature	Wetlands[2]
Uplands & Divides (UD)	Laterite-mantled upland (L)	Lateric gravels and pavements on slopes and summits	Principally lotic
	Goonapping Valley Unit (G)	Grey and yellow sands, ferruginous gravels and duricrust	Principally lotic; some lentic e.g. Manaring Lake
Westward Drainage System (WDS)	Beraking Surface (B)	Sands over mottled dense clays	Flat-floored valleys and swamps
	Nockine Surface (N)	Colluvial sands and gravels over mottled clays	Principally lotic
	Darkin Surface (D)	Yellowish and reddish colluvial deposits	Principally lotic
	Helena Surface (H)	Podzolic soils over fresh rock	Principally lotic
Eastward Drainage System (EDS)	Dissected lateritic slope (DS)	Complex of geomorphic elements on slopes	Principally lotic
	Mortlock Surface (M)	Laterized valley floor deposits	Both lentic (swamps) and lotic wetlands
	Rocky slopes (R)	Podzolic soils over fresh rock upslope; colluvial aprons below	Principally lotic
	Avon surface (A)	Relatively fresh alluvial soils	Principally lotic, some swamps

1. Adapted from Mulcahy, Churchward and Dimmock (1972)

2. Many of these wetlands, particularly lentic environments, are seasonal

TABLE 7: Proposed lotic classification scheme (LCS) for System 6

Drainage complex	First order rivers	Associated wetlands	Second order rivers	Associated wetlands	etc.
1. Moore (M)	Moore (m) Gingin (g)				
2. Swan (S)	Swan (s) Avon (a) Canning (c)				
3. Peel (P)	Serpentine (se) Dandalup (d) Murray (mu) Harvey (h)				
4. Leschenault (L)	Brunswick (b) Collie (co) Preston (p)				
5. Capel (C)	Capel (ca)				
6. Hardy (H)*	Blackwood (bl) Scott (sc)				

* The Blackwood complex extends into Systems 1 and 2 as well as System 6 and the Scott complex is totally within System 2. Several other river complexes extend into other Systems than 6.

TABLE 8: Microclassification of Wetlands (South-East Corridor)[1]

Soil Association	Type	Features	Land Use
Southern River (SR)[2]	Jandakot (J)	Low-lying flats subject to periodic inundation due to raised water levels. Highly organic soils. Vegetation of dense sedges, melaleucas and hakeas with periphery of larger melaleucas, banksia and flooded gum.	Urban development often leading to drainage and landscaping. Sanitary landfill etc. for provision of sports fields. Environmental impact of land use: catastrophic, water, soil and vegetation status completely changed.
	Punrack (P)	Similar to Jandakot but with clay basements. Suspected higher salinity than J.	Drainage for agriculture. Potential for urban development. Alteration of hydrology may affect salinity.
	Nicholson (N)	Permanent swamps. Usually occurs within Jandakot. Vegetation sedges and rushes including typha with melaleucas. High individual variation in water quality and quantity.	Optimum waterfowl habitats. Urban development and agriculture which may lead to entrophication.
	Westfield (W)	Alluvial arising from Wungong and Serpentine Rivers meeting dune systems. Great variability.	-
Pinjarra Plain (PP)	-	Natural water relationships completely altered by drainage. Much of Guildford, Beermullah & Serpentine associations were wetlands prior to drainage.	Agriculture
Ridge Hill Shelf (RH)	1	Great variability necessitates individual description of wetlands, examples: Shallow, saline, seasonally wet with grey mottled clay floor.	
	2	Artificially drained lake, sandy surface.	Agriculture
	3	Similar to Nicholson but sand surface has different origins.	

[1] Suggested by Honey, F. R. and Hick, P. T. (1976). Classification of the wetlands of the South-east Corridor. CSIRO Div. Land Res. Mgmt. Ecosystem Assessment Group.

[2] Lake Forrestdale which occurs in the Southern River System is described separately as it is the only large, relatively deep lake within the study area.

TABLE 9: Wetlands classification of United States Fish & Wildlife Service (1953)[1]

Wetland category		Type	Water Depth
Inland Fresh Areas	1.	Seasonally flooded basins or flats	Few inches in upland; few feet along rivers
	1A.	Flooded agricultural land	Few inches in upland; few feet along rivers
	2.	Inland fresh meadows	Few inches after heavy rains
	3.	Inland shallow fresh marshes	Up to 6 inches
	4.	Inland deep fresh marshes	Up to 3 feet
	5.	Inland open fresh water	Up to 10 feet; marshy border may be present
	5P.	Permanent Open Water (Reservoirs)	Up to 10 feet
	6.	Shrub swamps	Up to 6 inches
	7.	Wooded	Up to 1 foot
	8.	Bogs	Shallow ponds may be present
Inland Saline Areas	9.	Inland saline flats	Few inches after heavy rain
	10.	Inland saline marshes	Up to 2 feet
	11.	Inland open saline water	Up to 10 feet; marshy border
Coastal Fresh Areas	12.	Coastal shallow fresh marshes	Up to 6 inches at high tide
	13.	Coastal deep fresh marshes	Up to 3 feet at high tide
	14.	Coastal open fresh water	Up to 10 feet; marshy border often present
Coastal Saline Areas	15.	Coastal salt flats	May have few inches at high tide
	16.	Coastal salt meadows	May have few inches at high tide
	17.	Irregularly flooded salt marshes	Few inches at wind tide
	18.	Regularly flooded salt marshes	Up to 1 foot at high tide
	19.	Sounds and bays	Up to 10 feet at high tide
	20.	Mangrove swamps	Up to 2 feet

[1] Adapted from Riggert, T. L. (1966). A Study of the Wetlands of the Swan Coastal Plain. Dept. of Fisheries and Fauna, Western Australia.

TABLE 10: Classification of wetlands of the Swan Coastal Plain (Riggert 1966)[1]

Category	Type[2]	Zone	Drainage	Area (1966) (km^2)	No. of wetlands	Average area (km^2)
Inland Fresh	1	A	*[3]	45.8	296	0.154
		B	*	45.3	187	0.242
		C	*	4.6	73	0.063
	1-A	A	-	38.07	27	1.410
		B	-	60.29	12	5.025
		C	-	51.32	14	3.666
	2	A	*	11.65	42	0.277
		B	*	14.08	1	-
		C	*	0.11	1	-
	3	A	*	10.02	119	0.084
		B	*	12.48	139	0.090
		C	*	5.94	8	0.742
	4	A	*	5.14	34	0.151
		B	*	8.71	6	1.452
		C	*	0.08	1	-
	5	A	*	13.07	7	1.867
		B	*	10.74	5	2.148
	5-P	A	-	12.85	4	3.212
		B	-	12.69	3	4.233
		C	-	20.06	2	10.03
Inland Saline	11	B	*	42.71	9	4.745
Coastal Fresh	12	A	*	13.31	8	1.664
	13	A	*	3.44	7	0.491
		B	*	3.32	13	0.255
	14	A	*	5.50	2	2.752
Coastal Saline	15	C	*	0.32	1	0.324
	18	C	*	2.48	1	2.485
	19	A	-	36.15	2	18.073
		B	-	127.46	2	63.731
		C	-	27.89	4	6.972

1 Adapted from Tables 2-9 of Riggert (1966)

2 For Types see Table 8

3 * indicates drainable wetlands

- indicates non-drainable wetlands

TABLE 11 (cont'd)

Division[1]					Name
1	2	3	4	5	
		Ct	Qrg	M	Munster Lake
				S	Boundary Lake Lake Clifton* Duck Pond Kooallup Lagoon Martin Tank Lake*
			Qrw	N	Beonaddy Swamp Carabooda Lake Coogee Swamp Loch McNess* Mindarie Lake Neerabup Lake Nowergup Lake* Wilgarup Lake* Yonderup Lake*
				M	Long Swamp
				S	Mealup Lake*
		K/Ct	Qrw	N	Claremont Lake Joondalup Lake*
	S/B	K/B	Qrw	N	Jandabup Lake* Lake Pinjar*
				M	Bibra Lake* Bollard Bullrush Swamp Goegrup Lake* Kogolup Lake Mandogalup Swamp North Lake Thompson Lake* Yangebup Lake
				S	Mialla Swamp Myalup Swamp
	B	B	Qrw	N	Lake Adams Badgebup Lake Bindiar Lake* Bulrush Lake Caladenia Lake Coogee Lake Culcadarra Lake Deep Water Lagoon Emu Swamp

TABLE 11 (cont'd)

Division[1]					Name
1	2	3	4	5	
	B	B	Qrw	N	Gnangara Lake
					Harris Swamp*
					Horse Swamp
					Little Coogee Flat*
					Little Dundarbar Swamp
					Mission Lake
					Lake Muckenburra*
					Snake Swamp
					Yeal Swamp*
					Yeerealup Lake
				M	Balmannup Lake
					Banjup Lake
					Bannister Swamp
					Big Bullrush Swamp
					Booragoon Swamp
					Crargs Lake
					Jim Pool
					Magenup Lake
					Magenup Bullrush Swamp
					The Pools
					Yangedi Swamp
		SR	Qrw	M	Balmannup Lake
					Lake Jandakot*
	B/PP	B	Qrw	N	Bambun Lake*
					Lake Mungala*
					Lake Nambun*
		G	Qrw	N	Bootine Spring
		B/G	Qrw	N	Boonalarup Lake
					Bootine Swamp
					Catambro Lake
					Chandala Lake
					Little Bootine Swamp
					Wallering Swamp*
				M	Kelmscott Lake
	PP	G	Qrw	N	Beedamanup Swamp
					Coondaree Swamp
					Yanga Swamp
				M	Duck Pool
		Ca	Qrw	S	Nine Mile Lake*

TABLE 11 (cont'd)

Division[1]					Name
1	2	3	4	5	
		Bm	Qrw	N	Twin Swamp
		Ca/Sp	Qrw	S	Benger Swamp*
†				N	Bidaminna Lake
†					Burringarrah Swamp
†					Nine Mile Swamp
†					Salt Lake
†					Six Mile Swamp*
†					Spade Lake
†					White Lake
†					Yurine Swamp*
DR				N	Beermullah Lake
					Black Swamp
					Chittering Lake*
	UD	G			Darkin Swamp
					Lake Leschenaultia*
	UD	G			Little Darkin Swamp
	UD	G			Manaring Lake
					Mundlunun Swamp*
					Nangar Lake*
					Needoonga Lake*
					Wannamal Lake
	UD	G		M	Browns Swamp
	UD	G			Dababerry Swamp
	UD	G			Goonapping Swamp
					Wild Pig Swamp
				S	Big Carnelup Swamp
					Bulrush Swamp
					Little Carnelup Swamp
					Long Swamp
					Nalyerin Lake*
					Nundenine Lake
					Small Lake
					Yourdamung Lake*

1
Division 1 : CP (Coastal Plain); DR (Darling Range)

2 : Geomorphic Element
Q (Quindalup), Q/S (Quindalup/Spearwood), Q/B (Quindalup/Bassendean), S (Spearwood), S/B (Spearwood/Bassendean), B (Bassendean), B/PP (Bassendean/Pinjarra Plain), PP (Pinjarra Plain), UD (Uplands & Divides).

3 : Soil Association
Q (Quindalup), Q/Ct (Quindalup/Cottesloe), Q/SR (Quindalup/Southern River), K (Karrakatta), Ct (Cottesloe), K/Ct (Karrakatta/Cottesloe), K/B (Karrakatta/Bassendean), B (Bassendean), SR (Southern River), G (Guildford), B/G (Bassendean/Guildford), Ca (Cannington), Bm (Beermullah), Ca/Sp (Cannington/Serpentine River), G (Goonapping).

TABLE 11 (cont'd)

4 : Soil Unit
- Qro - fossiliferous limestone
- Qrg - alluvium: clay, sand, loam
- Qrw - peat

5 : Location
- N (North - north of Swan River)
- M (Middle - from Swan River south to Murray-Dandalup system)
- S (South - south of Murray-Dandalup system)

* Reserve

† Soils information is not available for these wetlands which are located in the most northerly section of System 6 - Coastal Plain.

TABLE 12: Lotic wetlands inventory of System 6

Drainage complex	First-order rivers	Associated wetlands	Second-order rivers	Associated wetlands	Third-order rivers	Associated wetlands	Fourth-order rivers	Associated wetlands	Fifth-order rivers	Associated wetlands
Moore	Moore R. *	Bewulgurru Pool Cowalia Pool Kowigin Pool Mandigan Pool Noonee Pool Round Pool Walbaroo Pool Yucangully Pl.	Breaks Bk. Karakin Bk.							
	Gingin Bk*		Towra Brook Mungala Brook Wallering Bk. Boonanarring Bk* Whitfield Bk. Lennard Brook*		Red Gully Ck*					
Swan	Swan R.	Walyunga Pl	Brockman R.*	Gayamin Pl. Chittering L. Yalawarra Pl. Neil Spring Joontagit Sp. Moenjoro Sp. Bulrush Sp. Sandalwood Pl. Chidlow Pl. Cartabin Pl. Beermullah Pl. Cullalla Pl. Wattle Flat waterhole Eatha Sp.	Spice Brook Udumung Bk.* Longbridge Gully*	Udumung Pl.	Munyerring Bk.		Biggs Bk.	
			Ellen Bk.	Garbora Pl. Chandala Sp.	Yabyal Bk. Nambab Bk. Monger Bk. Rocky Gully Breera Bk. Nullilla Bk. Sawpit Gully Dicky Jones Gy.		Marala Ck.			
			Jane Bk*	Mongin Sp.	Mahogany Ck.					
			Helena R.	Helena Res. Yetar Sp. Wallating Ebenezer Flats	Helena Bk. Darkin R. Wundabinining Bk. Emu Bk. Wariin Bk.* Smiths Mill Bk Piesse Gy. Little Darkin R. Pickering Bk.	Darkin Swp Little Darkin Swp Wariin Wl	Middle Bk. Beraking Bk.			
			Woorooloo Bk.	Weilling Pl.	Cookes Bk. Chinganning Gy.* Rocky Bk. Equitus Gy.	L. Leschenaultia Chinganning Well				
			Poison Gy.							
			Bennett Bk.							
			Susannah Bk.	Roland Sp.						
	Avon R.	Cobbler Pl. Goonabbin Sp.	Red Swamp Bk. Julimar Bk. Malkup Bk. Jumperding Bk.	McKnow Sp. Nerramenging Sp. Warrajenny Wl. Gabidine Sp.* Bandaling Sp. Kidderginuyding Sp. Chauncey Sp.	Jingaling Bk. Jim Crow Gy. Red Swamp Gy.	Belaring Sp. (FF)* Goonaring Sp. (FF)*				
			Encampment Gy.							

Drainage complex	First-order rivers	Associated wetlands	Second-order rivers	Associated wetlands	Third-order rivers	Associated wetlands	Fourth-order rivers	Associated wetlands	Fifth-order rivers	Associa wetlan
			Munappin Bk.							
			Mortigup Bk.							
			Toodyay Bk.		Yulgan Bk.	Yulgan Sp.	Solomon Bk.			
					Anvil Gy.*					
			Phillips Bk.*	Dewar Pl.						
			Dale R.		Gibbs Gy.					
					Kettlerock Gy.					
					Flint Gy.					
					Conolly Gy.					
	Canning R.	Canning Res.	Churchman Bk.	Churchman D.						
		Turtle Pl.	Bickley Bk.	Victoria Res.	Munday Bk.*					
		Yaganing W.	Wungong R.							
			Stony Bk.							
			Slab Gy.							
			Stinton Ck.							
			Kangaroo Gy.							
			Turtle Bk.							
			Death Adder Ck.							
			Poison Gy.							
			Bull Ck.							
			Woodlupine Ck.		Whistlepipe Gully					
			Yule Bk.		Jerrbinyan Gully	Lesmurdie Falls				
Peel*	Serpentine River	Serpentine Dam	Big Bk.		O'Neill Bk.					
		Goegrup L.*	Karnet Bk.*							
		Yalbanberup Pool	Dirk Bk.							
		Guarnanup Pool	Myalla Bk.							
		Kerulup Pl.	Nambeelup Bk.							
		Folly Pl.	Snake Bk.							
		Maramanup Pool	Goordalong Bk.*							
		Bollard Bulrush Swamp	Bull Brook							
		Balmoral Well	Lucy Bk.							
		Coogly Sp.	Honor Bk.							
			Medulla Bk.		Korrininjal Bk.					
			Manjedah Bk.*		Gingagup Bk.					
			Cardup Bk.							
	Dandalup		North Dandalup R.*	Wandarrah Sp.	Kronin Bk.					
					Wilson Bk.	Wild Pig Swp.				
					Foster Bk.					
					Dillon Bk.					
					Finlay Bk.					
			South Dandalup R.	Kennedy Pl.	Little Dandalup R.					
	Murray R.*	Rushy Sp.	Oakley Bk.							
		Baden Powell Water Spt.	Swamp Oak Bk.							
			Marinup Bk.							
			Long Gully							
			Yarragil Bk.							
			Big Bk.*							
			Howse Bk.							
			Tumlo Bk.							
			Logue Bk.	Logue Bk.Res.						
			Kangaroo Bk.							
			Almanac Bk.							
			Nanga Bk.							
			Hotham R.*	Boddington Soak	Wattle Hollow Bk.					
					34 mile Brook					
					Devil's Den Ck.					
				Cambilling Waterhole						
			Williams R.*	Quindanning Pool	Old Stockyard Brook					
				(Pollard Sp.	Warrenbing Gy.					
			Bell Brook	(Nalyerin L.	Quenam Spring Gully					
			Chark Bk.							

TABLE 12 (cont'd)

Drainage complex	First-order rivers	Associated wetlands	Second-order rivers	Associated wetlands	Third-order rivers	Associated wetlands	Fourth-order rivers	Associated wetlands	Fifth-order rivers	Associated wetlands
	Harvey R.	Harvey Weir*	Drakes Bk.	Drakes Brook Reservoir						
		Stirling Dam*	Samson Bk.		McNoe Bk.					
		Harvey Est.*	Yalup Bk.							
		Nerigardup Sp.	Weekes Bk.							
		Warrangup Sp.	Bancell Bk.							
		Willie Pool	Clarke Bk.							
			Falls Bk.							
			Summer Bk.							
Leschen-ault*	Brunswick R.		Wellesley R.*		Mornington R.	Benger Swp.*	Norah Bk.			
			Eleura Gully		Kojajanup R.					
			Lunenburgh R.		Sophia River					
					Matilda R.					
					Otho River					
			Frederic R.							
			Augustus R.							
			Ernest R.							
	Collie R.*	Bowelling Pl.	Henty Brook		Waterfall Ck.					
		Byrine Pl.	Stones Bk.							
		Duderling Pl.	Mill Brook							
		Boddington Well	Gervase Bk.							
		Frank Well								
		Mungalup Dam	Hamilton R.							
		Wellington Dam								
		Youardup Soakage	Harris R.		Hanson Bk.					
			Bingham R.*	Delayney Pl.	Pollard Bk.					
					Stinkwood Bk.					
			Gavin Gy.							
			Flaherty Bk.							
			Riches Gy.							
			Salmon Bk.							
			Worsley R.							
			Silver Wattle Gy.							
	Preston R.	Attey Sp.*	Ferguson R.		Hough Bk.					
					Paradise Ck.					
			Crooked Bk.							
			Coolingutup Bk.							
			Mill Brook							
			Charleys Ck.	Charleys Sp.						
			Waterfall Gy.		Rocky Brook					
Capel	Capel R.		Waideman Gy.							
			Violet Bk.		Breakneck Ck.*					
			Camp Gully							
			Brittle Gy.							
			Maidenhair Gully							
			Thompson Bk.	Native Dog Spring						
			Station Bk.	Station Sp.						
Hardy	Blackwood R.*	Quargerup Pool	St. John Bk.		St. Paul Bk.					
					Rocky Gully					
					Mill Brook*					
					Harrington Bk.					
			Pinch Gully		Padbury Brook					
			Dundinyillup Gully Brook	(Wilgee Sp.						
			Balingup Bk.	(Balingup Pl.						
			Hester Brook	(15-mile Well 8 Mile Sp.						
			Waterhole Gy.	(Wilyungulup Sp.						
			Boyup Brook	(Benjinup Sp.						
			Tweed River	(Wingallup Sp.						
			Salt Water Gy.							
			Wanerup Bk.							
			Norlup Brook		Cowan Brook					
					Spring Gully Bk.					
					Dumpling Gully					
			Smith Brook							

* Denotes runs through reserve(s)

TABLE 13a: Details of wetland reserves in System 6 arranged according to Shires

Shire	Litho	Wetland	Reserve No.	Purpose	Vesting
Armadale-Kelmscott (A-K)	341/80	Lake Jandakot/	27165	R	A-K Shire (W)
		Lake Forrestdale	24781	FF	WAWLA
		Unnamed creeks	5704	T	-
		Beenyup Brook	24843	G	MRD
Beverley (BE)	342/80	Jarrah Pool	33188	FF	WAWLA
		Unnamed creeks	13139	W	-
		Serpentine River	16634	W	-
Boddington (BO)	384/80	Hotham River	23467	Ca	-
		" "	16394	R	-
		" "	23466	C & F	-
	379/80	Unnamed creek	528	W	c/BO Shire
	380/80	Unnamed creek	A4596	T & PL	-
Boyup Brook (BB)	438/80	Blackwood River	1333	W	-
	415/80	" "	2725	W	c/BB Shire
	414/80	Soak	5261		-
		Unnamed creeks	12331	W	-
Bridgetown-Greenbushes (BG)	438/80	Blackwood River	2722	W	c/BG Shire
Canning (CA)		Lesmurdie Falls	22515	NP	NP Board
		" "	26247	NP	NP Board
Chittering (CH)	31/80	Unduming Brook	965	R	CH Shire
		Lake Nangar	1775	Churchland	-
		Longbridge Gully (part)	29100	Buffer Strip	-
	28/80	Rocky Gully	209	RP	-
		" "	4070	Ca	-
		Lake Chittering	29538	FF	WAWLA
		Lennard Brook	4069	Ca	CH Shire
Cockburn (CO)	341/80	Thompson Lake	15556	F & Dr	-
		Banganup Lake	29241	FF	WAWLA
		Bibra Lake	A6208	R	c/CO Town Council
		Unnamed swamp	7756	F & Dr	-
Collie (CE)	410/80	Bingham River	32775	G	-
		Yourdamung Lake (part)	6902	W	
	411/80	Unnamed creek	16043	RR	-
		" "	6039	W	-
		Collie River	7945	PL	c/Collie Shire
		" "	7927	PWD & R	" "
	384/80	Nalyerin Lake	7322	Gr	-
Dandaragan (DG)	31/80	Moore River	16833	Ab	Aborigines L.T.

TABLE 13a (cont'd)

Shire	Litho	Wetland	Reserve No.	Purpose	Vesting
Dardanup (DA)	414/80	Permanent spring	21583	Q & W	PWD
Donnybrook (DO)	414/80	Small creeks	17114	Ra & W	-
		" "	15703	Ra & W	-
		'Powlalup' Blackwood River	A3412	FF	-
		Creek	163/25	Timber Reserve	
Gosnells (GO)	1/80	Ellis Brook	A11681	PL	GO Town Council
Gingin (GG)	30/80	Gingin Brook	257	PU	Gingin Shire
		Moore River	16817	W	" "
		Karakin lakes (south)	7504	W	-
		Moore River & Mission Lake	28462	NP	NP Board
		Harris swamp	-	W	
	31/80	Six-mile swamp & Whitfield Brook	A28462	NP	
		Red Gully Brook	33032	SP	-
		Sand Spring Well	15928	W	Gingin Shire
		Beermullah Lake	22223	R	" "
		Yurine swamp	9676	FF	WAWLA
		Unnamed swamps on	(22602	W	-
		Gnangara mound	(24559	W	-
			(24560	W	
			2334	W	Gingin Shire
		Wannamal Lake	A 9838	FF	WAWLA
		Moore River	17702	Ab	Aborigines L.T.
		" "	12047	W	-
		" "	16833	Ab	
		" "	25591	W & PU	-
		" "	15816	W	Gingin Shire
		Boonanarring Brook	539	SP	" "
		Lake Nangar	17753	Q	Chittering Shre.
	29/80	Moore River	17949	Ca	Gingin Shire
	28/80	Unnamed swamp	31241	FF	WAWLA
		Lake Muckenburra	20366	R	Gingin Shire
		Unnamed swamp	33784	Go	-
		Lake Bambun/Nambun/ Mungala	24257	Flora	-
		Wellering swamp	26756	FF	WAWLA
Harvey (HA)	411/80	Leschenault Inlet	A12636(?)	R	Bunbury T.C.
		" "	5275	Harb. & Indust.	
		" "	13531	Ca-Pic.Gd.	Bunbury T.C.
		" "	9722	R	Harvey Shire
		Small swamp adjacent to Leschenault Inlet	A18414	SP	-
	383/80	Unnamed creeks	22797	FF	-
		" " & waterfall	10745	Beauty Spot	-
		" "	14564	T	-

TABLE 13a (cont'd)

Shire	Litho	Wetland	Reserve No.	Purpose	Vesting
Murray (MU)	380/80	Peel Inlet	B24036	FF	WAWLA
		" "	A 4990	FF	WAWLA
		Lake Mealup (part)	6627	W	-
		Murray River	26526	R	-
		" "	25077	R	Murray Shire
		" "	8900	R	" "
		" "	26735		
		" " (Yunderup)	A20215	NP	" "
		Austin Bay, Peel Inlet	28087	F	WAWLA
		Murray River	23016	Ca & R	c/Murray Shire
		Goegrup Lake	25846	R	-
Nannup (NN)	439/80	Unnamed creek	1461	W	-
	414/80	" "	615	Tr	-
Northam (NO)	2/80	Sand spring	909	W	-
		Wariin Brook & Woottating spring	6203	W	P.W.D.
Perth (PE)	1/80	Lake Monger	A 8731	PU PL & R	L.T. in Trust to City of Perth
Rockingham (RO)	341/80	Lake Walyungup	A23780	NP	Rockingham Shire
		Lake Cooloongup	A24411	NP	" "
		" "	A18452	R & Pic.Gd.	" "
		Lake Richmond	9458	R	" "
Serpentine-Jarrahdale (SJ)	341/80	Unnamed swamp	23012	FF	-
		Serpentine River	28862	NP	NP Board
		Unnamed creeks	904	Tr	-
		Gooralong Brook	28862	NP	NP Board
		Karnet Brook	32202	FF	-
		Manjedal Brook	7125	Asylum	-
		Mundlunun Swamp	V†648	P.W.D. Resumption	
Swan (SW)	1/80	Twin Swamps	27620	FF	WAWLA
		" "	27621	FF	WAWLA
		Unnamed creek	2145	R	Swan Shire
		Roland spring	2148	W	-
		Woorooloo Brook	A 2146	R	Swan Shire
	28/80	Unnamed creek	3020	W	MWSSDB
		Brockman River	22981	PU	-
Toodyay (TO)	31/80	Longbridge Gully (part)	29100	Buffer Strip	-
	32/80	Anvil Gully	30306	Fauna	-
	27/80	Unnamed creeks	22096	FF	WAWLA
		Bindoon spring	3156	Tr	Toodyay Shire
		Phillips Brook	3204	Ca;Bot. & Ecol.	-
		Unnamed creeks	21429	T	-
		" "	5273	Ca	Toodyay Shire
		Avon River	20702	Cemetery	" "
		Gabidine spring	2876	R	-
		Small unnamed creek	7678	W	-
		" " "	17775	RR	-
		Belaring spring	529	FF	WAWLA

TABLE 13a (cont'd)

Shire	Litho	Wetland	Reserve No.	Purpose	Vesting
Harvey (HA)	383/80	Harvey Reservoir & creeks & Big Brook	(15515 (	W	MWSSDB
		Stirling Dam	25727	W	"
		Wellesley River	23931	Agric.Res.	-
		Red Lake (part)	10687	W	-
		Unnamed swamp	12632	W & FF	-
		" "	12049	W & FF	-
		" "	24472	FF	WAWLA
		" "	1086	Dr	-
		Lake Preston	27458	R	-
		Lake Preston, Lake Clifton, Martin Tanks) lakes, Salt Lake, unnamed swamps)	A11710	NP (Yalgorup)	NP Board
Kalamunda (KA)	1/80	Munday Brook	21172	W	MWSSDB
		Unnamed creeks	21314	NP	NP Board
Mandurah (MA)	380/80	Peel Inlet	8185	R	Mandurah Shire
		" "	A24729	R	-
		Goegrup Lake	25360	R	-
		" "	26351	P & R	-
		Lake Clifton	A12189	NP	NP Board
		Harvey Estuary	2990	R & Ca	Mandurah Shire
Melville (ME)	1/80	Blue Gum Swamp	A25562	R + Fauna	Melville C.C.
Mundaring (MD)	1/80	Unnamed creeks	2994	NP	NP Board
		" "	2995	NP	NP Board
		Jane Brook	A 7537	NP	NP Board
		Unnamed creeks	8164	NP	NP Board
		" "	15955	T	-
		" "	20990	Q	Mundaring Shire
		Lake Leschenaultia	23165	R	" "
		Unnamed creek	29269	PL & R	" "
	2/80	Wariin Brook	6203	W	P.W.D.
		Woorooloo Brook (part)	14073	Prison	Chief Secretary
Murray (MU)	380/80	North Dandalup River	21038	PL & R	-
		Murray River	A 5100	R & PL	Forests
		" "	5101	R & PL	"
		" "	5102	R & PL	"
		Unnamed creek	3585	W & SP	Murray Shire
		" " - permanent	8756	W	-
		" "	A 5099	R & PL	Forests
		Lake Clifton	21271	NP	NP Board
		Nine Mile Lake (part)	16907	W	-
		Harvey Estuary	A23756	FF	WAWLA
		" "	2738	R	-
		" "	2707	PU & FF	-
		" "	31922	R	Murray Shire

TABLE 13a (cont'd)

Shire	Litho	Wetland	Reserve No.	Purpose	Vesting
Toodyay (TO)	27/80	Goonaring spring	659	FF	WAWLA
		Small unnamed creek	32400	FF	WAWLA
		" " "	19904	T	-
	28/80	Avon River	2165	RP	-
		Unnamed creeks	30192	FF	WAWLA
		" "	13971	W	-
		" "	20210	W & PU	-
		" "	29100	Buffer	
Victoria Plains (VP)	31/80	Moore River	3345	F	-
		Yarawundah Brook	A27595	Ecology & Fauna	-
	32/80	Gavin Gully	402	RP	-
		Tributary of Solomon Brook	2391	PU	-
Wandering (WG)	379/80	Unnamed creek	334	RP	Wandering Shire
	341/80	" "	335	W & Tr	" "
Wanneroo (WA)	1/80	Lake Joondalup	A 313	Ca + Boy Scouts	Boy Scouts Assn
		" "	A21708	FF	-
		" "	834	Ca & R	Wanneroo Shire
		" "	21176	Forestry	Forests
		Lake Jandabup	7349	Fauna	Fisheries Dept.
	29/80	Loch McNess	A 9868	? NP	NP Board
	28/80	Lake Pinjar (part)	11598	R	-
		Loch McNess) Yonderup Lake) Wilgarup Lake)	A 9868	NP	
		Nowergup Lake	A24581	Fauna	NP Board
		Little Coogee Flat	21490	W	-
Waroona (WR)	380/80	Murray River	A 5100	R & PL	
		" "	5101	R & PL	
		" "	5102	R & PL	
		Unnamed creek	A 5099	R & PL	-
		" "	A 5098	R & PL	-
	383/80	Lake Preston	A22057	NP	NP Board
		" "	A22091	R & Ca	Waroona Shire
		" " Lake Clifton, unnamed swamps	11710	NP	NP Board
		Harvey River & estuary	A23756	FF	WAWLA
		" "	13987	Ca	-
		" "	12408	Ca	Waroona Shire
		" "	A23172	Ca	Waroona Shire
West Arthur (WE)	410/80	Boddington Well	10690	W	-
		Collie River (E.branch) (part)) Unnamed creeks)	18175	W & Ra	
		Collie River (E.branch)	9124	Ca	-
	415/80	Collie River	11683	W	-
		Lake Ngartiminny	19203	W	-

TABLE 13a (cont'd)

Shire	Litho	Wetland	Reserve No	Purpose	Vesting
Williams (WL)	410/80	Bingham River	A7675	Tr	-
		" "	A4555	Tr	-
	384/80	Williams River	8178	R	Williams Shire
York (YO)	2/80	Unnamed spring	424	Tr	-
		Sand spring	909	W	-

TABLE 13b: Numerical list of wetland reserves within System 6

Number	Wetland	Shire	Purpose	Vesting
209	Rocky Gully	CH	RP	-
257	Gingin Brook	GG	PU	Gingin Shire
313	Lake Joondalup	WA	Ca + Boy Scouts	Boy Scout Assocn.
334	Unnamed creek	WG	RP	Wandering Shire
335	Unnamed creek	WG	W & Tr	" "
402	Gavin Gully	VP	RP	-
424	Unnamed spring	YO	Tr	-
528	Unnamed creek	BO	W	Boddington Shire
529	Belaring Spring	TO	FF	WAWLA
539	Boonanarring Brook	GG	SP	Gingin Shire
615	Unnamed creek	NN	Tr	-
V†648	Mundlunun swamp	SJ	PWD resumption	Catchment area
659	Goonaring Spring	TO	FF	WAWLA
834	Lake Joondalup	WA	Ca & R	Wanneroo Shire
904	Unnamed creek	SJ	Tr	-
909	Sand Spring	NO	W	-
965	Unduming Brook	CH	R	Chittering Shire
1086	Unnamed swamp	HA	Dr	-
1333	Blackwood River	BB	W	-
1461	Unnamed creek	NN	W	-
1507	Collie River	CE	RR	-
2065	Avon River	SW	NP	NP Board
2145	Unnamed creek	SW	R	Swan Shire
A2146	Woorooloo Brook	SW	R	" "
2148	Roland Spring	SW	W	-
2165	Avon River	TO	RP	-
2334	Solomon Brook	VP	PU	-
2391	" "	VP	PU	-
2707	Harvey Estuary	MU	PU & FF	-
2722	Blackwood River	BG	W	Bridgetown-Greenbushes Shire
2725	Blackwood River	BB	W	Boyup Brook Shire
2738	Harvey Estuary	MU	R	-
2783	Jandabup Lake	WA	-	-
2876	Gabidine Spring	TO	R	-
2990	Harvey Estuary	MA	R & Ca	Mandurah Shire
2994	Jane Brook	MD	NP	National Parks Board
2995	" "	MD	NP	" " "
3020	Unnamed creek	SW	W	MWSSDB
3156	Bindoon Spring	TO	Tr	Toodyay Shire
3204	Phillips Brook	TO	Ca; Bot. & Ecology	-
3345	Moore River	VP	Flora	-
A3412	Blackwood River	DO	FF	WAWLA
3588	Unnamed creek	MU	W & SP	Murray Shire
4069	Lennard Brook	CH	Ca	Chittering Shire
4070	Rocky Gully	CH	Ca	-

TABLE 13b (cont'd)

Number	Wetland	Shire	Purpose	Vesting
4555	Bingham River	WL	Tr	-
4596	Unnamed creek	BO	T & PL	-
4990	Peel Inlet	MU	FF	WAWLA
5098	Unnamed creek	WA	R & PL	-
5099	" "	MU	R & PL	Forests Department
5100	Murray River	MU	R & PL	" "
5101	" "	MU	R & PL	" "
5102	" "	MU	R & PL	" "
5261	Soak	BB	-	-
5273	Unnamed creek	TO	Ca	Toodyay Shire
5275	Leschenault Inlet	HA	Harb. & Indust.	-
5704	Unnamed creeks	AK	T	-
6039	" "	CE	W	-
6203	Wariin Brook	MD	W	P.W.D.
6208	Bibra Lake	CO	R	Cockburn Town Council
6627	Lake Mealup	MU	W	-
6902	Yourdamung Lake	CE	W	-
7125	Manjedal Brook	SJ	Asylum	-
7322	Nalyerin Lake	CE	Gr	-
7349	Jandabup Lake	WA	Fauna	Fisheries & Wildlife Dep.
7504	Karakin Lakes	GG	W	-
7537	Jane Brook	MD	NP	National Parks Board
7675	Bingham River	WL	Tr	-
7678	Unnamed creek	TO	W	-
7756	" "	CO	F & Dr	-
7927	Collie River	CE	PWD & R	Collie Shire
7945	" "	CE	PL	" "
8164	Jane Brook	MD	NP	National Parks Board
8178	Williams River	WL	R	Williams Shire
8185	Peel Inlet	MA	R	Mandurah Shire
A8731	Monger Lake	PE	Public Park & R	City of Perth
8756	Unnamed creek	MU	W	-
8900	Murray River	MU	R	Murray Shire
9124	Collie River	WE	Ca	-
9458	Richmond Lake	RO	R	Rockingham Shire
9676	Yurine Swamp	GG	FF	WAWLA
9722	Leschenault Inlet	HA	R	Harvey Shire
A9838	Wannamal Lake	GG	FF	WAWLA
A9868	Lock McNess	WA	NP	National Parks Board
10687	Red Lake	HA	W	-
10690	Boddington Well	WE	W	-
10745	Unnamed creek	HA	Beauty Spot	-
11598	Lake Pinjar	WA	R	-
11681	Ellis Brook	GO	PL	Gosnells Town Council
11683	Collie River	WE	W	-
11710	Lakes Preston & Clifton	HA	NP	National Parks Board
12047	Moore River	GG	W	-
12049	Unnamed swamp	HA	W & FF	-
12189	Lake Clifton	MA	NP	National Parks Board

TABLE 13b (cont'd)

Number	Wetland	Shire	Purpose	Vesting
12331	Unnamed creek	BB	W	-
12408	Harvey River	WR	Ca	Waroona Shire
12632	Unnamed swamp	HA	W & FF	-
12636	Leschenault Inlet	HA	R	Bunbury Town Council
13139	Unnamed creek	BE	W	-
13531	Leschenault Inlet	HA	Ca & Pic. Grd.	Bunbury Town Council
13971	Unnamed creek	TO	W	-
13987	Harvey River	WR	Ca	-
14073	Woorooloo Brook	MD	Prison	Chief Secretary
14564	Unnamed creek	HA	T	-
15515	Harvey Reservoir	HA	W	MWSSDB
15556	Thompson Lake	CO	F & Dr	-
15703	Small creeks	DO	Ra & W	-
15816	Moore River	GG	W	Gingin Shire
15928	Sand Spring Well	GG	W	" "
15955	Unnamed creek	MD	T	-
16043	" "	CE	RR	-
16394	Hotham River	BO	R	-
16634	Serpentine River	BE	W	-
16817	Moore River	GG	W	Gingin Shire
16833	" "	DG	Ab	Aborigines Land Trust
16907	Nine Mile Lake	MU	W	-
17114	Small creeks	DO	Ra & W	-
17702	Moore River	GG	Ab	Aborigines Land Trust
17775	Unnamed creek	TO	RR	-
17949	Moore River	GG	Ca	Gingin Shire
18175	Collie River	WE	W & Ra	-
18414	Small swamp	HA	Sp	-
18452	Lake Cooloongup	RO	R & Pic.Gd.	Rockingham Shire
19203	Lake Ngartiminny	WE	W	-
19904	Unnamed creek	TO	T	-
20210	Unnamed creek	TO	W & PU	-
20215	Murray River	MU	NP	Murray Shire
20366	Lake Muckenbyrra	GG	R	Gingin Shire
20702	Avon River	TO	Cemetery	Toodyay Shire
20990	Unnamed creek	MD	Q	Mundaring Shire
21038	North Dandalup River	MU	PL & R	-
21172	Munday Brook	KA	W	MWSSDB
21176	Lake Joondalup	WA	Forestry	Forests Department
21271	Lakes Preston, Clifton	MU	NP	National Parks Board
21314	Unnamed creek	KA	NP	National Parks Board
21429	Unnamed creeks	TO	T	-
21490	Little Coogee Flat	WA	W	-
21569	Canning River	CA	NP	National Parks Board
21583	Permanent spring	DA	Q & W	P.W.D.
21708	Lake Joondalup	WA	FF	-
22057	Lake Preston	WR	NP	National Parks Board
22091	" "	WR	R & Ca	Waroona Shire
22096	Unnamed creeks	TO	FF	WAWLA
22223	Beermullah Lake	GG	R	Gingin Shire

TABLE 13b (cont'd)

Number	Wetland	Shire	Purpose	Vesting
22515	Lesmurdie Falls	KA	NP	National Parks Board
22602	Unnamed swamp	GG	W	-
22797	" creeks	HA	FF	-
22981	Brockman River	SW	PU	-
23012	Unnamed swamp	SJ	FF	-
23016	Murray River	MU	Ca & R	Murray Shire
23165	Lake Leschenaultia	MD	R	Mundaring Shire
23172	Harvey River	WR	Ca	Waroona Shire
23466	Hotham River	BO	C & F	-
23467	" "	BO	Ca	-
23756	Harvey Estuary	MU	FF	WAWLA
23780	Lake Walyungup	RO	NP	Rockingham Shire
23886	Unnamed creeks	CE	NP	National Parks Board
23931	Wellesley River	HA	Agric.Res.	-
24036	Peel Inlet	MU	FF	WAWLA
24257	Lakes Bambun, Nambun, Mungala	GG	FF	-
24411	Lake Cooloongup	RO	NP	Rockingham Shire
24472	Unnamed swamp	HA	FF	WAWLA
24559	" "	GG	W	-
24560	" "	GG	W	-
24581	Nowergup Lake	WA	Fauna	National Parks Board
24729	Peel Inlet	MA	R	-
24739	Harvey Estuary, Big Lake	MU	FF	-
24781	Forrestdale Lake	AK	FF	WAWLA
24843	Beenyup Brook	AK	G	Main Roads Department
25077	Murray River	MU	R	-
25360	Goegrup Lake	MA	R	-
25562	Blue Gum Swamp	ME	R & Fauna	Melville City Council
25591	Moore River	GG	W & PU	-
25727	Stirling Dam	HA	W	MWSSDB
25846	Goegrup Lake	MU	R	-
26247	Lesmurdie Falls	KA	NP	National Parks Board
26351	Goegrup Lake	MA	P & R	-
26526	Murray River	MU	R	-
26735	" "	MU		
26756	Wellering Swamp	GG	FF	WAWLA
27165	Lake Forrestdale	AK	R	Armadale-Kelmscott Shire
27458	Lake Preston	HA	R	-
27595	Yarawundah Brook	VP	Ecology & Fauna	-
27620) 27621)	Twin Swamps	SW	FF	WAWLA
28087	Austin Bay, Peel Inlet	MU	Fauna	WAWLA
28462	Moore River, Mission Lake	GG	NP	National Parks Board
28862	Serpentine River	SJ	NP	" " "
29100	Longbridge Gully	CH	Buffer Strip	-
29241	Banganup Lake	CO	FF	WAWLA
29269	Unnamed creek	MD	PL & R	Mundaring Shire
29538	Lake Chittering	CH	FF	WAWLA

TABLE 13b (cont'd)

Number	Wetland	Shire	Purpose	Vesting
30192	Avon River	SW	NP	National Parks Board
30306	Anvil Gully	TO	Fauna	-
31241	Unnamed swamp	GG	FF	WAWLA
31913	" "	CE	NP	National Parks Board
32202	Karnet Brook	SJ	FF	-
32400	Unnamed creek	TO	FF	WAWLA
33032	Red Gully Brook	GG	SP	-
33188	Jarrah Pool	BE	FF	WAWLA
33784	Unnamed swamp	GG	Go	-

KEY: Purpose

Ab = Aborigines

Ca = Camping

C = Common

Dr = Drainage

FF = Flora & Fauna

Go = Government requirements

Gr = Gravel

H = Hall

M = Mining

NP = National Park

PL = Parklands

PU = Public Use

Q = Quarry

Ra = Railways

Reaff = Reafforestation

R = Recreation

RP = Resting place

RR = Rifle range

Sa = Sanctuary

Sc - School

SP = Stopping place

T = Timber

Tr = Travellers

W = Water

TABLE 14: Non-reserved wetlands in System 6

Shire	Name	Litho
Armadale-Kelmscott	Canning R.	341/80
	Canning Reserve	
	Churchman Brk Dam & Churchman Brk	
	Slab Gully Greek	
	Stony Brook	
	Kangaroo Gully Cr	
	Death Adder Cr	
	Cardup Brk	
	Balannup L.	
	Kelmscott L.	
	Wugong R.	
Beverley	Goonaping Sw	342/80
	Browns Sw	
	Dadateny Sw	
	Beraking Bk	
	Dale R.	
	Flint Gully	
	Kettlerock Gully	
Boddington	Serpentine R.	379/80
	Bannister R.	
	34 Mile Bk	
	Wattle Hollow Bk	
	Hotham R.	
	Howse Bk	383/80
	Chalk Bk	
	Bell Bk	
	Lay Gully)	384/80
	Devil's Den Bk)	SF
	Murray R.)	No. 14
	Hotham R.)	
	Williams R.)	
Boyup Brook	Collie R.	415/80
	Boyup Bk	
	Blackwood R.	438/80
Brookton	Connelly Ck & Gully	342/80
	Cliff Gully	
Bunbury	Leschenault Inlet (Sth)	411/80
	Preston R.	
	Ferguson R.	
Chittering	Ellen Bk	28/80
	Chandala Bk	
	Rocky Gully Bk	
	L. Chandala (Mandowin L)	
	Garbora P.	
	Barracca Sp	

TABLE 14 (cont'd)

Shire	Name	Litho
Chittering	Yalyal Sp	28/80
	Toodyay Sp	
	Bullrush Sp	
	Meenjon Sp	
	Jootangit Sp	
	Brockman R.	
	Spice Bk	
	Brockman R.	31/80
	L. Nanjar (part reserved)	
	Longbridge Gully	
	Woobra Bk	
	Nooning Gully	
Cockburn	L. North	341/80
	L. Coogee	
	L. Yangebup	
	L. Kogolup	
	L. Banjup	
	Lutkins Swamp	
	Others unnamed E. of Thompson L.	
Collie	Yourdamung L (part)	410/80
	Bingham R.	
	Stickwoods R.	
	Pollard Bk	
	Collie R.	
	Bell Bk)	384/80
	Opossum Sp. Gully)	SF
	Pollard Sp)	No. 14
	Chalk Bk	383/80
	Lunenburgh R.	411/80
	Sophia R.	
	Matilda R.	
	Gervase R.)	Within
	Worsley R.)	Wellington
	Hamilton R.)	Dam Catch-
	Collie R. (E & S))	ment area
	Harris R.)	
	Hanson Bk)	
Dardanup	The long Swamp	411/80
	Collie R.	
	Henty Bk	
	Waterfall Ck	
	Mill Bk, Piches Gully, Salmon Bk	
	Paradise Ck	
	Ferguson R.	
	Hough Bk	
Donnybrook	Preston R.	414/80
	Coolingutup Bk	
	Gavin Gully SF 27	
	Camp Gully	
	Capel R.	
	Capel R. - north branch	
	Breakneck Crk	

TABLE 14 (cont'd)

Shire	Name	Litho
Donnybrook	Thompson Bk	414/80
	Charleys Ck	
	Wanerup Bk	
	Balingup Bk	
	Smith Bk	
	Blackwood R.	438/80
Gingin	Nth Karakin L.	30/80
	Dupater Sw	
	Karakin Bk	
	Moore R.	
	Bidaminna L	
	Yacangully Pool	
	Gogelup Pool	
	Warren Warren Pools	
	Buringarrah Sw	
	Spade L.	
	Caladinia L.	
	Gingin Bk	
	The Breaks Bk	
	Harris Sw	
	Barragoon L.	29/80
	Goppino L.	
	Red Gully Ck	31/80
	Whitfield Bk	
	Padbur Gully	
	White L.	
	Bootine Spring	
	Culcadarra L.	
	Salt L.	
	Gingin Bk	
	Mungala Bk	
	Wallung Bk	
	Yanga Sw	
	Beedamanup Sw	
	Deep Water Lagoon	28/30
	Gingin Brook	
	Breera Bk	
	Lennard Bk	
	Nullilla Bk	
	Nowra Bk	
	Many unnamed lakes - swamps	
Gosnells	Balannup L.	341/80
	Kelmscott L.	
	Wungong R.	
Harvey	Leschenault Inlet	411/80
	Brunswick R.	
	Wellesley R. (drained)	
	Mornington R. (drained)	
	Mialla Lagoon	
	Bungo L.	
	Collie R.	
	Flatwater Bk	

TABLE 14 (cont'd)

Shire	Name	Litho
Harvey	Kooallup Lagoon	383/80
	L. Josephine	
	Myalup Sw	
	Harvey R. (much drained)	
	Kojajanup R.	
	Wellesley R.	
	Logue Bk	
	Clarke Bk	
	Tumlo Bk	
Kalamunda	Helena River	1/80
	Piesse Gully	
	Pickering Brk	
	Little Darkin R.	
	Poison Gully	
	Yule Brook	
	Jerrbinyan Gully	
	Lesmurdie Falls	
	Woodlupine Brook	
	Lower Bickley Brk	
	Victoria Reservoir	
	Munday Brk	
Kwinana	L. Magenup	
	L. Balmanup	
	Long Swamp	
	Large Eye Sw (drained)	
	Bollard Bullrush Sw (drained)	
	Barney Sw (drained)	
Mandurah	Lake Clifton	380/80
	Swan Pool	
	Duck Pond	
	Boundary L.	
	Salt Lagoon	
	Entrance to Peel Inlet	
Mundaring	Jane Brook	1/80
	Mahogany Crk	
	Helena R.	
	Smiths Mill Crk	
	Helena Brk	
	Darkin R.	
	Manaring L. (part)	2/80
	Biringining Well	
	Yetar Sp.	
	Helena R.	
	Emu Bk	
	Warin Bk (& well)	
	Wooroloo Bk	
Murray	Goergrup L.	380/80
	Nambeelup Bk	
	Peel Inlet	
	Harvey Estuary	
	L. Mealup	
	Big L.	
	9 Mile L. (part)	

TABLE 14 (cont'd)

Shire	Name	Litho
Murray	St. Georges Pool	380/80
	Yundirup L.	
	Murray R.	
	Nth Dandalup R.	
	Sth Dandalup R.	
	Little Dandalup Crk)	
	Wilson Bk)	
	Wild Pig Sw)	In Serpentine R. water Reserve 16634
	Foster Bk)	
	Kronin Bk)	
	Dillon Bk)	
	Finlay Bil, Big Bk,)	
	O'Neill Bk)	
	Serpentine R.	
	Oakley Bk	380/80
	Marinup Bk	
	Swamp Oak Bk	
Nannup	St. John Bk	414/80
	Padbury Bk	
	Harrington Bk	
	Mill Bk	
	Blackwood R.	
	Blackwood R.	439/80
	Vasse R.	
	St. John Bk	
	Rocky Gully	
	Blackwood R.	40/80
Northam	Chinganning Gully (& Well)	2/80
	Wandadinning Bk	
	Wallating Ebenezer Flats	
	Helena R.	
	Warin Bk (& well)	
	Wooroloo Bk	
Perth Metro Area	Jackadder L.	1/80
	Herdsman L.	
	Gwelup L.	
	Carenuip Swp	
	Karrinyup L.	
	Big & Little Carine Swps	
	Canning R.	1/80
	Bickley Brk	
	Ellis Brk	
	Yule & Woodlupine Brks	
	Canning R.	
	Bannister Lagoon	
	Crargs L.	
	L. Claremont	
Rockingham	Folly Pool	341/80
	Maramanup Pool	
	Beenyup Pool	
	Serpentine R.	

TABLE 14 (cont'd)

Shire	Name	Litho
Serpentine-Jarrahdale	Gingagup Brook	341/80
	Manjedal Brook	
	Medulla Brook	
	Korribinjal Brook	
	Serpentine R.	
	Dirk Brook	
	Karnett Brook)	
	Honor Brook)	State
	Lucy Brook)	Forest
	Bull Brook)	No. 22
	Snake Brook)	
	Numerous small creeks	
	Yangedi Sw	380/80
	Dirk Brook	
	Myara Brook	
	Baloobin Brook	
	Serpentine R.	
Swan	Horse Swp	1/80
	Bennett Brk	
	Henley Brk	
	Ellen Brk	
	Coondaree Swp	
	Sawpit Gully	
	Marala Crk	
	Swan R.	
	Walyunga Pool	
	Wooroloo Brook	
	Rocky & Equitus Bk	
	Jane Bk	
	Blackadder Crk	
	Woodbridge Crk	
	Helena R.	
	Gidjiganup Brk	
	Ellen Bk	28/80
	Monger Bk	
	Namjab Bk	
	Brockman R.	
	Equitus Gully	
	Red Swamp Br	
	Yalawarra Pool	
Toodyay	Gakaling Sw and Sp	28/80
	Spice Bk	
	Julimar Bk	
	Avon R. (mostly reserved)	
	Mannapin Bk	
	Mortigup Bk	
	McKnoe Sp	
	Nerramonging Sp	
	Munyerring Sp	
	Jim Crow Gully	27/80
	Black Sw	
	Jingaling Bk	
	Bandaling Sp	
	Jimperding Bk	

TABLE 14 (cont'd)

Shire	Name	Litho
Toodyay	Avon R.	27/80
	Chauncey Sp	
	Goonaddin Sp	
	Codder Pool	
	Malkup Bk	
	Spice Bk	
	Phillips Bk	
	Dewar Pool	
	Warragenny Waterhole	
	Nunamullin L.	
	Anvil Gully	32/80
	Jim Crow Gully	
Victoria Plains	Solomon Bk	32/80
	Gavin Bk	
	Moore R.	31/80
Wandering	Bannister R.	379/80
	Hotham R.	
Wanneroo	Pipidinny Sw	28/80
	Beonaddy Sw	
	Mindarie L.	
	Coogee Spring	
	Carabooda L.	
	Neerabup L.	
	L. Pinjar	
	Little Coogee Sw	
	Little Coogee Flat	
	Lake Adams	
	Bulrush L.	29/80
	Coogee L.	1/80
	Little Mariginiup L.	
	Mariginiup L.	
	Little Dundarbar Sw	
	Wallubuenup Swp	
	Beenyup Swp	
	Badgerup L.	
	Gnanjara L.	
	Snake Swp	
	Goollelal L.	
	Emu Swp	
	12 unnamed swamps	
Waroona	Harvey R.	383/80
	L. Clifton (east side)	
	Nanja Bk	
	Yarrajil Bk	
	Big Bk	
	Murray R.	
	Almanac Bk	
	Kangaroo Bk	
	Drakes Bk	
	Samson Bk	
	McKnoe Bk	

TABLE 14 (cont'd)

Shire	Name	Litho
Waroona	Yalup Bk	383/80
	Bancells Bk	
	Numerous unnamed swamps around Harvey	
	Dirksbrook Reservoir	
	Murray R.	380/80
West Arthur	Bingham R.	410/80
	Nundedine L.	410/80
	5 unnamed swamps	
	Collie R.	
Williams	Old Stockyard Sw	384/80
	Coorakin Bk	
York	Darkin Sw	342/80
	Darkin R.	
	Helena R.	2/28
	Windabinning Bk	

TABLE 15: Details of all reserves within System 6 (wetlands and non-wetlands

Litho	Reserve No.	Purpose
1/80	20801	FF
	1556	W
	A313	W
	A21708	FF
	834	Ca + R
	21176	Cemetery
	7349	FF
	2783	
	20091	PU (FF)
	3446	FF
	18476	R
	A21406	R
	A8731	R
	25562	FF
	A11681	PL
	21172	
	7537	NP
	15955	T
	9320	
	20990	T
	23165	
	5220	W
	4967	
	23741	
	29269	
	2145	PU
	2148	W
	2146	PU
	777	
2/80	424	
	17759	T
	18516	T
	909	W
	2100	W
	6203	W
	25033	
	132	T
	14073	Hosp.
	15216	RR
	14725	
	14275	T
	23746	Ra
	4623	T
	11619	Ra
	26947	Sa
	22605	Go
	25225	R
	25860	PU
	25785	Rubbish
	25859	PU
	2098	W

TABLE 15 (cont'd)

Litho	Reserve No.	Purpose
27/80	22097	Go
	22096	FF (prop.)
	3156	Tr
	3204	
	19900	FF
	21429	T (FF)
	5273	
	20702	Cemetery
	3171	School
	2876	RP
	7678	RR
	17775	
	6665	Gra
	529	RP
	659	RP
	32400	FF
	20014	T
	19904	T
28/80	24436	FF
	31241	FF
	15997	FF
	20366	R
	33784	Go
	24084	RR
	24257	FF
	9667	R
	26756	FF
	22831	R
	2335	PU
	9213	School
	3020	W
	(T 427	
	11598	R
	10866	Q
	20432	Ca
	A9868	NP
	31236	
	6155	M
	22031	Q
	31237	
	27575	FF
	20801	
	24581	FF
	21771	Sa
	28376	
	31859	
	22915	R + Ca
	21490	W
	(T 403	Airfield
	10788	Cemetery
	1654	RP
	24776	Gr
	209	RP
	4070	Ca
	22981	PU
	2151	RP

TABLE 15 (cont'd)

Litho	Reserve No.	Purpose
28/80	2154	RP
	2164	
	2165	
	130191	F + F
	5273	Ca
	13971	W
	20210	W
	29100	Buffer
	5309	FF
	29358	FF
	42	
	32807	FF
	27161	RR
	4069	Ca
29/80	12439	Ca
	20561	R
	911	Tr
	A9868	NP
	17896	W
	17949	Ca
30/80	257	
	16817	W
	7504	W
	741	SP
	28462	NP
	23324	W
	5070	W
31/80	28462	NP
	33032	SP
	25950	Gr
	18352	Go
	15928	W
	1224	Ca
	25953	Gra
	22223	R
	9676	FF
	9193	W
	22602	W
	24559	W
	24564	W
	2334	W
	25956	Gr
	9838	FF
	3345	FF
	17702	Ab
	12047	W
	16833	Ab
	25591	W + PU
	3409	Ab
	5488	T
	15816	W
	27028	Gr
	965	
	27595	FF

TABLE 15 (cont'd)

Litho	Reserve No.	Purpose
31/80	29100	Buffer Strip
	16231	W
	539	Ca
	1775	
	9193	W
32/80	6779	W
	402	
	29100	Buffer Strip
	2391	
	775	
	30306	FF
	22097	Go
341/80	24162	RP
	20311	Church
	A23780	NP
	A24411	NP
	18452	R
	20226	Golf
	22412	Sa
	9458	W
	24204	FF
	17070	FF + R + Ca
	25117	Hospital
	25132	
	23914	
	24910	Q
	24784	Q
	28167	FF
	6168	Cemetery
	25883	FF
	27165	FF
	7756	FF + Dr
	26998	Prison
	15556	FF + Dr
	A6208	
	11681	PL
	20375	T
	7415	T
	26652	Gr
	4127	T
	4561	PL
	5704	T
	32728	FF
	19662	T
	527	W
	24843	
	33658	
	V†648	
	2998	
	904	
	1243	
	335	
	A20357	Pl + R
	32202	FF
	23012	FF
	7125	Asylum

TABLE 15 (cont'd)

Litho	Reserve No.	Purpose
342/80	33188	
	13139	W
	14581	
	14580	T
	16634	W
379/80	528	W
	333	W + Ca
	601	Ca
	334	RP
380/80	14629	T
	25634	Gr
	25635	Gr
	19413	T
	21038	PL + R
	17971	Sc
	21041	R
	16498	Ra + W
	16503	RR
	17749	Ra + W
	14410	RR
	16497	Ra + W
	24854	RR
	A4596	T + PL
	15419	RR
	A5100	R + PL
	5101	R + PL
	5102	R + PL
	3585	
	8756	W
	A5099	R + PL
	A5098	R + PL
	A20588	SP
	4832	PU
	13608	RP
	5829	RP
	19269	W
	25522	SP
	6038	R
	7567	H
	10150	
	16953	T
	16907	W
	A23756	FF
	A2991	R + Ca
	A24739	FF
	2738	R
	2707	PU + FF
	24036)	FF
	4990)	
	8185	R
	13359	Go
	6627	W
	525	C
	26526	R
	25077	
	8900	H

TABLE 15 (cont'd)

Litho	Reserve No.	Purpose
380/80	24710	
	24733	
	26736	
	A20215	
	28087	FF
	23016	Ca + R
	24456	
	25652	
	25297	R
	25588	R
	27051	R
	25043	R
	26469	R
	27066	R
	24880	R
	A25704	
	27874	
	A24729	
	25846	R
	25360	R
	26351	R
	27156	
	25202	
	A2851	R + Ca
	21271	
	24198	Ca + R
	12189	(NP) C
	27719	
	2990	R + ca
	22833	PU
383/80	21997	Sa
	13735	
	3672	
	16681	RR
	A23307	NP
	20412	T
	4109	T
	22797	FF
	10745	
	14564	T
	15515	W
	25727	W
	23931	Agric.Res.
	17482	R
	16030	RR
	23379	
	or	
	23319	
	27711	
	21587	Forestry Dept.
	10687	W
	12632	W + FF
	12049	FF
	24472	FF
	1086	Dr
	10416	Church

TABLE 15 (cont'd)

Litho	Reserve No.	Purpose
383/80	11709	W
	27458	R
	A22057	FF
	A22091	R + Ca
	11710	NP
	23597	NP
	22093	Hospital?
	11708	
	A997	Ca + R
	25960	PU
	A998	Ca + R
	25912	PU
	25349	PU
	A23756	FF
	A17037	Ca
	13987	Ca
	22545	Ca + W
	12408	
	A23172	Ca
	25712	Dr
	23932	Dr
	15087	Q
384/80	7322	
	14940	T
	8178	R
	11399	School
	17706	PU
	23467	Ca
	16394	Gr
	23466	Go
	23538	Cemetery
410/80	10690	W
	18175	W + Ra
	9124	Ca
	2642	W
	15410	T
	20608	W
	6063	Tr
	8705	
	6802	W
	A7675	Tr
	A4555	Tr
411/80	16043	RR
	6039	W
	7945	PL
	7927	R
	1507(?)	RR
	10014	RR
	8439	Ca
	670	
	19633	R
	7135	R
	12636(?)	R
	5275	
	13531	Ca

TABLE 15 (cont'd)

Litho	Reserve No.	Purpose
411/80	9722	R
	A24365	R
	A24364	W
	A18414	SP
	A26270	
	10839	W
	10837	
414/80	7852	
	A12553	Reaff.
	27081	T
	8361	R
	1381	W
	17383	Mining?
	681	SP + W
	2034	PU
	1152	W
	17114	Ra + W
	5261	
	12331	W
	10830	R
	16004	T
	14719?	
	11266	Sa
	21638?	
	20751	T
	15703	Ra + W
	27657	
	9990	W
	A3412	F + F
	5373	R
	615	Tr
	163	T
	13016	Reaff.
	2573	PU
	21277	PU
	11510	RR
	21583	
	2720	Q
415/80	11683	W
	20370	RR
	20757	Hall
	17156	Hall
	12638	W
	1241	
	16199	Ra + W
	2725	W
	4320	W
	14957	T
	16678	School
	18969	T
	20386	Gr
438/80	18934	Timber
	14957	T
	1333	
	2722	W
	8078?	W
	21263	

TABLE 15 (cont'd)

Litho	Reserve No.	Purpose
439/80	20399	
	12340	
	1461	W

KEY: Purpose

Ab = Aborigines

Ca = Camping

C = Common

Dr = Drainage

FF = Flora & Fauna

Go = Government requirements

Gr = Gravel

H = Hall

M = Mining

NP = National Park

PL = Parklands

PU = Public Use

Q = Quarry

Ra = Railways

Reaff = Reafforestation

R = Recreation

RP = Resting place

RR = Rifle range

Sa = Sanctuary

Sc - School

SP = Stopping place

T = Timber

Tr = Travellers

W = Water

TABLE 16: National Parks and other reserves within System 6 vested in the National Parks Board and containing wetlands[a]

Identification	Comprising Reserves	Area (Approx.) hectares	Description and Location	Management problems
Avon Valley Litho. Toodyay 40, Sheets 1, 2 & 3	A.30192	4430	Avon Loc. 28391. The Avon River and standard gauge railway winds through the Park. Bald Hill provides scenic views overlooking the river and railway, at Emu Spring Brook east of Bald Hill. A waterfall with a sheer drop of 90 ft. provides a winter feature. Jarrah and Marri country interspersed with Christmas trees, blackboys and grass trees and numerous wildflowers. Swan Loc. 6401 added.	
John Forrest Litho. IB/20SW IC/20NW	A.7537	1506	Situated at top of Darling Range Escarpment approx. 17 miles from Perth. Named after Sir John Forrest, famous explorer and statesman. Picnic area, tearooms and swimming pool on Jane Brook and wildflower gardens. Attractive Glen Brook Dam (32 million gallons capacity). Very popular resort for day visitors from City. Natural wildflower displays, hiking walking tracks in near virgin bush country. Comprises Swan Locs. 1447, 3217, 3218, 3248, 3731, 4116, 4936, 8204, 8339 and Swan View Sub Lots 44, 45, 46, 47, 65, 66 and 67. Also closed road abutting northern boundary of Swan Loc. 4936. Area reduced for road widening of Great Eastern Highway.	Dieback. Repeated burnings without ecological considerations due to local pressure.
	A.2994	7	Swan View Lots 24 and 105 adjoining main Reserve A.7537 on western side; entry to Rocky Pool and Hope Falls via Morrison and Pechey Roads east of Midland. Picnic area and scenic walks adjacent to Jane Brook.	
	A.2995	60	Swan View Sub Lots 25, 51 and 112, adjoining main Reserve A.7537 on western side. Forms part of the Park.	
	A.8164	4	Swan View Sub Lots 68, 69 & 70, adjoining main Reserve A.7537 on western side. Forms part of the Park.	
		1577		
Kalamunda Litho. IC/20NW	A.21314	375	Canning Loc. 975. Reserve near Kalamunda. Undeveloped at present. Canning Loc. 2711 included.	Overuse.
Lesmurdie Falls Litho. M241-4	A.22515	35	Canning Locs. 1177 & 1197 Lesmurdie Falls area is about 15 miles south-east of Perth. Parking and picnic areas have been provided. Lookouts and walking paths constructed, views over the Coastal Plain, City & Suburbs, with Indian Ocean and Rottnest Island in the distance. Canning Loc. 2626 added.	
	A.26247	21	Canning Loc. 2310 & 2311 included. Canning Locs. 1178, 2118 & 2151. Canning Loc. 2604 included.	
		56		
Moore River Litho. 31/80 & 30/30	C.28462	17546	An outstanding wildflower area, located about 70 miles north of Perth, near Regans Ford. It is left in its natural state. As in other National Parks picking of wildflowers or interference with plant or animal life is not permitted. Area amended to comprise Swan Locations 8172, 3230 and 8926. Swan Loc. 8833 included.	Application of fire management programme due to staff shortages.

TABLE 16 (cont'd)

Identification	Comprising Reserves	Area (Approx.) hectares	Description and Location	Management problems
Serpentine				
Litho.341C/40	A.28862	635	Serpentine Agricultural Area Lot 84 Cockburn Sound Locs. 515, 516, 517, 520, 627, 1727, 2117, 2118 and 2119. Cockburn Sound Loc. 821 added.	
			This reserve offers many attractions such as waterfalls, running water, picnic spots, massive granite outcrops, high hills offering excellent views over the plain to the ocean and is within easy motoring distance of Perth.	
Walyunga Litho. Toodyay 40, Sheet 3.	(Not finalised)	1618	Part of Swan Loc. 1316 and part Swan Loc. 2. This area was purchased by Government in 1966 for creation as a National Park. Located 24 miles north of Perth just off the Great Northern Highway and is a very popular resort for day visitors from the City. It includes "Long Pool" and "Walyunga Pool" on the Swan River north-east of Upper Swan.	
	C.2065	172	Reserve in north-east corner of Park adjacent to standard gauge railway plaque site.	
			Swan Loc. 8439 included. Swan Loc. 8982 added.	
		1790		
Yalgorup Litho. 383/80, 383A/40 A.1 381C/40	A.11710	8918	Wellington Locs. 1818, 1944, 2443, 3121, 3322, 4470, 4792, 4910 & 5003. Located south of Mandurah Townsite adjacent to Lakes Clifton and Preston. A reserve of historic interest and tourist potential. This beautiful Tuart forest country was occupied in the early days of the colony & some old buildings still remain. A great diversity of birdlife exists, many water fowl, black swans. Within easy reach of good roads.	Dune degradation due to 4-wheel drive vehicles and trail bikes; fires. Lack of support from Shires.
			Wellington Locs. 2731, 3015 & 4471 included in Reserve A.11710.	
			Wellington Loc. 4631 added.	
			Wellington Loc. 4630 added.	
			Wellington Locs. 5181 & 5182 added.	
			Wellington Locs. 1537, 1180, 1395, 5128 added.	
			Inclusion of 5018 ha Lakes Clifton & Preston. Lake Clifton is 12 miles long by 1 mile wide and near the scenic Old Coast Road; has practically fresh water. Lake Preston is 17 miles long by 1 mile wide & very salty but still a great water-way and being sheltered is an ideal picnic area.	
			Wellington Loc. 4981 added.	
	A.22057	359	Wellington Locs. 4079, 4732 & 4926.	
	A.12189	1384	Murray District north of Lake Clifton.	
	C.21271	520	Murray Location 1014	
		11181		
Yanchep Litho. 28/80, 29/80 Yanchep 40 Sheet 1	A.9868	2790	This reserve comprises the main settlement area, & contains caves, holiday resort, Yanchep Inn, Guest Houses, swimming pool, koalas, wildflowers, golf course, kangaroos, emus, black swans, caged birds, playing fields, boating & launch trips on Loch McNess, picnic grounds etc.	
			Situated approx. 32 miles north of Perth. Picnic shelters & barbecues provided. Reduced by Forests Dept. Headquarters. Swan Loc. 7953 added. Swan Loc. 422 added. Swan Loc. 8239 added. Swan Loc. 4402 added. Swan Loc. 6953 added. Swan Locs. 3306 & 3307 added.	
			Reserves Act 1967 area reduced.	

TABLE 16 (cont'd)

Identification	Comprising Reserves	Area (Approx.) hectares	Description and Location	Management problems
Araluen-Canning Dam Litho.341B/40	C.21569	20	This reserve comprises a long narrow strip of territory lying between the roadway and the Canning River from Araluen to Canning Dam.	
Haddleton Litho.415A/40 C-1.2	C.23886	164	Wellington Locs. 3754 & 5058, reserved for the protection of Boronia. Within Wellington Dam catchment area.	
415B/40 D.1	C.31913	1161	Wellington Locs. 4010 & 4663. 1½ miles east of Reserve 23886. For protection of Boronia. Increased by addition of Wellington Loc. 5141.	
		1325		
Nowergup Lake Litho. Yanchep 40 Sheet 3	A.24581	117	Swan Loc. 6038, north-east of Quinns Rock Townsite. Adjoins the Wanneroo Road & the northern portion of the Neerabup National Park.	Boundaries contain insufficient area

* Information supplied by National Parks Board (W.A.).

TABLE 17: Wetland flora and fauna reserves within System 6

Reserve No.	Wetland	Shire	Vesting	Area (ha)	Features and problems
529	Belaring Spring	Toodyay	WAWLA	39.6	Undescribed species of jilgie. Trail-bike use.
659	Goonaring Spring	Toodyay	WAWLA	52.2	Undescribed species of jilgie. Adjacent iron foundry.
2707	Harvey Estuary	Murray	-	-	
3345	Moore River	Victoria Plains			
A3412 (25446)	'Powlalup', Blackwood River	Balingup	WAWLA	37.2	
4990	Peel Inlet	Murray	WAWLA	139.2	Adjacent to Yunderup canals.
7349	Lake Jandabup	Wanneroo	Minister for Conservation	232.3	Introduced fish. Mineral claims and surveys. Groundwater extraction.
7756	Unnamed swamp	Cockburn	-	44.1	
9676	Yurine Swamp	Gingin	WAWLA	29.5	Game reserve.
9838	Wannamal Lake	Gingin	WAWLA	80.9	Game reserve. Pressure to exclude shooters due to disturbance of Freckled Ducks.
12049	Unnamed swamp	Harvey	-	-	Lapsed mining claims for ilmenite.
12632	Unnamed swamp	Harvey	-	37.2	" " " " "
15556	Thompson and Banganup Lakes	Cockburn	WAWLA	508.7	Mining claims. Fire management problems.
21429	Unnamed creeks	Toodyay	-	-	
21708	Lake Joondalup (island)	Wanneroo	WAWLA	4.1	
22096	Unnamed creeks	Toodyay	-	-	
22797	Unnamed creeks	Harvey		300.6	
23012	Unnamed swamp	Serpentine-Jarrahdale	Not Vested	28.3	Grazing. Adjacent rubbish dump.
23756	Harvey River	Murray	WAWLA	1019.0	Lapsed mining claims.
23780	Lake Walyungup	Rockingham	Rockingham Council		Development pressures.
24036	Peel Inlet	Murray	WAWLA	362.2	Straw-necked Ibis nesting site. Stock and fire control problems.
24257	Lakes Bambun, Nambun & Mungala	Gingin			Damage by stock.
24472	Unnamed swamp	Harvey	WAWLA	36.8	
24411	Lake Cooloongup	Rockingham	Rockingham Council	-	Development pressures.
24581	Nowergup Lake	Wanneroo	N.P. Board	-	
24739	Harvey Estuary	Murray	-	-	
24781	Lake Forrestdale	Armadale-Kelmscott	WAWLA	243.6	Spraying for midge control. Important waterfowl sanctuary.
25562	Blue Gum Swamp	Melville	City of Melville	7.7	Encroachment. Eutrophication.
26756	Wallering Swamp	Gingin	-	-	Damage by stock.
27165	Lake Forrestdale	Armadale-Kelmscott	Armadale-Kelmscott Council	133.1	Mining claims. Shire considering development.
27595	Yarawundah Brook	Victoria Plains	-	-	
27620 & 27621	Twin Swamps, Ellen Brook	Swan	WAWLA	221.8	Short-necked tortoise reserves. Adjacent claypits.
28087	Peel Inlet	Murray	WAWLA	-	Pelican nesting site.
29241	Banganup Lake	Cockburn	WAWLA	235.9	University research station.
29358	Chittering Lake	Chittering	WAWLA	230.3	Very important waterbird area. Water levels controlled.
30192	Unnamed creeks	Toodyay	-	-	
30306	Anvil Gully	Toodyay	-	-	
31241	Unnamed swamp	Gingin	WAWLA	336.7	Permanent deep freshwater lake.
32202	Karnet Brook	Serpentine-Jarrahdale	Not Vested	302.0	Possible addition to Serpentine National Park.
32400	Unnamed creeks	Toodyay	-	-	

WAWLA = Western Australian Wildlife Authority

TABLE 18: Wetlands directly affected by drainage*

(a) Lentic

Name	Drainage Map Location
Banjup Lake	46150-24-8
Beenyup Swamp	46150-24-8
Benger Swamp	46150-16-7
† Bibra Lake	Metro. area - south
Big Carine Swamp	Metro. area - north
Blue Gum Swamp	
Bollard Bullrush Swamp	46150-24-8
† Bushmead Lakes	Metro. area - north
Careniup Lake	Metro. area - north
Chandala Lake	
† Coogee Lake	Metro. area - south
Coollelal Lake	Metro. area - north
† Emu Swamp	Metro. area - north
Forrestdale (Jandakot) Lake	Metro. area - south
† Gnangara Lake	Metro. area - north
Gwelup Lake	Metro. area - north
Herdsman	Metro. area - north
Hyde Park	Metro. area - north
Jackadder Lake	Metro. area - north
Karrinyup Lake	Metro. area - north
† Kogolup Lake	Metro. area - south
† Little Carine	Metro. area - north
† Little Rush Lake	Metro. area - south
Magenup Lake	46150-24-8
Mealup Lake	46150-20-7
Monger Lake	Metro. area - north
† North Lake	Metro. area - south
Open Lake	46150-17-7
Perry Lakes	Metro. area - north
Red Lake	46150-17-7
Richmond Lake	Metro. area - south
Shenton Park Lake	Metro. area - north
† Star Swamp	Metro. area - north
† Thompson Lake	Metro. area - south
† Wallubuenup Swamp	Metro. area - north
Yangebup Lake	Metro. area - south

TABLE 18 (cont'd)

(b) Lotic

Name	Drainage Map Location
Austin Bay (Peel Inlet)	46150-20-7
Bancell Brook	46150-18-7
Beenyup Brook	46150-24-8
Bennet Brook	Metro. area - north
Bickley Brook	Metro. area - north
† Blackadder Creek	Metro. area - north
Brunswick River	46150-15-6 and -16-7
Canning River	Metro. area - south and north
Cardup Brook	46150-24-8
Clarke Brook	46150-18-7
Collie River	46150-15-6
Dirk Brook	46150-22-8
Duck Pool (Serpentine R.)	46150-23-8
Elvira Gully	46150-15-6
Ferguson River	46150-14-6
Flaherty Brook	46150-15-7
Folly Pool (Serpentine R.)	46150-23-8
Gavins Gully	46150-14-6
Hardeys Creek	46150-23-8
Harvey Estuary	46150-20-6 and -15-6
Harvey River	46150-17-7
Henty Brook	46150-15-6
Logue Brook	46150-18-7
Kojajanup River	46150-17-7
Maramanup Pool (Serpentine R.)	46150-23-8
Millars Creek	46150-15-6
Mornington River	46150-16-7
Murray River	46150-20-7
Neerigen Brook	Metro. area - south
Norah Brook	46150-16-7
Paradise Creek	46150-14-6
Preston River	46150-14-6
Robert Bay (Peel Inlet)	46150-20-7
Samson Brook	46150-18-7
Serpentine River	46150-22-8

TABLE 18 (cont'd)

(b) Lotic

Name	Drainage Map Location
South Dandalup River	46150-21-7
Southern River	Metro. area - south
Swan River	Metro. area - north (23 drain outlets)
Weekes Brook	46150-17-7
Wellesley River	46150-16-7
Wokalup River	46150-17-7
† Woodbridge Creek	Metro. area - north
Woodlupine Brook	Metro. area - north
Wungong Brook and south branch	46150-24-8 and Metro. area - south
Yalup Brook	46150-18-7
Yule Brook	Metro. area - north

* Information from Drainage Maps supplied by the Public Works Department and the Metropolitan Water Supply, Sewerage and Drainage Board.

† Proposed drain

TABLE 19: Lentic Wetlands with Mining Claims*

Name	Mining Map Location	Claim
Adams Lake	Yanchep 40 sheet 4	MC 70; MC 14230
Balmanup Lake	341 A/40	ML 1SA†
Banganup Lake	341 A/40	ML 1SA†
Beridup Lake	411 D/40	MC 6285 H
Bibra Lake	341 A/40	ML 1SA†
Big Lake	380 D/40	ML 1SA†
Big Camelup Swamp	414 B/40	ALWEST†; ML 1SA†; CML 1268
Bollard Bulrush Swamp	341 D/40	ML 1SA†
Bootine Spring	31/80	MC 14960
Bootine Swamp	31/80	MC 14963, 14964, 14973
Coogee Lake	341 A/40	ML 1SA†
Cooloongup Lake	341 D/40	ML 1SA†
Ebenezer Flats	2A/40	PACMINEX†
Freshwater Lake	30/80	MC 16290; MC 16292
Gnangara Lake	1A/40	(MC 78; MC 30; (MC 241H; MC 10673
Goergrup Lake	380 A/40	ML 1SA†
Jandabup Lake	1A/40	MC 10675-10677
Jandakot Lake (Forrestdale)	341A/40	ML 1SA†
Joondalup Lake	1A/40	DC 600; MC 1176H
Josephine Lake	383 D/40	MC 11623
Kogolup Lake	341 A/40	MC 12207; ML 1SA†
Leschenaultia Lake	1B/20 SE	ML 1SA†
Little Camelup Swamp	414 B/40	ML 1SA†; ALWEST; †CML 1267
Long Swamp	341 A/40	ML 1SA†
Manarin Lake	2A/40	ML 1SA†
Mangenup Lake	341 A/40	ML 1SA†
Mariginiup Lake	1A/40	MC 10674
Mealup Lake	380 D/40	ML 1SA†
Mundlunun Swamp	341 C/40	ML 236 SA
Nalyerin Lake	384 D/40	ML 1SA†
Neerabup Lake	Yanchep 40 sheet 3	CML 2143
Ngartiminny Lake	415 A/40	ALWEST†
Nundedine Lake	410 D/40	ML 1SA†

TABLE 19 (cont'd)

Name	Mining Map Location	Claim
Preston Lake	383 A/40 & D/40	MC 1298H; MC 11623
Richmond Lake	341 D/40	ML 1SA†
Salt Lagoon	380A/40	ML 1SA†
Spade Lake	30/80	MC 16287
Thompson Lake	341 A/40	ML 1SA†
Walyungup Lake	341 D/40	MC 13363; ML 1SA†
White Lake	31/80	MC 14978
Wild Pig Swamp	380 B/40	ML 240 SA
Yangebup Lake	341 A/40	ML 1SA†
Yangedi Swamp	341 D/40	ML 1SA†
Yeal Swamp	Gingin 40 sheet 4	MC 15771
Yourdamung Lake	410 A/40	ML 1SA†

* Information compiled from 40 chain lithos supplied by the Mines Department.

† ML 1SA, ALWEST and PACMINEX refer to the large bauxite lease areas which cover much of System 6.

TABLE 20: Lotic wetlands with existing or possible future dam sites

Bancell Brook	Joshua Creek
Bickley Brook*	Logue Brook*
Blackwood River	Long Gully
Brunswick River	Marrinup Brook
Canning River*	McKnoe Brook
Canning River south	Moore River
Chalk Brook	Munday Brook*
Charleys Creek	Murray River (2)
Churchmans Brook*	North Dandalup River
Clarke Brook	Nowra Brook
Collie River (2)*	Preston River (2)
Collie River east	Red Swamp Brook
Crooked Brook	St. John Brook
Darkin River	Samson Brook
Davis Brook	Serpentine River (3)**
Dirk Brook	South Dandalup River (2)**
Ferguson River	Susannah Brook
Gingin Brook	Swamp Oak Brook
Harris River	Thirty-four Mile Brook
Harvey River (4)**	Thomson Brook
Helena River*	Wooroloo Brook
Helena River east	Wungong Brook*
Honor Brook	Yarragil Brook

* denotes existing dam

Bracketed number indicates number of sites

TABLE 21: Wetlands that may be affected by Groundwater extraction schemes

Jandakot Scheme	Wanneroo Scheme	Gwelup Scheme
Balmannup Lake	Adams Lake	Big Carine Swamp
Banganup Lake	Badgerup Lake	Careniup Swamp
Banjup Lake	Barragoon Lake	Gwelup Lake
Bibra Lake	Beenyup Swamp	Herdsman Lake
Jandakot Lake	Beonaddy Swamp	Jackadder Lake
Kogolup Lake	Carabooda Lake	Karrinyup Lake
Thompson Lake	Coogee Swamp	Little Carine Swamp
Yangebup Lake	Emu Swamp	
	Goollelal Lake	
	Jandabup Lake	
	Joondalup Lake	
	Little Badgerup Swamp	
	Little Coogee Swamp	
	Little Dundarbar Sw	
	Little Mariginiup Lake	
	Loch McNess	
	Mariginiup Lake	
	Melaleuca Park Swamps	
	Neerabup Lake	
	Nowergup Lake	
	Pipidinny Swamp	
	Snake Swamp	
	Wallubuenup Swamp	
	Wilgarup Lake	
	Yeal Swamp	
	Yonderup Lake	

TABLE 22 (a): Land-fill projects in wetlands (1950-71)

A. Foreshores - Permanent Bodies of Water

Local Authority	Location	Date commenced	Date completed	Area Reclaimed	Average depth of fill
Town of Claremont	Lake Claremont	June 1955	December 1969	24.3 hectares (60 acres)	1.8 - 2.7m (6-9 ft)
City of Perth	Lake Monger	March 1950	1964	101.2 hectares (250 acres)	1.2 m (4 feet)
Shire of Cockburn	Bibra Lake	September 1968	1st & 2nd Sections 1971	6 hectares (15 acres)	1.2 m (4 feet)
			TOTAL:	131.5 hectares (325 acres)	

B. River - Foreshore

City of Stirling	Deeley St., Maylands	February 1960	July 1960	1.2 hectares (3 acres)	0.9 - 1.8 m (3-6 ft)
Shire of Bayswater	Kilne-Slade-King William Streets, Bayswater	July 1960	Several Sections December 1971	18.2 hectares (45 acres)	1.5 - 2.4 m (5-8 ft)
City of Perth	Rivervale	1950	1972	101 hectares (250 acres)	1.2 - 1.5 m (4-5 ft)
City of South Perth	Swan View St., South Perth	1959	1969	32.4 hectares (80 acres)	1.8 - 2.4 m (6-8 ft)
City of Melville	Canning Highway, Burke Dr., Attadale	August 1952	2 Sections by August 1969	60.7 hectares (150 acres)	1.4 m (4½ feet)
Shire of Belmont	Stoneham St., Belmont	1952	Still Proceeding	8 hectares (20 acres)	3.6 m (12 feet)
Shire of Canning	Wendourie Rd., Wilson	January 1962	Still Proceeding	14.2 hectares (35 acres)	1.5 m (5 feet)
			TOTAL:	236 hectares (583 acres)	

C. Low Lying Areas and Swamp Lands

City of Stirling	Hertha Rd., Osborne Park	June 1959	1st Section April, 1970	26.3 hectares (65 acres)	2.4 m (8 feet)
City of Stirling	Queen Street, Maylands	July 1961	1963	2.4 hectares (6 acres)	1.2 m (4 feet)
Shire of Bassendean	Guildford Rd., Ashfield	March 1963	1964	2.4 hectares (6 acres)	1.8 m (6 feet)
Shire of Swan-Guildford	3rd Ave., West Midland	June 1958	1st & 2nd Sections 1971	8 hectares (20 acres)	2.7 - 3 m (9-10 ft)
Shire of Canning	Kent St., Cannington	January 1956	December 1959	0.80 hectares (2 acres)	0.9 - 1.2 m (3-4 ft)
Shire of Canning	High Rd., Riverton	March 1960	1964	6 hectares (15 acres)	1.5 m (5 feet)
Shire of Cockburn	Hurford St., Hamilton Hill	September 1968	February 1969	4 hectares (10 acres)	1.8 - 2.4 m (6-8 ft)
City of Stirling	Wordsworth Ave., Yokine	July 1969	1971	4 hectares (10 acres)	1.2 m (4 feet)
Shire of Armadale	3rd Avenue, Kelmscott	February 1968	Still Proceeding	14.2 hectares (35 acres)	3-3.6 m (10-12 ft)
City of Melville	Bateman Rd., Bateman	August 1969	Still Proceeding	6 hectares (15 acres)	1.2 - 3 m (4-10 ft)
Shire of Wanneroo	Lake Pinjar	1971	Still Proceeding	0.40 hectares (1 acre)	1.2 m (4 feet)
			TOTAL:	75 hectares (185 acres)	

SUMMARY Since 1950 there has been approximately 445 hectares (1100 acres) of Wetlands and River foreshore reclaimed by land-fill at average depth of 1.8 m (6 feet).

TABLE 22 (b): Existing wetland land-fill sites 1973

Used By	Under Control of	Location	Whether Located MWB Restricted Area	Nature of Location	Method of Operation	Estimated Area	Anticipated Life of Site
South Perth C.C.	South Perth C.C.	Manning Rd, Manning	No	Wetlands	Excavation and filling	4 hectares (10 acres)	2 years
Canning T.C. South Perth C.C.	Canning T.C.	Wendouree Rd, Wilson	No	River foreshore	Filling	about 4 hectares (10 acres)	5 years +
Gosnells T.C.	Gosnells T.C.	Hume Rd, Thornlie	No	Wetlands	Excavation and filling	0.2 to 0.4 hectares (½ to 1 acre)	Limited to a few months
Armadale Shire	Armadale Shire	Third Avenue, Kelmscott	No	Wetlands	Excavation and filling	0.2 to 0.4 hectares (½ to 1 acre)	Limited to a few months
Perth C.C.	Swan Shire	West Midland	No	River flood plain & foreshore	Filling	about 28 hectares (70 acres)	5 years
Perth C.C. Stirling C.C.	Stirling C.C.	Hertha Rd, Osborne Park	Yes	Wetlands	Filling	about 12 hectares (30 acres)	2 years
Bassendean Shire Bayswater Shire	Bayswater Shire	Slade St., Bayswater	No	River foreshore	Filling	about 20 hectares (50 acres)	10 years
Belmont Shire	Belmont Shire	Stoneham St, Belmont	No	River foreshore	Filling	about 12 hectares (30 acres)	10 years
Wanneroo Shire	Wanneroo Shire	Lake Pinjar	Yes	Lake foreshore	Excavation and filling	61 hectares (150 acres)	10 years +
Cockburn T.C.	Cockburn T.C.	Bibra Lake	Yes	Lake foreshore	Excavation and filling	8 hectares (about) (20 acres)	5 years

SUMMARY

No. of river foreshore sites	4
Approx. area of River foreshore sites	69 hectares (170 acres)
No. of sites located on wetlands	6
Approx. area wetland sites	81 hectares (200 acres)

TABLE 22 (c): Possible future wetland land-fill sites (1973)

Location	Whether Located in MWB Restricted Area	Nature of Location	Approx. area	Remarks
Applecross Pine Plantation	Yes	Elevated dunes and wetlands	40 hectares (100 acres)	Development not likely
Elderfield Rd, Manning	No	River foreshore	about 12 hectares (30 acres)	Site recently nominated as alternative dry refuse site
Ellam St, South Perth	No	River foreshore	about 20 hectares (50 acres)	
S.Perth Pine Plantation	No	Elevated sand dunes and wetlands	about 20 hectares (50 acres)	
Guildford Grammar	No	River flood plain & foreshore	about 40 hectares (100 acres)	
Kings Meadow Guildford	No	River foreshore	about 12 hectares (30 acres)	
Gnangara Lake	Yes	Lake foreshore	about 12 hectares (30 acres)	Development not likely
Gribble Rd, Gwelup	Yes	Wetlands	about 20 hectares (50 acres)	
Wilson-Riverton area	No	River foreshore	81-121 hectares (200-300 acres) possible	
Westfield Park	No	Lake foreshore	about 20 hectares (50 acres)	Long term possibilities
Jandakot Lake	Yes	Lake foreshore	142 hectares (350 acres)	Development on land-fill site unlikely due to high ground water implications.
Pyrton - Eden Hill	No	Flood plain	about 48 hectares (120 acres)	
Bayswater-Bassendean	No	River foreshore	28-32 hectares (70-80 acres)	Proposed extension of existing site
Garvey Park - Belmont	No	River foreshore	about 20 hectares (50 acres)	
Brockway Ave, Swanbourne	No	Elevated sand dunes	about 12 hectares (30 acres)	

Summary	Listed	Non Listed	Totals
No. of sites located on River foreshore	4	4	8
Approx. area river foreshore sites	81 hectares (200 acres)	202 hectares (500 acres)	283 hectares (700 acres)
No. of sites located on wetlands	4	2	6
Approx. area wetland sites	89 hectares (220 acres)	32 hectares (80 acres)	121 hectares (300 acres)

TABLE 22 (d): Summary of land-fill sites in the Perth Metropolitan Area (1973)

	Total No. of Sites	Estimated Area	No. Sites Located MWB restricted area	Estimated Area restricted sites	No. sites Located river foreshores	Estimated Area River foreshore Sites	No. sites Located on wetlands	Estimated area sites located wetlands
Existing Sites	16	243 hectares (600 acres)	4	121 hectares (300 acres)	4	69 hectares (170 acres)	6	81 hectares (200 acres)
Alternative Sites	10	405 hectares (1000 acres)	3	202 hectares (500 acres)	4	129 hectares (320 acres)	2	170 hectares (420 acres)
Possible Future Sites Listed	14	607 hectares (1500 acres)	5	223 hectares (550 acres)	4	81 hectares (200 acres)	4	89 hectares (220 acres)
Non Listed	7	405 hectares (1000 acres)	1	142 hectares (350 acres)	4	202 hectares (500 acres)	2	32 hectares (80 acres)
TOTALS	47	1659 hectares (4100 acres)	13	688 hectares (1700 acres)	16	482 hectares (1190 acres)	14	372 hectares (920 acres)

* Tables 22 (a) - (d) are adapted from The Metropolitan Refuse Disposal Planning Committee Report (1974)