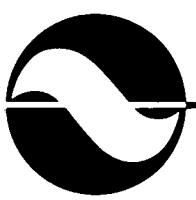
PROPOSED HARVEY-KWINANA 330kV TRANSMISSION LINE

PUBLIC ENVIRONMENTAL REPORT



STATE ENERGY COMMISSION
WESTERN AUSTRALIA

Prepared by

Report No. SD233
February 1988

Environmental Protection Authority
Public Environmental Report

Proposed Harvey-Kwinana 330kV Transmission Line

PUBLIC COMMENT INVITED

THE STATE ENERGY COMMISSION OF WESTERN AUSTRALIA has had a Public Environmental Report (PER) prepared on the proposed Harvey-Kwinana 330kV transmission line from the proposed Harvey substation site via the Pinjarra and Mandogalup areas to the existing power station at Kwinana, a distance of approximately 102km.

The Pubic Environmental Report will be available for Public review for 8 weeks from February 15th, 1988 to April 8th, 1988. Copies will be available for examination or loan at the following locations:—

- **Environmental Protection Authority, Reading Room, Ground Floor, 1 Mount Street, Perth.**
- **Environmental Protection Authority, Parmelia House, 165 Gilmore Avenue, Kwinana.**
- **Rockingham Shire Offices, Administration Centre, Council Avenue, Rockingham.**
- **Serpentine-Jarrahdale Shire Offices, Patterson Street, Mundijong.**
- **Shire of Harvey Offices, 102 Uduc Road, Harvey.**
- **Environment Centre of W.A., 794 Hay Street, Perth.**
- **State Reference Library, "Alexander Library Building", Perth Cultural Centre, Perth.**
- **Kwinana Town Council, Municipal Offices, Gilmore Avenue, Kwinana.**
- **Waroona Shire Offices, Hesse Street, Waroona.**
- **Shire of Murray Offices, Pinjarra Road, Pinjarra.**

Copies of the PER may be purchased for $5.00 from:—

State Energy Commission of Western Australia, Ground Floor, 363-365 Wellington Street, Perth.

Written submissions on the PER are sought by the Environmental Protection Authority. These should be submitted by April 8th, 1988 and addressed to:

Environmental Protection Authority
BP House, 1 Mount Street, Perth.
Attention: Ms G. Hanrahan-Smith

A guide to the preparation of submissions is included in the PER.

Ogilvy/SPI/841

PUBLIC ENVIRONMENTAL REPORT
PROPOSED HARVEY–KWINANA 330kV TRANSMISSION LINE

prepared for
the State Energy Commission of Western Australia

Dames & Moore Job No. 08038-092-071
February 1988

PUBLIC ENVIRONMENTAL REPORT
PROPOSED HARVEY-KWINANA 330kV TRANSMISSION LINE

prepared for

the State Energy Commission of Western Australia

The Environmental Protection Authority (EPA) invites people to make a submission on this proposal.

The Public Environmental Report (PER) for the proposed Harvey-Kwinana 330kV Transmission Line has been prepared by Dames & Moore for the State Energy Commission of Western Australia in accordance with Western Australian Government procedures. The report will be available for comment for 8 weeks, beginning on 15 February 1988 and finishing on 8 April 1988.

Comments from government agencies and from the public will assist the EPA to prepare an Assessment Report in which it will make a recommendation to Government concerning the proposal.

Following receipt of comments from government agencies and the public, the EPA will discuss the issues raised with the Proponent, and may ask for further information. The EPA will then prepare its Assessment Report with recommendations to Government, taking into account issues raised in the public submissions.

WHY WRITE A SUBMISSION?

A submission is a way to provide information, express your opinion and put forward your suggested course of action, including any alternative approach. It is useful if you indicate any suggestions you have to improve the proposal.

All submissions received will be acknowledged.

DEVELOPING A SUBMISSION

You may agree or disagree with, or comment on, the general issues discussed in the PER or specific proposals made by the proponent. It helps if you give reasons for your conclusions, supported by relevant data. You may make an important contribution by suggesting ways to make the proposal more acceptable.

When making comments on specific proposals in the PER:

- o clearly state your point of view,
- o indicate the source of your information or argument if this is applicable, and
- o suggest recommendations, safeguards or alternatives.

POINTS TO KEEP IN MIND

By keeping the following points in mind, you will make it easier for your submission to be analysed.

Attempt to list points so that the issues raised are clear. A summary of your submission is helpful. Refer each point to the appropriate section or chapter in the PER. If you discuss sections of the PER, keep them distinct and separate, so that there is no confusion as to which section you are considering.

Attach any factual information you wish to provide and give details of the source. Make sure your information is accurate.

Please indicate whether your submission can be quoted, in part or in full, by the EPA in its Assessment Report.

REMEMBER TO INCLUDE:

Your name, address, date.
The closing date for submissions is 8 April 1988.
Submissions should be addressed to:

The Chairman
Environmental Protection Authority
1 Mount Street
PERTH WA 6000

Attention: Ms. G. Hanran-Smith

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SUMMARY

In order to fulfill future power demands, the State Energy Commission of Western Australia (SECWA) proposes to construct a 330kV transmission line from Muja to Kwinana. This Public Environmental Report (PER) is one of a series of reports and ongoing studies related to that development. It addresses the section of the transmission line and easement extending from the proposed substation site near Harvey to the Kwinana Power Station, a distance of approximately 102km. For most of this distance, the proposed transmission line will traverse in parallel and on easements common with existing transmission lines. For the last 7km of line at the northern end of the route the line will be strung on existing towers. This factor, together with other technical, economic, social and environmental factors, was considered in the route selection for the transmission line.

The proposed route is located on the Swan Coastal Plain, a largely flat section of the Perth Basin. The transmission line will traverse mainly freehold agricultural land under pasture and will experience only a minimal loss of production over a short period during construction. Careful alignment, tower-siting and buffer vegetation will minimise this effect.

Natural vegetation and fauna of the region are mostly limited in distribution to existing and proposed conservation and recreation reserves, some of which are known to contain rare and geographically restricted species of flora and fauna. Although most of these reserves will be avoided, some sensitive areas will be traversed by the line, in which case the towers will be sited in locations that will cause minimal damage and clearing will be kept to a minimum. Ethnographic and archaeological investigations of known and newly identified sites have shown there to be a total of 54 sites within the vicinity of the line. None, however, is within the proposed easement and hence no disturbance will result.

The exact date of construction commencement is yet to be finalised as future power demands are difficult to accurately predict, however, it is expected that the project will be completed before 1995. The construction will take about 18 months, and will employ approximately 80 people. The SECWA proposes to consult land owners as to the time of year that least disruption to agricultural activities will occur due to construction activities. This will be considered when construction works are planned.

The SECWA does negotiate compensation to land holders for damage or loss of productivity brought about by the establishment of an easement.

An energised transmission line creates electric and magnetic fields surrounding the line conductors that diminish sharply with distance from the line. The World Health Organisation (WHO) has published documents containing recommended limits for exposure to both electric and magnetic fields. Comparison of these limits with field measurements made near to operating 330kV transmission lines in Western Australia shows the field strengths both outside and within the new transmission line easement will be below the WHO standards under normal operating conditions and will remain below these standards even under emergency load conditions. In addition, no dwellings or activities that would involve a prolonged presence within the easement will be permitted.

Depending on the local topography and vegetation cover, the transmission line will be visible for some distance in the surrounding countryside, although the visual impact of the transmission line will be kept to a minimum by appropriate tower sitings and with the use of buffer vegetation.

Careful consideration of environmental factors during the route selection process together with further studies along the route corridor indicates that construction and operation of the proposed transmission line can take place without unacceptable environmental impacts.

1.0 INTRODUCTION

1.1 BACKGROUND, OBJECTIVES AND SCOPE OF THE PROPOSAL

The State Energy Commission of Western Australia (SECWA) is responsible for the planning, design, construction, operation and maintenance of the transmission lines and substations required for the supply of electrical energy in Western Australia.

This study is one in a series of ongoing studies related to the construction of a 330kV transmission line interconnection between Muja and Kwinana, in the south-west of Western Australia. This interconnection will form an important part of the State's transmission network by connecting SECWA's two major generating stations. A Public Environmental Report (PER), produced in March 1985, addressed the proposed transmission line interconnections from Muja Power Station to a proposed substation near Harvey.

Dames & Moore has been commissioned by the SECWA to prepare a PER for the proposed Harvey - Kwinana 330kV transmission line. This document is the PER and, unless otherwise stated, refers to the Harvey - Kwinana 330kV transmission line and proposed easement only. Figure 1 shows the location of the proposed route for the line in a regional context.

The development will comprise a single circuit overhead 330kV transmission line from the proposed Harvey substation site via the Pinjarra and Mandogalup areas to the existing power station at Kwinana, a distance of approximately 102km. For most of the route, the 330kV transmission line will traverse in parallel and in a common easement with existing transmission lines. The 500m wide transmission line route corridor, together with the preferred transmission line route are shown on Figure 2.

The selection of this route corridor has involved consideration of technical, economic, social and environmental factors. Determination of the precise alignment of the transmission line within the corridor will be based on the results of a detailed centre line survey and design studies yet to be undertaken. The results of environmental studies undertaken to date, and ongoing environmental input, will be taken into account during alignment optimisation along the selected route.

1.2 DETAILS OF THE PROPONENT

The proponent for this proposal is the SECWA, the Government Authority responsible for management, planning, construction and supply of energy resources in Western Australia. Its main office is located at:

365 Wellington Street
PERTH WA 6000
Telephone: 326 4911

1.3 LOCATION AND TIMING OF THE PROPOSAL

The proposed project is to be located in the south-west of Western Australia, along a primarily northward route from the proposed Harvey Substation site to the existing Kwinana Power Station (Figure 1). For almost the entire length of the route the 330kV transmission line will traverse in parallel and in a common easement with existing transmission lines. The route is best described in three sections:

- Harvey to Pinjarra (51km),
- Pinjarra to Mandogalup (44km), and
- Mandogalup to Kwinana (7km).

The first section of the route parallels the existing Bunbury - Cannington (BU-CT) No. 1 132kV line from the Harvey Substation site almost to Pinjarra. There are minor deviations for major road intersections, to avoid dwellings and their environs and to minimise environmental impacts. The only major deviation is to the south and west of the Pinjarra townsite, where the new line will skirt the Pinjarra industrial estate boundary will cross the Murray River at a point of minimal impact.

Along the second section, the route joins the existing Muja - Southern Terminal 330kV line and follows it for most of the section. There is a deviation around existing domestic dwellings and small holdings at Anketell and the line then remains in a separate easement for the remaining 4km to Mandogalup.

The final section of the line into the Kwinana Power Station will be strung on the spare side of the double circuit structures presently carrying the Kwinana - Southern Terminal 330kV line.

The project was referred by the SECWA to the Environmental Protection Authority on 30 October 1986. The SECWA noted that the timing of the project is dependent upon the growth of power demand, although present load projections show the line will be required by mid-1994. In response, the EPA indicated that a PER should be prepared for the proposal, and advised that, in view of the uncertainty of the timing of the project, any environmental clearances should apply for a specified time only (this requirement has been referred to as a "sunset" clause). As project timing is still unclear, the SECWA proposes that, should the "sunset" clause be invoked by the EPA, the SECWA will prepare a supplement to this PER, containing new or updated material of relevance to the project and providing updated or new commitments to environmental management regarding matters such as any changes in land use, current practice in the development of clearing profiles, etc.

It is currently anticipated that the design and tender stage of the project will occupy approximately twelve months, and that construction of the project will be completed over a period of eighteen months to two years.

1.4 RELEVANT LEGISLATION

Legislation pertaining to the proposed development and to this PER includes:

- Environmental Protection Act, 1986
- Wildlife Conservation Act, 1950-1980
- Aboriginal Heritage Act, 1972-1980
- Conservation and Land Management Act, 1984
- State Energy Commission Act, 1979
- State Planning Commission Act, 1985
- Bush Fires Act, 1954-1981
- Agriculture and Related Resources Protection Act, 1976-1981
- Soil and Land Conservation Act, 1945-1982
- Town Planning and Development Act, 1928

1.5 THE EIA PROCESS

The Environmental Impact Assessment procedure is a formalised process designed to provide information to the Environmental Protection Authority (EPA) and the public about proposed developments which have the potential to generate significant environmental effects.

The Environmental Protection Act, 1986 was proclaimed on 20 February 1987 and the proposal will be assessed under this legislation. These new procedures formalise the review process that evolved under the previous legislation (Environmental Protection Act, 1971 - 1980) and provide for enforcement of management commitments made by the Proponent.

Following referral of a proposal to the EPA, the Authority determines the level of environmental assessment required and, in conjunction with the Proponent, develops guidelines for the appropriate environmental report. In the case of the Harvey-Kwinana 330kV transmission line proposal, the EPA required that a PER be produced. The guidelines for the document are given in Appendix A.

A PER is a public document and submissions by interested persons and groups are encouraged in order to assist the EPA in its assessment of the proposal and in framing its advice to the Minister for the Environment.

2.0 NEED FOR THE PROPOSAL

Studies have revealed that in order to meet the increasing energy demand from the SECWA's interconnected power system it will be necessary to construct a new 330kV transmission line between the major generating stations in the Collie coalfield and the metropolitan area. The transmission line is essential to the security of power supplies to the metropolitan area.

Present load growth projections indicate that the transmission line will be required by the middle of 1994. Development of the first stage of a new power station near Collie is expected to proceed concurrently.

The capital cost of the project will amount to about $70 million in 1993, more than 90% of which will be retained within Western Australia. Up to 80 full-time jobs will be created during the project construction period.

Later stages of the new Collie Power section are not yet determined but present planning indicates 2001 at the earliest. Depending upon system load growth and the location where such growth occurs, there may at that time be a need for another 330kV transmission line from the Collie area.

3.0 DESCRIPTION OF THE PROJECT

3.1 PROJECT ELEMENTS

The easement for a single circuit 330kV transmission line is 60m wide, with the line located centrally in that easement.

If the proposed line were to abut an existing 330kV line, as is the case for part of this proposed transmission line (Figure 2), the existing easement would be widened by 50m to a width of 110m, thus accommodating both lines. This would allow 50m between each line and 30m to the edges of the easement. The towers would be located adjacent to one another rather than staggered along the length of the line. In the case of a shared easement with lower voltage lines, such as the 132kV BU-CT line, the combined easement would also be 110m wide, in order to provide for upgrading of the 132kV line to a 330kV line in the future. However, structures would be staggered due to the differing span lengths.

Details of the transmission line are likely to be as follows:

Tower construction	:	4 leg steel lattice
Tower height (range)	:	22 - 40m
Minimum ground clearance at maximum conductor sag	:	8m
Typical span between towers	:	300 - 400m

Various arrangements of tower heights and spans can be expected, as optimisation depends on detailed analysis of the topography along the route. Depending on the topography, it may be economically and environmentally desirable to opt for higher towers with longer spans resulting in fewer towers along the route.

The 8m minimum clearance between the ground and the conductors at their lowest point represents a worst case condition; under normal operating conditions, clearance is significantly greater.

3.2 TRANSMISSION LINE DEVELOPMENT PHASES

The following activities are undertaken during the design, tender, construction and operation of a 330kV transmission line.

3.2.1 Design and Tender

During the design and tender phase, the following activities occur:

- Planning,
- Route selection,
- Consultation with affected Local Authorities, property owners and occupiers,
- Route survey and centreline pegging,
- Preliminary design of transmission lines,
- Preparation of specifications and drawings,
- Evaluation of tenders and selection of contractor, and
- Awarding of contract.

3.2.2 Construction

During the construction phase of the transmission line project, the following activities occur:

- Consultation with property owners and occupiers,
- Level survey, tower spotting and clearing,
- Foundation construction,
- Assembly and erection of towers,
- Earthing of tower bases,
- Stringing and tensioning of phase and earth conductors, and
- Commissioning.

The SECWA's Properties Officers have established and will maintain contact with property owners and occupiers in order to ascertain individual requirements affecting the project.

The most suitable period for construction work will be during the dry season (November to April). However, since the transmission line construction work is expected to take approximately 18 months to two years to complete and will therefore need to proceed at all times of the year.

Timing of construction activities will, where possible, take into account landholders' farming practices so as to minimise disturbance to the farmers' use of land. Compensation will be negotiated where farmers suffer loss of production.

3.2.3 Operation and Maintenance

Periodic line inspections will be undertaken so as to maintain the desired "clearing profile" of the easement. (The "clearing profile" for a typical 330kV transmission line is depicted on Figure B1, in Appendix B).

On average, every two years some vegetation maintenance work will be required along the transmission line. In these instances the vegetation will be cut back to the maximum permissible height as defined by the clearing profile. Other considerations that may influence the decision to maintain a particular area are:

- the degree of fire risk, and
- the type of season experienced.

3.3 WORKFORCE AND MATERIAL SOURCES

Work on the 330kV transmission line will be undertaken by contractors under the supervision of the SECWA. The number of people employed on site is expected to range from 10 workers at the commencement of the construction phase to a peak workforce of approximately 80 workers.

The nominal breakdown of the source of materials for the transmission line work is estimated to be 90% Australian and 10% overseas. For the line work it is expected that the insulators may be imported, but the galvanised steel, the aluminium conductor and the attachment fittings will be manufactured in Australia.

4.0 ALTERNATIVE ROUTES CONSIDERED AND SELECTION OF THE MOST FAVOURED

The route preferred for economic and, in general, for environmental reasons is one which parallels existing transmission lines, sharing easements with them but not crossing them. Other major options which were considered, but were rejected for economic and environmental reasons are shown on Figure 2.

The preferred route was deviated westward from the existing 132kV line, at Johnston Road and Peel Road West to minimise visual intrusion to residences, and at Old Bunbury Road to reduce impacts on Recreation Reserve 6038 and its rifle range, native vegetation and wildlife. The route also deviates around the western side of Pinjarra and at the Murray River to avoid a riverside reserve (Reserve 30342), a drag strip and native vegetation fringing a wetland. It deviates from the existing 330kV line in Anketell to avoid dwellings.

Two additional deviations have been considered on environmental grounds. The two areas concerned are the Hymus Swamp area, north of Karnup Road, and a pair of wetlands, north of Thomas Road and east of The Spectacles.

The northern part of the Hymus Swamp area, between Karnup Road and the Serpentine River drain north of it, is subject to an EPA System 6 recommendation (EPA, 1983), which is discussed later in this report in Section 5.1. The preferred route for the proposed transmission line parallels the existing 330kV line and shares the western side of the existing easement. An alternative option deviates westward, north of Karnup Road, crosses the Serpentine River drain and joins the preferred route north of the drain.

This alternative route was not preferred because it would be more visually obtrusive, would require more vegetation clearing, particularly of large eucalypts, and would be much more expensive to construct. Special attention will be given to minimal clearing through the System 6 recommended area to ensure revegetation of the easement and maintenance of the vegetation in it.

The alternative route in the Thomas Road area is not preferred for social reasons, these were to avoid several blocks of private property near dwellings; because the southern, larger wetland and fringing vegetation of the pair of wetlands has recently been partially cleared; and because "minimal clearing" will leave the southern wetland undisturbed by the project. Construction along the preferred route will mean that the eastern edge of the northern wetland paperbark forest will be cleared, but rehabilitation will encourage the growth of a myrtaceous thicket to replace the cleared strip of forest.

5.0 THE EXISTING ENVIRONMENT

5.1 LAND USE AND TENURE

The proposed transmission line route is located on the Swan Coastal plain. Land tenure along the route is depicted in Figure 2.

The first section of the transmission line route, from the proposed Harvey Substation site to Pinjarra, follows an existing 132kV transmission line route, with minor deviations to allow for major road intersections, to avoid dwellings and environs and to minimise impacts on the natural environment. The transmission line crosses the Harvey River and several minor drainage lines, through primarily privately owned rural land. At the southern perimeter of the Pinjarra townsite, the route deviates to the west, away from the existing 132kV line and skirts outside the western boundary of the Pinjarra industrial estate. This deviation also results in the line crossing the Murray River at the most environmentally sound location.

The second section, from Pinjarra to Mandogalup, follows the existing Muja-Southern Terminal 330kV line across mainly privately owned rural land over almost its entire length. The proposed route corridor in one part of this area has taken into consideration two constraints relating to airstrips. In the Serpentine area there is a light aircraft landing strip, currently leased to a private club. Directly adjacent and to the east is a site which is under consideration by the Department of Aviation for development as an airport similar to that at Jandakot.

Directly to the north of Karnup Road in the Serpentine area is Hymus Swamp, which the System 6 Study (Environmental Protection Authority, 1983) identifies as an open space of regional significance and to be designated as a regional park. The existing 330kV line traverses the swamp, and it is considered environmentally preferable to locate the new line on the west side of this line with a shared easement.

For the rest of the route, the transmission line crosses numerous small roads.

The common route arrangement continues as far as Thomas Road in Anketell where, because of existing domestic dwellings, the route has to be deviated slightly to the west and away from the existing 330kV line. Immediately to the north of Thomas Road, the proposed line is maintained to the west of the existing 330kV line, through an area of privately owned rural land.

The final section of the proposed transmission line, from Mandogalup into the Kwinana Power Station, will be strung along the spare side of the existing double circuit structures which presently have the Kwinana - Southern Terminal 330kV line on them. This will have minimal impact on the surrounding environment, which is primarily privately owned rural land.

No conservation reserves are crossed by the route. However, the route does cross one System 6 area recommended for conservation by the EPA (Hymus Swamp), and one Recreation Reserve near Pinjarra (Reserve 6038 next to Old Bunbury Road). Several drains and drain reserves and two narrow strips of vacant crown land, north of Harvey River and north of Coronation Road, are also crossed by the route.

5.2 NATURAL ENVIRONMENT

5.2.1 Physical Environment

The climate of the project area is dry Mediterranean, which is characterised by warm dry summers and mild, wet winters. Annual average rainfall ranges between 800mm and 1,000mm (Beard, 1981).

The proposed transmission line passes over the Swan Coastal Plain, which is part of the Perth Basin geological formation. This Basin is a deep trough filled with Phanerozoic sedimentary rocks and with a surface mantle of Quaternary deposits (Playford et al., 1975).

The Swan Coastal Plain is a narrow (20 - 30km wide) strip of Quaternary alluvial and aeolian sediments, generally of low relief. The two main landform units in the project area are the Pinjarra Plain, containing several alluvial units of different ages, and the Bassendean Dune system, characterised by highly leached siliceous sands and interdunal swamps (Seddon, 1972). For the most part, the soils are medium-coarse-textured sands (Churchward and McArthur, 1980).

Along the entire length of the proposed transmission line route only three major natural drainages are intersected. These are the Harvey, Murray and Serpentine Rivers. Several minor channels are also crossed.

5.2.2 Biological Environment

The Harvey - Kwinana part of the proposed Muja - Kwinana 330kV transmission line route runs along the centre of the Swan Coastal Plain. Consequently, only Swan Coastal Plain vegetation, flora and fauna will be intercepted or affected by the project. General descriptions of Swan Coastal Plain native vegetation, flora and fauna given in Appendix B of the Muja - Harvey PER (Dames & Moore, 1985) also apply to the Harvey - Kwinana PER. The following, more specific descriptions are based upon interpretation of aerial photographs and a spring field survey of the route.

5.2.2.1 Vegetation

The native vegetation of the route comprises a few stands of woodland, low forest, heaths, shrublands and swamps and remnant trees in pastures. Most of the relatively intact woodlands are dominated by jarrah (Eucalyptus marginata) and, to a lesser extent, marri (Eucalyptus calophylla), with banksias (Banksia attenuata and others), peppermint (Agonis flexuosa) and sheoak (Allocasuarina fraseriana) as understorey trees. Moonah paperbark (Melaleuca preissiana) is dominant in most swamp woodlands, while swamp paperbark (Melaleuca rhaphiophylla), sometimes with flooded gum (Eucalyptus rudis), forms dense swamp low forest in some seasonally wet areas. Various species of shrubby melaleucas, Tea-trees and other shrubs and sedges constitute thickets and complexes in other seasonally wet areas.

Areas of native vegetation, including sensitive species, are indicated in Figure 2, and are summarised in Table 1.

TABLE 1

VEGETATION OF THE PROPOSED TRANSMISSION LINE ROUTE

SYMBOL	VEGETATION UNIT
CL	Non-Native and Partially Native Vegetation
	Cleared Land, mostly pastures, irrigated and unirrigated, and grazing land, some with scattered individual trees, primarily Marri, groves and thickets
CL/(J)(M)	Cleared Land with scattered Jarrah and Marri and/or small degraded groves
CL/JM	Cleared Land and remnant, degraded Jarrah-Marri Open Forest or Woodland
CL/BS	Cleared Land with remnant, degraded patches of Banksia woodland and swamp vegetation
	Open Forest and Woodland
J	Jarrah (Eucalyptus marginata) dominant
M	Marri (Eucalyptus calophylla) dominant
JM ...	Jarrah, Marri, ... co-dominant
A	Peppermint (Agonis flexuosa) a co-dominant with Jarrah and Marri
J (M)(R)(P)(...)	Jarrah dominant; Marri, Swamp Paperbark, Moonah Paperbark, ... subdominant to scattered
T	Tuart
	Fringing Forest or Woodland and Low Woodland or Open Woodland
F;(F)	Flooded Gum (Eucalyptus rudis) dominant; (isolated trees)
R;(R)	Swamp Paperbark (Melaleuca rhaphiophylla) dominant; (isolated trees)
P;(P)	Moonah Paperbark (Melaleuca preissiana) dominant; (isolated trees)
B;(B)	Banksia species (B. attenuata, B. menziesii) dominant; (isolated trees)
S	Swamp Vegetation and Heathlands
SP	Sedgelands and Swamps with scattered Moonah Paperbark trees in or around the periphery
SA	Swamps or Heathlands dominated by Agonis linearifolia, Astartea fascicularis or Pericalymma ellipticum

There are five significant areas of relatively natural native vegetation traversed by the proposed route. All of these support native vegetation which provides valuable native flora and fauna habitats; four of the five are on private property. The five areas and their native vegetation are:

1 **Location 3071 – south side of Riverdale Road – southern end of Harvey–Kwinana route** – Jarrah–banksia Woodland and Melaleuca–Tea–tree–Kunzea Swamps and intermediate vegetation. The route largely follows a ridge between the substation site and Riverdale Road where damage to native vegetation and the Acacias species will be least severe. The vegetation and flora are described in greater detail in a 1986 (10 July) report by Dames & Moore to the SECWA.

2 **Parts of Locations 323 and 688, between Buller Road and Coronation Road**– Hilltop Jarrah Woodland (to Open Forest) with Banksia attenuata, sheoak, woody pear (Xylomelum occidentale) and, on lower slopes, holly–leafed banksia (B. ilicifolia) and Kunzea (Kunzea ericifolia); plus edge of paperbark swamp with swamp paperbarks, Kunzea and Astartea fascicularis, with grazed weeds and pasture grasses. This is part of the block of vegetation containing Reserve C22199 (System 6 Recommendation C59), "the only large area of its type between Mandurah and Bunbury" (Environmental Protection Authority, 1983). The proposed route shares the western side of an existing easement through the centre of the western part of the block.

3 **Recreation Reserve 6038 and Murray Pistol Club grounds in corner of Browns Road and Old Bunbury Road** – Paperbark swamp and shrub vegetation with Marri Woodland and understorey vegetation in moderate to good condition. Route runs through south–west corner of reserve.

4 **Nine of ten contiguous, unseparated Locations, 1191 – 1199, east of the Peel Estate's "The Spectacles", between Thomas Street and Hope Valley Road** – South end: Flooded Gum (Eucalyptus rudis) Woodland, Moonah Paperbark Woodland and Swamp Paperbark Forest, all recently partly cleared; **North end**: Banksia menziesii, (and B. attenuata and B. ilicifolia) Low Woodland with scattered jarrah overstory; **Between**: Banksia Low Woodland to Open Forest, mostly with jarrah, some with tuart (Eucalyptus gomphocephala), and one stand of dense Swamp Paperbark Forest. Aside from the effects of P.c. Dieback (Phytophthora cinnamomi) most of the vegetation is in good condition. The route runs along the eastern side of the block.

5 Hymus Swamp

The vegetation along the proposed route between Karnup Road and Serpentine River drain is, in terms of condition and structure, of four basic types. The types are clearly distinguishable on black and white aerial photographs and are separated from each other by fences. They are indicated in Figure 2 by the symbols A, B, C and D, and some are illustrated on Plate 1.

o Vegetation Type A

The southernmost vegetation in the block running north from Karnup Road is principally fallow, ungrazed pasture with an abundance of rushes (Juncus pallidus). On the west, and intruding into the easement, there is a low forest and woodland of flooded gums (Eucalyptus rudis) and Moonah paperbarks (Melaleuca preissiana) with an understorey of the native shrub Astartea fascicularis and herbaceous pasture grasses, weeds and the restionaceous sedge Restio stenostachyus. The Restio occurs as a flowering carpet to over 50cm tall and has many orchids in it.

o Vegetation Type B

The vegetation north of A is similar, except that the herbaceous vegetation, including the Restio, is heavily grazed and without orchids and there are fewer trees. In the southern part of the block, west of the easement, there is a farm dam surrounded by young flooded gums.

o Vegetation Type C

Vegetation Type C is in the area recommended by the EPA as M105.

East of the existing easement, it is a Banksia Low Forest (Vegetation Type C1) with a sparse understorey. Although many of the banksias in the forest are dead, it is impressive for its height, density and age. The common trees in the forest include Banksia attenuata, B. ilicifolia, B. menziesii, Nuytsia floribunda, Melaleuca preissiana and, more commonly as a large shrub, Kunzea ericifolia. Marri, jarrah and flooded gums are occasional members of the forest overstorey, and Dasypogon bromeliifolia, Phlebocarya ciliata and ? Loxocarya fasciculata are common in the understorey.

On the west side of the existing easement the forest is broken up by small stands of Moonah paperbarks, tall thickets of Kunzea ericifolia and low thickets of Regelia aff. inops and Hypocalymma angustifolium (Vegetation Type C2). Grazed Restio stenostachyus is also common along the route in this area, along with Jacksonia sericea.

Kunzea ericifolia to 3m tall is regenerating well under the existing transmission line.

- **Vegetation Type D**

North of Vegetation Type C, and between it and the Serpentine River drain to the west, there is a woodland of what appears to be flooded gums, with some marri, and a ground layer of grazed pasture grasses and weeds.

5.2.2.2 Flora

The Harvey - Kwinana transmission line route is in the Swan Coastal Plain portion of the Drummond Botanical Subdistrict (Beard, 1981). The vascular plant species of the Swan Coastal Plain are described in the Flora of the Perth Region (Marchant et al., 1987), and the plant names used in this PER conforms to usage in this publication.

The 19 flora species listed in Table 2 recorded from the broad vicinity of the route are rare or geographically restricted, or are poorly known but may be rare or restricted. The list includes three species which are gazetted as rare (Government Gazette, W.A., 25 September 1987): Aponogeton hexatepalus, Caladenia sp. and Diuris purdiei. No gazetted rare species was found along the route or is believed to occur there. Three species variously regarded as rare, restricted or poorly known (by, e.g., Marchant and Keighery, 1979), Acacia flagelliformis, Acacia semitrullata and Evandra pauciflora, were found at the southern end of the route, in the Riverdale Road area, and two others, Jacksonia sericea and Restio stenostachyus, were found in the Hymus Swamp area. This is well south of the previously recorded range for the Restio, which is Gingin to Perth (Marchant et al., 1987). These species are shown on Plate 2.

Villarsia violifolia occurs in the corridor, in paperbark low forest west of the route in paperbark forest north of Thomas Street.

TABLE 2

RARE, RESTRICTED AND POORLY COLLECTED PLANT SPECIES POSSIBLY IN PROJECT AREA

SCIENTIFIC NAME	FLOWERS(±)	HABITAT
Acacia flagelliformis	May - Aug	Seasonal semi-swamps; Drummond Subdistrict
Acacia semitrullata	May - Sep	Lower, sandy slopes under Jarrah-Marri-Kunzea ericifolia; Drummond and Warren Subdistricts
* Aponogeton hexatepalus	Aug - Sep	Seasonal swamps, in water or at water's edge; Drummond and Warren Subdistricts
Boronia capitata ssp. gracilis	Jun - Oct ?	In or near seasonal swamps; Drummond Subdistrict
* Caladenia sp. A? (SDH 3400)	Sep - Oct	Lush undergrowth under Banksias; Drummond Subdistrict
Cartonema philydroides	Oct - Nov	Low-lying sandy soils in Jarrah-Marri woodland on coastal plain. Ludlow to Gingin (and Kalbarri)
* Diuris purdiei	Sep - Oct	Swampy areas on sandy clay between Cannington and Pinjarra
Drakaea jeanensis	Sep - Oct	Sandy soils near swamps; Swan Coastal Plain
Evandra pauciflora	Sep - Oct ?	Seasonal swamps; Drummond Subdistrict
Helipterum pyrethrum	Oct - Nov	Seasonal swamps, in water or at water's edge; Drummond Subdistrict
Hemigenia microphylla	Sep - Nov	Seasonal swamps; Drummond Subdistrict
Jacksonia sericea	Dec - Feb	Sandy soils in Banksia woodland; Perth to Pinjarra
Lasiopetalum membranaceum	Sep - Nov	Tuart woodland; Drummond Subdistrict
Parsonsia diaphanophleba	Jan - Jun ?	River banks from the Harvey River to Murray River
Pultenaea skinneri	Jul - Sep	Ecotone between swamps and Jarrah-Marri-Banksia forest; Dale, Drummond and Menzies Subdistricts
Restio stenostachyus	Feb-May	Sandy, winter-wet depressions and along watercourses. Gingin to Hymus Swamp
Stylidium utricularioides	Oct - Nov	Flat, swampy areas; Bunbury to Gnangara
Villarsia violifolia	Nov - Feb	Seasonal freshwater swamps and streams; Drummond and Warren Subdistricts
Xyris lacera	Dec - Mar	Freshwater swamps; Drummond, Warren and Eyre Subdistricts, but rarely recorded in Perth Region

* Listed in Government Gazette, W.A., 25 September 1987, as rare species

5.2.2.3 Fauna

The five significant areas of relatively natural native vegetation discussed above and other, smaller and more disturbed areas of native vegetation along the route provide habitats for native fauna. The importance of these habitats is continually increasing as remnants of native vegetation on the heavily agriculturalised Coastal Plain are further degraded and reduced in quantity and extent.

Most native species of vertebrates expected along the route are wide-ranging and reasonably common, but three which may occur along the route or in its vicinity are gazetted as "rare, or otherwise in need of special protection" (Government Gazette, W.A., 22 November 1985, p. 4408). These species are Freckled Duck (Stictonetta naevosa), Red-eared Firetail (Emblema oculatum) and Carpet Python (Morelia spilota imbricata).

The Freckled Duck is also considered to be vulnerable and at risk (Ride and Wilson, 1982). Freckled Ducks are known to occur and could breed in "The Spectacles" wetland immediately west of the significant vegetation Area 4 (in Anketell) discussed above (Jaensch, pers. comm.), and Area 4 contains suitable habitat for the duck.

5.3 SOCIAL ENVIRONMENT

The existing social environment along the proposed transmission line is largely rural, with sparse dwellings located on large farms. There are two major towns in the vicinity of the line, Pinjarra (population 1,589, ABS 1986 Census), which lies 2km from the line, and Kwinana (population 11,798, ABS 1986 Census), into which the line extends. There are several smaller rural areas which will also be in the vicinity of the line - Karnup, Baldivis, Welland, Anketell and Mandogalup. The proposed route avoids all of these more populated areas.

5.4 ARCHAEOLOGY AND ETHNOGRAPHY

An Aboriginal site survey of the proposed Harvey - Kwinana 330kV transmission line was undertaken in July 1987. The survey comprised archaeological and ethnographic components.

The objectives of the archaeological survey were:

- o The assembly of previous data to form a predictive strategy and framework,
- o A systematic sample survey of the proposed route corridor,
- o An investigation of likely archaeological areas, and
- o The location and recording of archaeological sites.

Previous work had identified 47 archaeological sites in the general vicinity of the proposed route. All of the sites are registered with the Western Australian Museum, and all are small (less than 100 pieces), with predominantly quartz artefact scatters. They are situated either on watercourse or swamp margins or in areas where vegetation is absent due to sand quarrying, grading or natural blow-outs. None are in the proposed easement or nearby.

During the archaeological survey, seven archaeological sites were located and recorded. As with the previously recorded sites they are all small, low density quartz surface artefact scatters. Six are situated on the margins of swamps and the other is on the northern bank of the Murray River. Of the seven sites, none is located in the proposed easement or likely to be affected by the construction of the transmission line.

Four phases were involved in the ethnographic work:

- o Examination of existing ethnographic data bases,
- o Consultation and discussions with key Aboriginal persons and organisations,
- o Scouting the powerline route with Aboriginal assistants, and
- o Report preparation.

Near the point where the transmission line will cross the Murray River, four Aboriginal sites have been previously recorded.

The preferred route avoids all of these sites, but two of the sites, S2229 and S2230, are within the corridor.

The ethnographic survey recorded only one new Aboriginal site, an Aboriginal camping ground used in the 1930's and 1940's. The site is located to the south of Buller Road, immediately east of the existing Muja – Southern Terminal 330kV transmission line and approximately 1.5km east of the proposed 330kV transmission line. This site is outside the transmission line corridor.

Appendices C and D give full details of the archaeological and ethnographic studies undertaken.

6.0 ENVIRONMENTAL IMPACTS AND THEIR MANAGEMENT

6.1 IMPACT ON RESOURCES AND LAND USE

6.1.1 Water Resources

The proposed transmission line will utilise extensions to existing easements and will run through cleared or partially cleared land for most of its route. Consequently, increases in salinity in neighbouring rivers due to clearing are unlikely.

Clearing activities will be restricted to tower positions, track access and vegetation which extends into the clearing profile. These activities have some potential to increase runoff and erosion, which could increase sedimentation and turbidity of the two main rivers (Harvey and Murray) and several other drainage lines. Such runoff cannot be completely avoided on slopes since the access track must remain trafficable to four wheel drive vehicles at all times, for inspection and maintenance. However, the route is generally flat, and in any areas where the access track must be oriented down steep gradients, precautions will be taken to divert runoff into vegetated, more stable areas while maintaining vehicle access. This should limit erosion and stream turbidity to within acceptable levels.

6.1.2 Land Use

Observation of existing transmission lines through farming areas in the vicinity of the proposed transmission line route indicates that the loss of productive land due to the presence of a transmission line is very small. Even the transmission line access track supports some growth, often comparable with that which occurs outside the transmission line easement.

There will be some unavoidable inconvenience to landholders during construction, and the limitations on construction within the easement may also cause some inconvenience. The SECWA does negotiate compensation to landholders for damage or loss of productivity brought about by establishment of an easement.

Although alternatives have been sought, the proposed transmission line will pass through, and nearby to, several recreation and conservation reserves. This will cause some degree of visual impact, which will slightly decrease the recreation value of some of these areas.

6.2 BIOLOGICAL EFFECTS

Conceptual alignments for the transmission line were selected, where possible, to avoid areas of sensitive and restricted ecosystems. Where such areas could not be avoided altogether, the route has been selected to cross over the least sensitive parts of the areas or minimal breadths of them. For example, the proposed route runs along a ridge between the Harvey substation site and Riverdale Road where Acacia flagelliformis, Acacia semitrullata, Evandra pauciflora and their restricted habitat in the area are poorly represented relative to the rest of the area. The clearing profile will be high enough to avoid the lower vegetation strata of which the rare, restricted and uncommon species are components.

6.2.1 Clearing of vegetation

Construction of the transmission line will require clearing of native vegetation which extends into the "clearing profile" (see Appendix B) within a strip 60m wide (30m either side of the centreline), and complete clearing to ground level of a 4m wide strip of vegetation for access.

Due to the ecological value of the dense shrub vegetation and wetland communities on the coastal plain, steps will be taken to minimise clearing in these places. Design studies will be aimed, where practicable, at maximising the height of the conductors. In these areas span lengths can be increased. Permanent access tracks will be detoured to use existing wetland crossings wherever practicable, enabling retention of the shrub layers and other vegetation.

6.2.2 Rehabilitation and Maintenance

Maintenance activities for the life of the transmission line will preclude re-establishment of vegetation in the 4m wide access track and under the transmission towers. The procedures to be adopted for easement clearing (see Appendix B) will result in retention of rootstock and seedstock of understorey species. Easement maintenance will be aimed at restricting/preventing vegetation growing into the required clearing profile. Groundcover and a shrub layer under the transmission line will be permitted to a maximum height of 1.5m.

6.2.3 P.c. Dieback Disease

The spread of P.c. dieback disease (Phytophthora cinnamomi) has been linked to the movement through native vegetation of vehicles and, more particularly, heavy earthmoving machinery. Dieback is widespread on the Swan Coastal Plain, and it is clear that parts of the vegetation in the route are infected by the disease. Safeguards to prevent or minimise the spread of dieback into dieback-free areas of native vegetation and croplands during transmission line clearing have been established in consultation with CALM. These safeguards are outlined in Appendix B. They include restrictions on construction clearing following heavy rain, washdown of vehicles before moving from "non-protectable" to "protectable" areas and a workforce awareness programme.

6.3 ARCHAEOLOGICAL AND ETHNOGRAPHIC EFFECTS

The newly recorded ethnographic Aboriginal sites and the previously recorded sites are outside the preferred transmission line route, and therefore will not be affected by construction of the line. However, one site, WA Museum Site S2229, lies in the corridor, immediately west of the proposed easement, and should not be affected by the project. If any need to disturb the site develops, formal application will be made through the Department of Aboriginal Sites to disturb this site (see Addendum D-I of Appendix D, for details).

When, as previously planned, the route would have crossed the site, key Aboriginal persons were satisfied that permission to disturb this site should be granted. It is recognised that an overhead transmission line constitutes minimal disturbance and that the history of the area is amply preserved through registration and recording at the Western Australian Museum.

As human interference to Aboriginal sites is an offence unless authorised under the Aboriginal Heritage Act (1972-1980), the SECWA will take adequate measures to inform project personnel of this requirement.

6.4 AESTHETIC EFFECTS

The proposed transmission line route crosses generally flat country with some areas of low hilly relief. Field inspection by a landscape architect indicates that visibility of the transmission line from roads and habitations will generally be restricted, due both to vegetation blocking the view and to distances from most roads and dwellings.

Throughout the length of the transmission line, spacing of the towers and their levels will be given special attention during detailed design, in order to minimise visual intrusion on the landscape.

Towers will, where possible, be located close to the edges of wooded areas and rows of trees in order to minimise the visual intrusion of structures located on cleared land.

Where the Murray River is crossed, the proposed route has been selected in a section of river that will not be readily viewed by the general public.

There are no major highway crossings on the proposed route. In the cases where other roads are crossed, the following guidelines will be applied, where possible, to minimise visual impacts:

- o Ideally, the crossing will be effected at right angles, but where this is impracticable the closest possible alignment to this will be achieved;
- o Towers will be located as far as practicable from the road;
- o A strip of understorey shrubs up to three metres high will, where possible and practicable, be maintained for at least 10m on either side of the road. This will depend to a large extent on the nature of the vegetation at the precise crossing location selected; and
- o If little or no vegetation occurs at the crossing, then appropriate roadside verge planting of local vegetation will assist in reducing the impact.

By keeping the towers set back from the road (at least 50m from the road centreline), their impact will be reduced, particularly where the intervening shrub layer can be retained or re-established.

The intervening shrubs and small trees do not have to be high to be effective, as illustrated on Figure 3 and Plates 1 and 2.

6.5 EFFECTS OF ELECTRIC AND MAGNETIC FIELDS

An energised transmission line creates electric and magnetic fields surrounding the line conductors. In recent years, media attention in Australia has been directed towards possible health effects associated with such fields, and consequently, the EPA has recently commissioned a report entitled "Review of High Voltage ELF Transmission Line Field and Human Health Effects" (Scott & Furphy, 1987).

The report states that any link between human health and ELF (extra low frequency) electric or magnetic field exposure is neither proven nor disproven at this time. In view of this uncertainty, various international bodies have established recommended maximum levels for electric and magnetic field strengths. Studies of field measurements have been carried out in Western Australia as part of the Scott & Furphy study and both electric and magnetic field values beneath transmission lines were found to be considerably lower than the recommended limiting values.

Electric and magnetic field strengths at one metre above ground across the line easement at various locations between Muja and Kwinana are shown in Figures 4A to 4D. These show the fields that are expected to be generated by existing lines and the proposed line.

The Emergency Load curves represent the magnetic field for the highest possible load conditions. These are unlikely to ever occur and, if they do, would last only a few hours. The shaded areas represent the range of magnetic fields that will occur over a typical 24 hour period. Field strengths towards the top of the shaded bands will arise during peak load periods, in summer and winter, whereas lower field strengths will occur at night, during spring and autumn when loads are at a minimum.

The World Health Organisation has advised that it will soon be publishing a new document on magnetic fields and related health effects entitled "Environmental Health Criteria 69 - Magnetic fields". This publication will supplement the existing Environmental Health Criteria 35 (WHO, 1984), which are principally concerned with electric fields.

It is understood that the new document will reduce the recommended limit for exposure to low frequency magnetic fields from 0.3mT to 0.2mT (3,000 milligauss to 2,000milligauss). The limit for electric fields remains at 10 kV/m as indicated in Environmental Health Criteria 35.

The highest magnetic fields that could occur within the easement under emergency conditions are less than 30% of the 0.2mT limit. Under normal loading conditions, the fields are less than 10% of the limit. The highest magnetic fields at the edge of the easement are 2.5% of the limit.

The highest electric field that could occur within the easement is slightly less than 8kV/m, which represents 80% of the recommended 10kV/m limit for short-term exposure. At the edge of the easement, the maximum field is less than 1kV/m.

In evaluating these results, it is important to note that:

- No dwellings will be permitted within the easement for the proposed line.
- Activities within the easement that would involve a prolonged presence within the easement will not be permitted.

6.6 PUBLIC ACCESS

The SECWA's policy is to discourage public access along its transmission lines. This policy reflects the need to protect the transmission line installations from such actions as:

- Removal of angle iron from the tower structures,
- Shooting at insulators,
- Passage of overheight vehicles beneath conductors, and
- Damage to the access track.

Gates will be established where transmission lines cross existing fences. Under normal circumstances, these gates will be kept locked.

In order to minimise environmental damage and to discourage public use of access tracks, their construction and maintenance will be only to the minimum standard that is consistent with convenient four wheel drive access by the SECWA vehicles.

7.0 CONCLUSIONS

This report has examined the route corridor and the preferred centre line route for the new 330kV transmission line between the proposed Harvey substation and the Kwinana Power Station. It has also reviewed the alternatives and the reasons for selecting the proposed route.

The proposed 330kV transmission line is an essential component of the State's plans to connect the SECWA's two major generating stations.

Studies within the proposed route easement indicate that the alignment will enable construction and operation of the transmission line without unacceptable environmental impacts.

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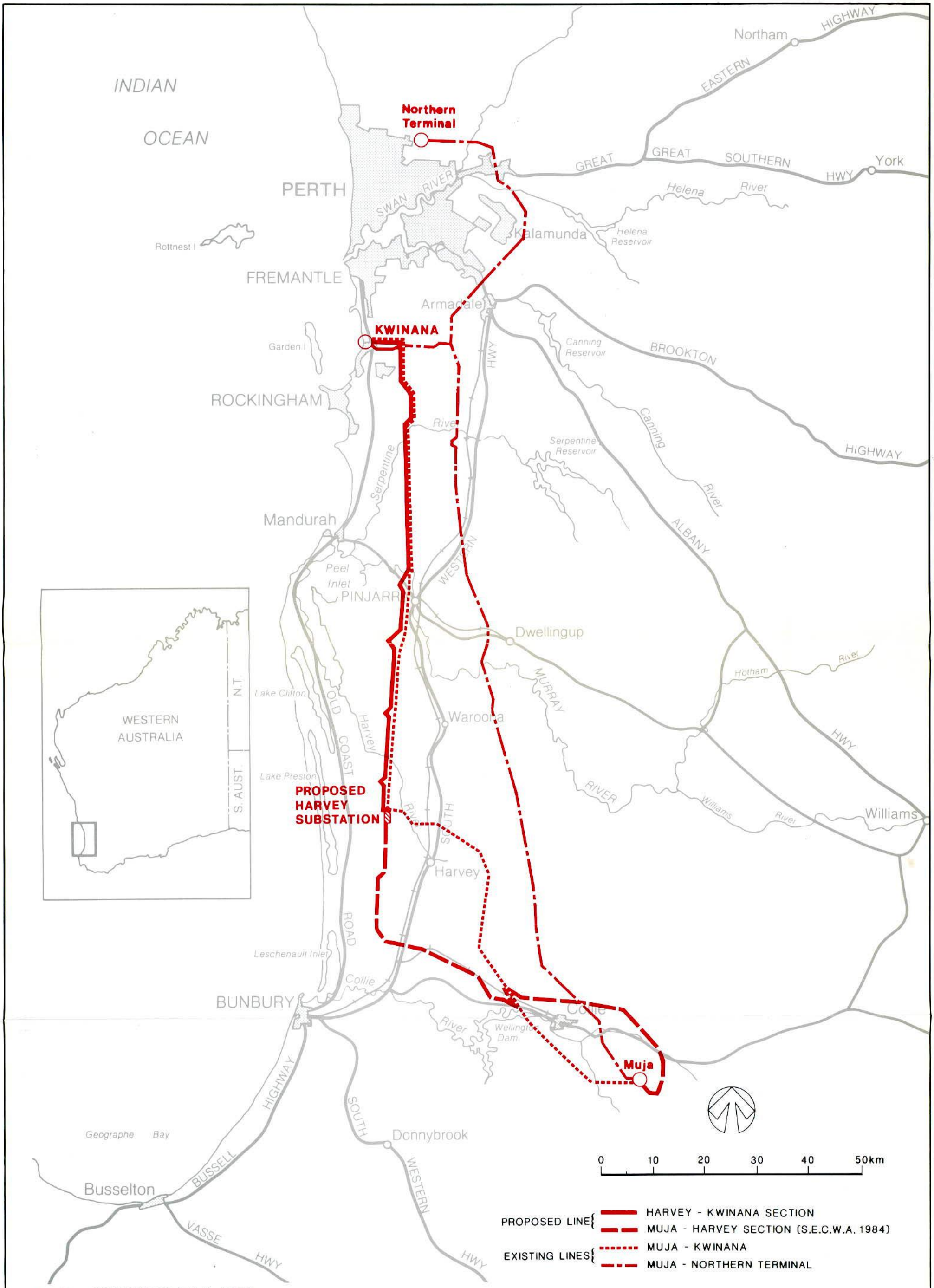
9.0 GLOSSARY

Aeolian	Deposits arranged by the wind, mostly consisting of sandy material
Alluvial	Stream or river deposited material of comparitively recent origin
Archaeology	Study of antiquities, especially of prehistoric persons
Artefact	Any object made by human agency
Blowout	Saucer or trough shaped hollows formed by wind erosion on a pre-existing dune or other sand deposit
Clearing profile	Height and width dimensions of vegetation removal
Conductor	Wire or line which allows the transmission of electricity
Conductor sag	The amount which the conductor lines sag or bow under gravity when supported from towers
Corridor	A width of land within which the transmission line route will be located - 500m wide for the Harvey-Kwinana section
Easement	The strip of land which is acquired to accommodate the transmission line and its associated facilities. The width of the easement depends on the number and type of transmission lines, the need for a permanent access track and, to some extent, the contraints imposed by terrain and land use. In this case the easement is 110m wide
Electric and magnetic fields	Electric and magnetic fields are created around any energised electrical line. This field effect is in the extremely low frequency category and decreases sharply with distance away from the line. There are many other sources of electric and magnetic fields, such as TV, radio, electrical devices, the sun and earth, etc.
Ethnography	Scientific description of races of men
Fauna	The totality of animals in a specified area
Flora	The totality of plant species in a specified area
Quaternary	Rocks and deposits said to be up to 2 million years old
Siliceous sands	Those sands containing abundant quartz
Topography	Detailed description of surface features, both natural and artificial
Tranmission line	The conductive wires along which electricity moves
Wetland	Lakes, pools, rivers, streams and swamps and their associated margins

10.0 ABBREVIATIONS

ABS	Australian Bureau of Statistics
CALM	Conservation and Land Management
EIA	Environmental Impact Assessment
ELF	Extra Low Frequency
EPA	Environmental Protection Authority
km	kilometre
kV	kilovolts
m	metre
mT	millitesla
PER	Public Environmental Report
SECWA	State Energy Commission of Western Australia
W.A.M.	Western Australian Museum
WHO	World Health Organisation
%	percent

FIGURES



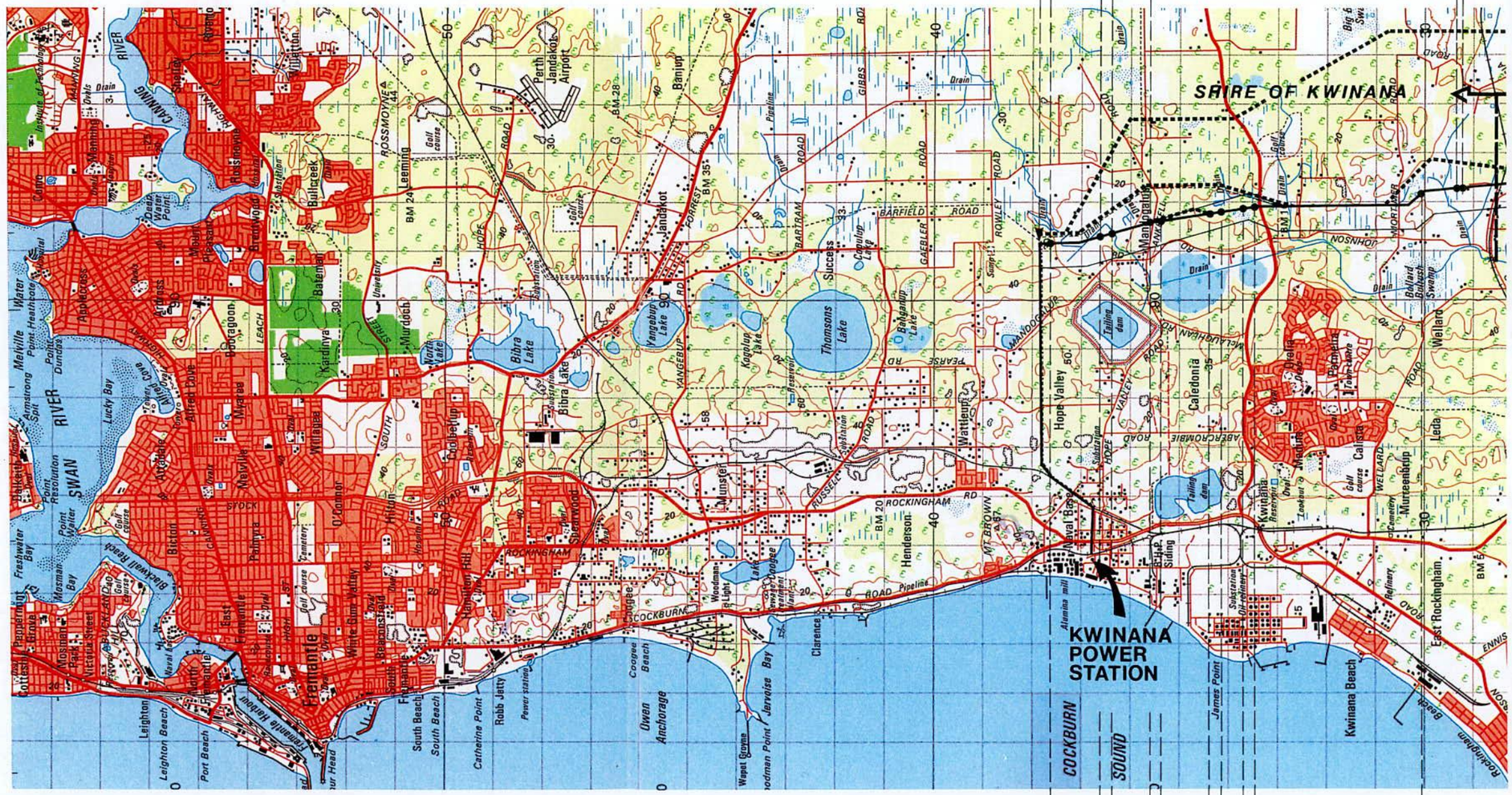
MUJA – METROPOLITAN AREA
330kV TRANSMISSION LINES

Figure 1
Dames & Moore

* Private Land, mostly cleared and pastured, crossed by road reserves and drains

LAND TENURE

In existing S.E.C.W.A. corridor — Crops — Crops — Crops



1 — Acacia flagelliformis
2 — Acacia semitrullata
3 — Evandra pauciflora
4 — Jacksonia sericea
5 — Restio stenostachyus

VEGETATION

NOTE: See Table 1 for description of vegetation units.

"Hymus Swamp", System 6
Recommendation M105

Avocado Farm

S.E.C.W.A.

Murray River

*

*

*

*

CL/(P)(M)

Type D 4, 5
Type C 5
Type B 5
Type A 5

See text Section
5.2.2.1 (5)

CL/(P)(M)S

PR

CL

CL/(P)(M)

CL/S

CL

CL/B(J)
CL/P

CL/(P)

SPFR

CL

S

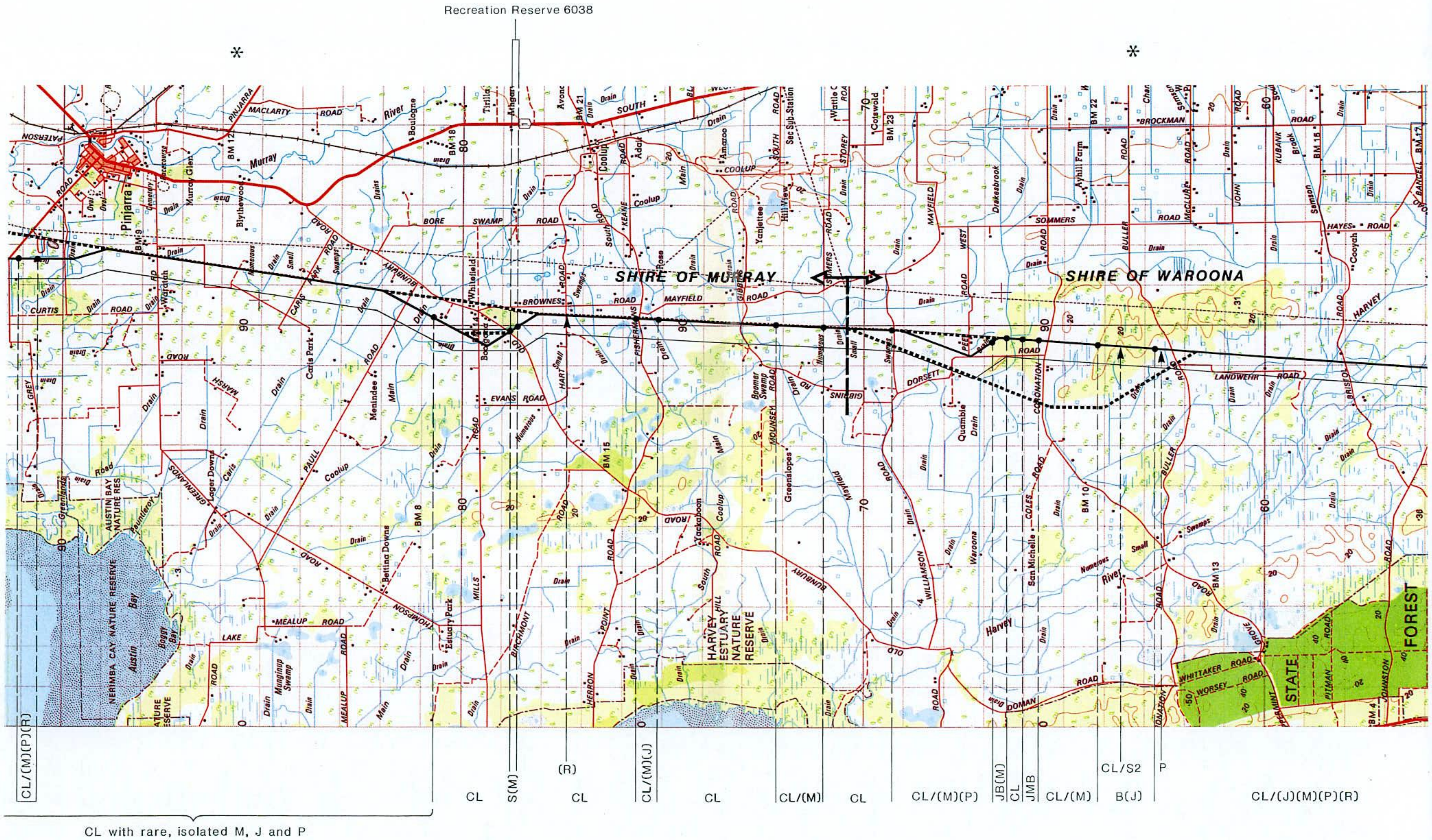
CL

CL/JM

CL

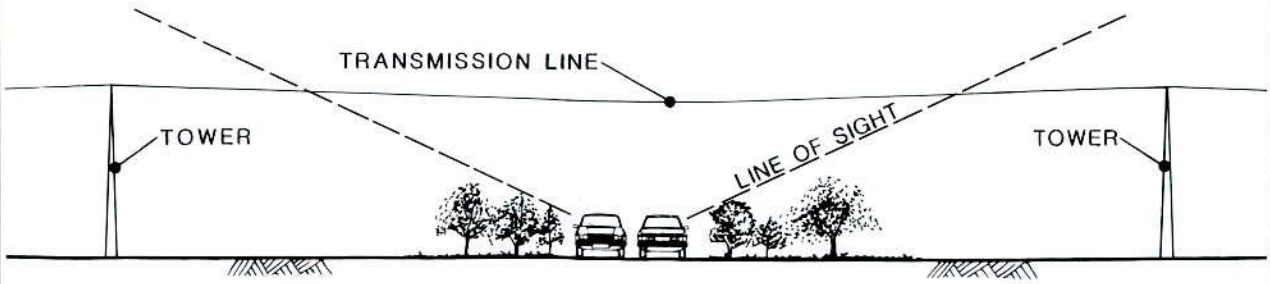
CL/(F)(R)(P)

FR(P)

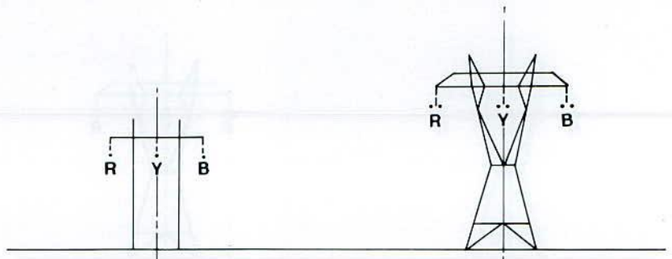

Recreation Reserve 6038
*
*
SHIRE OF MURRAY
SHIRE OF WAROONA
Pinjarra
HARVEY ESTUARY NATURE RESERVE
NERIMBA CAY NATURE RESERVE
AUSTIN BAY NATURE RES
STATE FOREST
CL/(M)(P)(R)
CL
S(M)
(R)
CL
CL/(M)(J)
CL
CL/(M)
CL
CL/(M)(P)
JB(M)
CL
JMB
CL/(M)
CL/S2
B(J)
P
CL/(J)(M)(P)(R)
CL with rare, isolated M, J and P

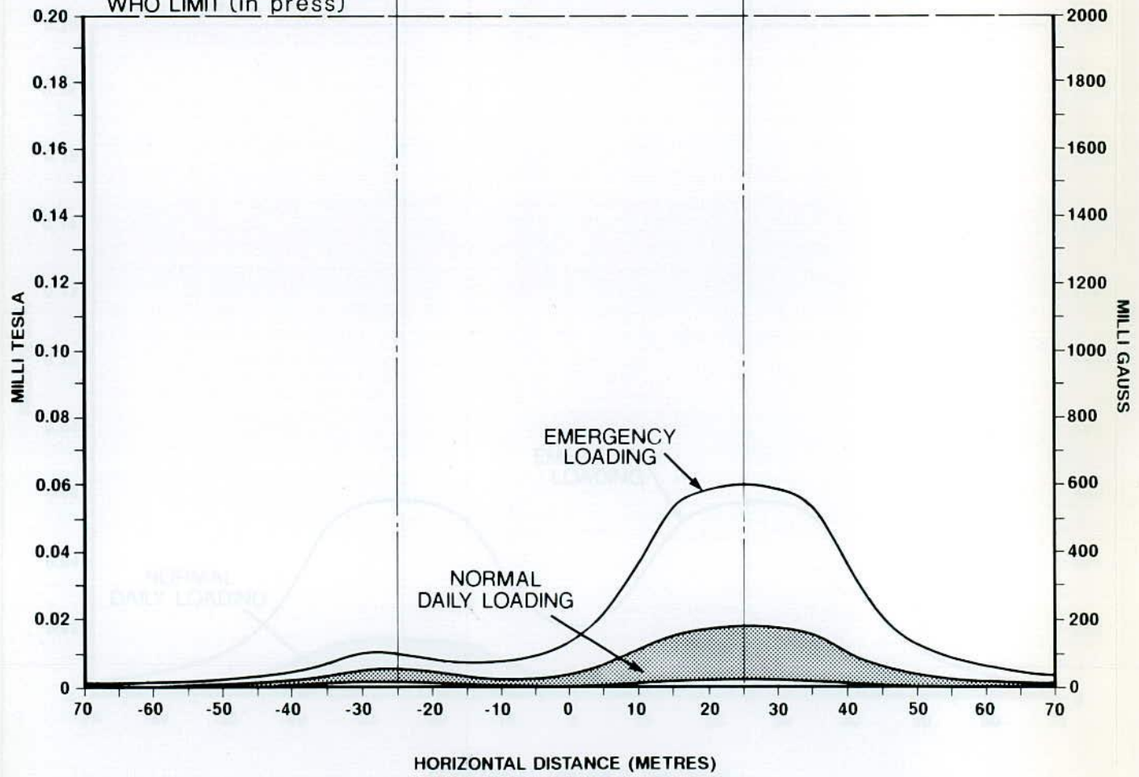
VEGETATION AND LAND TENURE ALONG PREFERRED ROUTE

Figure 2



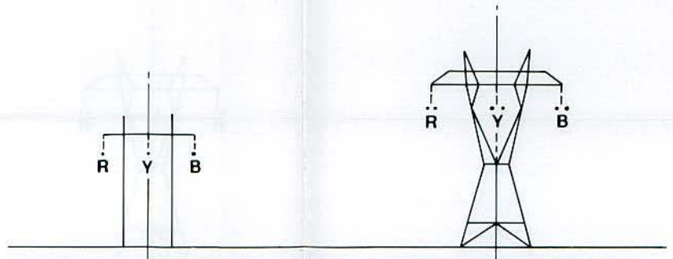
UTILISATION OF SHRUBS AND SMALL TREES TO MINIMISE VISUAL IMPACT

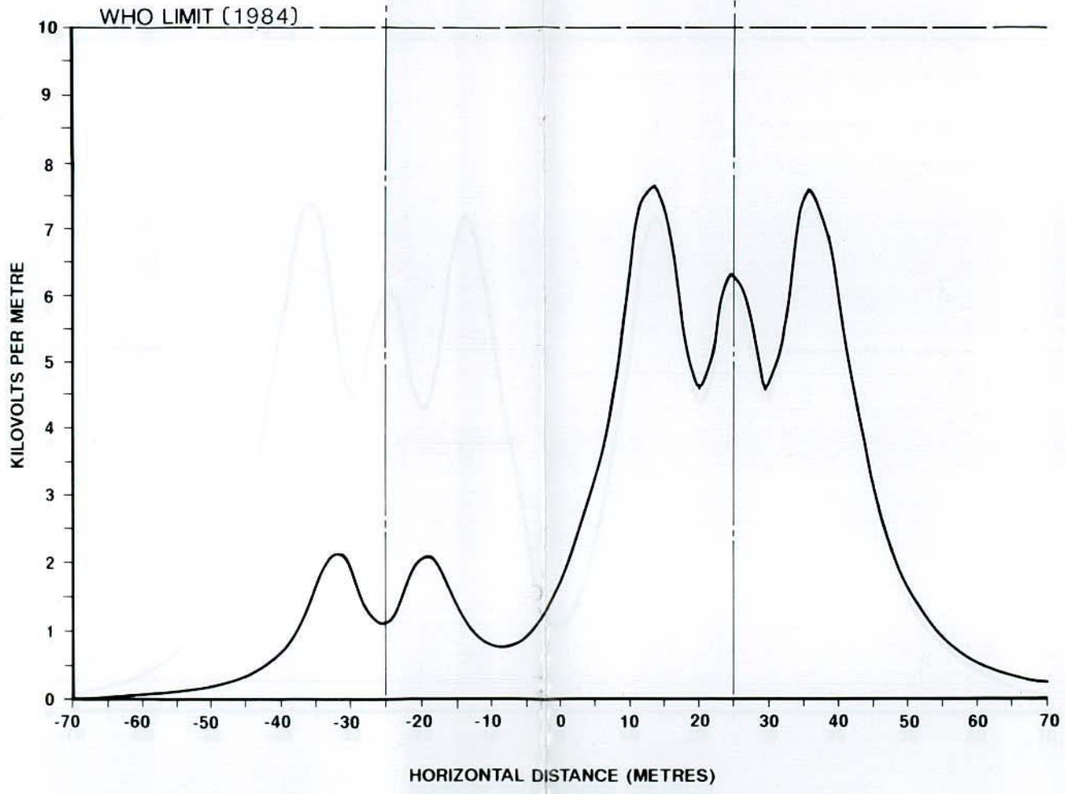




MAGNETIC FIELD INTENSITY DISTRIBUTION

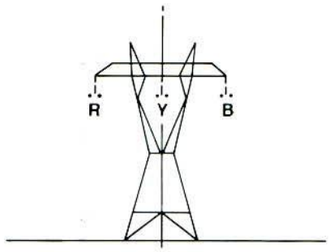
- 1 x132kV and 1 x 330kV line.

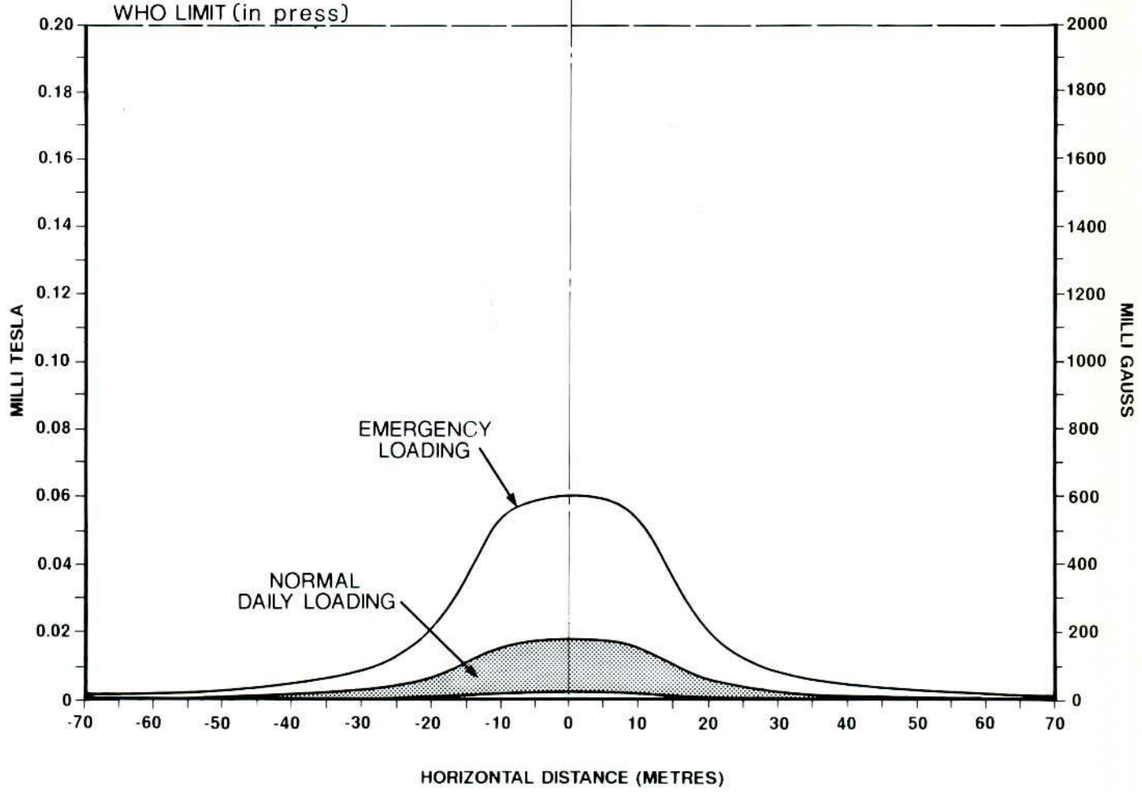




ELECTRIC FIELD INTENSITY DISTRIBUTION

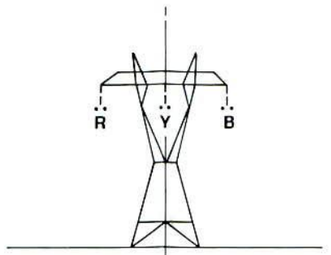
ELECTRIC AND MAGNETIC FIELD DISTRIBUTION AT 1 METRE ABOVE GROUND BELOW THE TRANSMISSION LINE BETWEEN SOUTH OF HARVEY AND PINJARRA

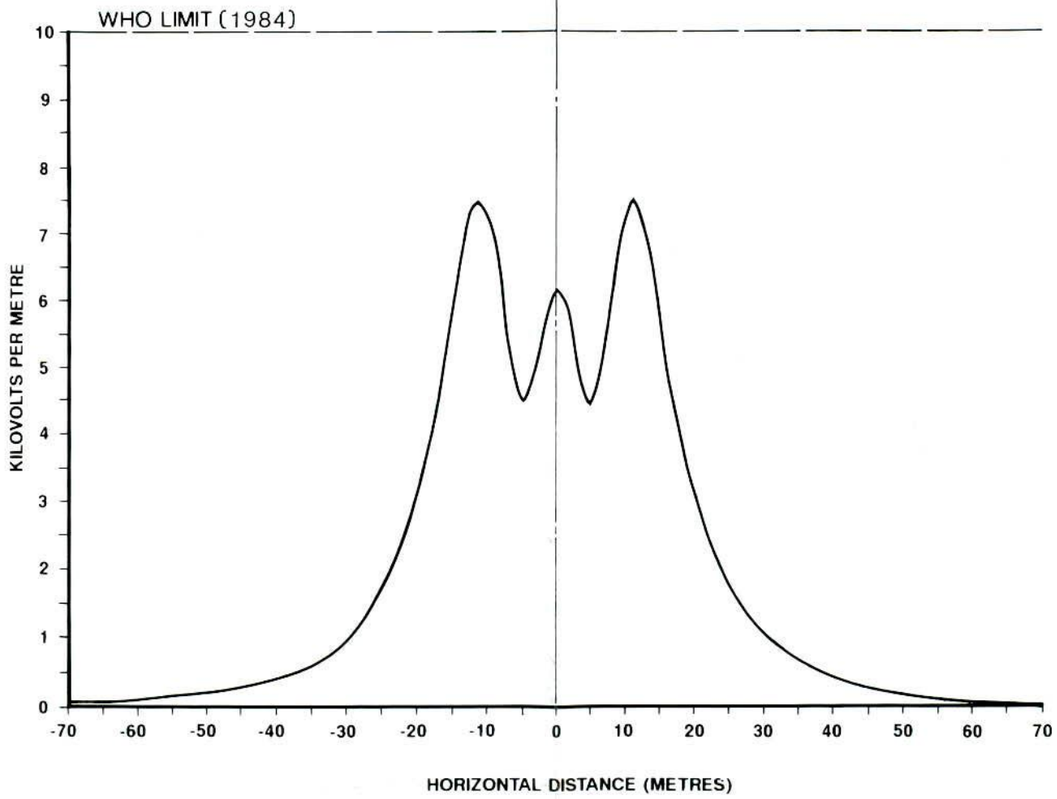




MAGNETIC FIELD INTENSITY DISTRIBUTION

- Single circuit 330kV line.





ELECTRIC FIELD INTENSITY DISTRIBUTION

ELECTRIC AND MAGNETIC FIELD DISTRIBUTION AT 1 METRE ABOVE GROUND BELOW THE TRANSMISSION LINE FOR SINGLE TOWER CONFIGURATION AS FOR DEVIATIONS THAT DO NOT SHARE AN EASEMENT

PLATES

CAPTIONS – PLATE 1

VEGETATION

A. Moonah Paperbark (Melaleuca preissiana) open woodland overlapping a Heathland dominated by Pericalymma ellipticum; in Location 3071, between Riverdale Road and Harvey Substation site.

B. Banksia Low Forest (Vegetation Type C1) on east side of existing 300kV transmission line easement; Hymus Swamp (EPA Recommendation M105), between Karnup Road and Serpentine River drain.

C. Kunzea ericifolia regenerating under 330kV transmission line, with Vegetation Type C1 to right and Vegetation Type C2 to left; in EPA Recommendation M105 adjacent to Plate 2B. Jacksonia sericea occurs as understorey in left side of photograph.

D. Vegetation Type A, including Restio stenostachyus, approximately 300m north of Karnup Road.

E. Agricultural land north of Serpentine Drain used for pasture and hay production.

F. Banksia Woodland with Jarrah (Eucalyptus marginata) between Thomas Street and Hope Valley Road.

G. Swamp Paperbark (Melaleuca rhaphiophylla) Forest in the southern most swamp between Thomas Street and Hope Valley Road.

H. Roadside paperbark shrubs minimising visual impact of transmission line tower from road.

A

B

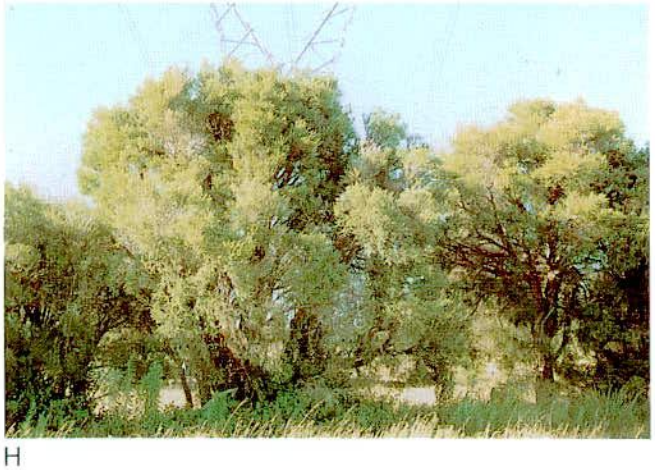
C

D

E

F

G



H

CAPTIONS – PLATE 2

RARE, RESTRICTED AND POORLY KNOWN PLANTS SPECIES FOUND ALONG PREFERRED ROUTE

A. Habitat south of Riverdale Road in which Acacia flagelliformis and A. semitrullata occur: interface between Jarrah–Banksia woodland and low–lying heathland characterised by Blackboys.

B. Moonah Paperbark woodland habitat of Evandra pauciflora sedge south of Riverdale Road. The tussocks are Evandra pauciflora.

C. Acacia flagelliformis.

D. Acacia semitrullata.

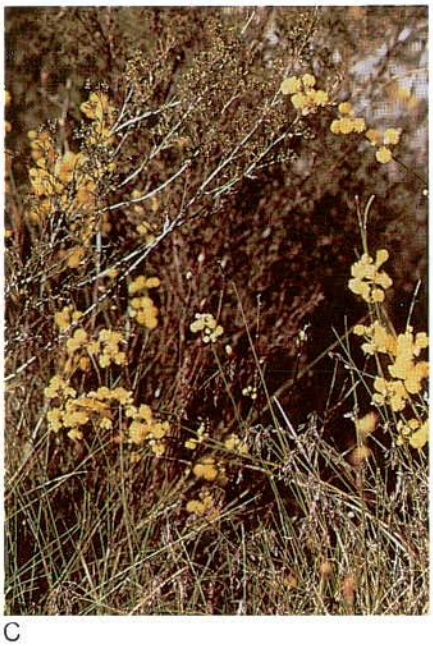
E. Evandra pauciflora.

F. Restio stenostachyus (habitat is shown in Plate 1D).

G. Jacksonia sericea (habitat is shown in Plate 1C).

A

B



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D

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APPENDIX A

APPENDIX A

EPA GUIDELINES

GUIDELINES

PUBLIC ENVIRONMENTAL REPORT
PROPOSED 330kV HARVEY - KWINANA TRANSMISSION LINE

The guidelines identify issues that should be addressed within the Public Environmental Report (PER). They are not intended to be exhaustive and the proponent may consider that other issues should also be included in the document.

The PER is intended to be a brief document; its purpose should be explained, and the contents should be concise and accurate and able to be readily understood by interested members of the public. Specialist information and technical description should be included where it assists in the understanding of the proposal.

Where specific information has been requested by a Government Department or Local Authority, this should be included in the document.

SUMMARY

This section should contain a clear and concise summary of the document.

1. INTRODUCTION

- Background, objectives and scope of the proposal
- Identification of the proponent
- Location and timing of the proposal
- Relevant legislation requirements and approval processes
- The EIA process

2. NEED FOR THE PROPOSAL

Describing the rationale for the project and the broad costs and benefits to the proponent, the State and the community.

3. THE PROPOSAL

A description of the important elements of the proposal including both construction and operation.

4. ALTERNATIVES

An evaluation of the alternative routes considered, and a description of the process leading to the selection of the preferred route, including the factors which led to alternative routes being rejected should be addressed.

5. THE EXISTING ENVIRONMENT

A description of the existing environment, including the physical, biological and social elements should be given.

6. ENVIRONMENTAL IMPACTS

Predicted environmental impacts to be addressed include:

- visual impact
- impacts on historic, archaeological and ethnographic sites
- biological impacts
- impact on resources
- the impact of electo-magnetic radiation (EMR)
- requirements for clearing of vegetation and justification for clearing requirements
- impacts during construction
- long term impacts during operation.

This section should show the overall effect on the environment and the region. Where possible effects should be quantified and uncertainities highlighted.

7. ENVIRONMENTAL MANAGEMENT

Appropiate management techniques for minimisation or amelioration of adverse impacts to be discussed. The objectives, scope and details of the management programme should be described. Assignment of responsibility for environmental management should be stated and committments for implementation given.

Monitoring proposals should be described as well as how the environmental management programme will be adapted in response to monitoring results. Procedures for reporting results of monitoring should also be discussed.

Discussion of the results of a programme of public information dissemination, including a review of comments received should be included.

8. CONCLUSIONS

A brief synthesis of the proposal, the receiving environment, the likely impacts on that environment and the management procedures that are proposed.

9. BIBLIOGRAPHY

10. GLOSSARY

11. APPENDICES - PER GUIDELINES

- TECHNICAL DETAILS

- LIST OF ENVIRONMENTAL COMMITMENTS

APPENDIX B

APPENDIX B

SECWA ENVIRONMENTAL SPECIFICATIONS FOR TRANSMISSION LINES

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APPENDIX B

SECWA ENVIRONMENTAL SPECIFICATIONS FOR TRANSMISSION LINES

1.0 ENVIRONMENTAL SPECIFICATIONS

1.1 CLEARING WITHIN STATE AND PRIVATE WOODLAND AREAS

Clearing is the first phase of a single contract for the entire transmission works programme. Clearing for 330kV, 132kV and 66kV transmission lines is carried out according to a predetermined "clearing profile". This "clearing profile" outlines the easement width and clearance limit for the route. The limits indicate the maximum allowable height of trees, undergrowth and scrub that may, in certain cases, remain within the cleared width (Figure B1). Within State and private forests, the following criteria area followed:

- The complete removal of all trees for a distance of 30m (330kV line) or 20m (132kV/66kV) either side of the centreline of the easement.
- The removal of all undergrowth, scrub and stumps, large rocks and other obstructions up to a maximum width of 5m. This area shall be levelled and graded to form an access track suitable for four wheel drive construction vehicles to travel along the route.
- The windrowing of all timber, undergrowth, scrub and stumps which have been cleared and the preparation of this windrowed timber for flash burning. This includes the construction of all necessary firebreaks.

1.2 CLEARING ON PRIVATE AND NON-FORESTED PROPERTY

- The removal of all trees, undergrowth, scrub and stumps for the total easement width. However, where the property owner wishes to retain certain vegetation, lopping and trimming is to be carried out in accordance with the clearance limits.
- Clearing of the track, windrowing and burning/removal is the same as for State or Private forests, and conforms to the "clearing profile".

All holes caused during felling of trees and stump removal are to be bladed in.

Where the transmission line angles or deviates, the area around these locations shall be cleared completely for a minimum of 30m (330kV lines) or 20m (132kV/66kV lines). No windrow timber shall be stacked within this area and the access track shall clear the angle peg by a minimum of 20m in 330kV lines and 20m in 132kV/66kV lines. In wet areas, the cleared area shall be graded to prevent wash or erosion occurring.

* NB Clearing specifications for 132kV and 66kV are generally the same.

1.3 SPECIAL REQUIREMENTS FOR THE CONTROL OF PHYTOPHTHORA sp. (DIEBACK)

To minimise the risk of spreading dieback disease, the CALM Department requires the following precautions to be taken:

- All clearing operations shall be completed in the dry months, generally considered to be December-March, unless otherwise authorised by the Principal and the CALM Department.

- The CALM Department has classified some of the land under its control into Disease Risk Areas. A permit is required for entry into Disease Risk Areas. Tenderer shall determine from the CALM Department, how the route is classified.

The following hygiene requirements have been specified by the CALM Department. These requirements shall be met by the Contractor.

When working in areas not infected by dieback, the Contractor may be required to cease operations temporarily in the event of rainfall. Recommencement of operations will be subject to the approval of a Forest Officer.

All Contractor's personnel, including staff not fully employed on the contract, sub-contractor and others, shall be instructed on hygiene requirements by the CALM Department before they commence clearing the route.

The Contractor's supervisor shall liaise with the CALM Department's Office-in-Charge for the section in which he is working, so that the following items can be defined:

- Roads and tracks which crews may be permitted to use and to gain access to the line route.
- The location of dieback along the proposed route.
- The locations along the proposed where all vehicles, plant and equipment must be cleaned before entering dieback free areas.
- The necessity for a cleaning down unit to be stationed at the boundary between dieback infected areas and areas not infected by dieback, to clean vehicles and equipment as they enter the uninfected areas. Vehicles shall be raised on a platform, e.g. rubber-belting or wood ramp during the clean-down procedure.

Signs defining the boundaries between dieback free, dieback infected and uninterpretable areas will be erected by the CALM Department.

Before clearing commences on land vested in CALM, all vehicles, plant and equipment shall be cleaned to the satisfaction of the CALM Department's Officer-in-Charge of the relevant District, or such other officer as he may delegate.

The Contractor shall provide all equipment for cleaning vehicles. This may be in the form of:

- Mobile washing unit shall consist of a tank of suitable capacity, coupled to a high pressure pump and hose with jet nozzle, all mounted on a suitable vehicle, and, compressor unit fitted with air hose and jet nozzle mounted on or part of a suitable vehicle.
- All washing down water shall be dosed with sodium hypochlorite. The required minimum dosage shall be 250ml of chemical for 500L of water. Renew sodium hypochlorite dosage every 24 hours.

The Contractor shall submit a list of all persons who will be directly engaged in the clearing. This shall include part-time personnel, such as relief drivers, pay officers and plant maintenance personnel and any other persons who may be associated with the work. Only those persons who have been instructed in the control of dieback shall be permitted in the area of operation.

It may be in the Contractor's interest to work all the dieback infected areas and the uninfected areas separately, so as to minimise the washing of plant and vehicles. Any such proposal will be acceptable to the Superintendent, provided a consistent policy is adopted.

1.4 WINDROWS

All trees, undergrowth, scrub and stumps shall be stacked in windrows using a rubber tyred machine fitted with a rake blade. Windrows to be no closer than 16m (for 330kV) and 10m (for 132kV/66kV) to the centreline of the route. A clear distance of no less than four metres shall be maintained between the edge of the windrow and the edge of the clearing. Where possible, only one windrow shall be used, and it shall be placed on the side opposite to the access track. The windrows shall be tightly packed, so as to allow flash burning to be undertaken when required. No windrows shall be stacked within 35m (330kV) or 25m (132kV/66kV) of an angle peg.

Any one section of windrow shall have a maximum length of 100m. A cleared distance of 20m shall be maintained between any two sections of windrow.

The maximum allowable windrow height shall be 3m.

Burning of windrows will be done given approval from the local CALM District Office. Material in the burning windrows will be reheaped until it has been completely burnt away.

1.5 ACCESS TO LINE ROUTE

Entry to forest areas shall be restricted to existing access tracks that have been nominated by CALM. Any deviation from these access tracks shall require the Superintendent's approval.

The Principal will supply the Contractor with drawings which will indicate access to the line route where the line route passes through private property. The Contractor shall not use any alternative means of access to the line route without the approval of the property owner and the Superintendent.

The Contractor shall be held responsible for all damage to access routes during the clearing operation and shall make good to the satisfaction of the property owner and the Superintendent, any damage caused.

1.6 ACCESS ROAD

The Contractor shall construct a two-wheel drive track along the centreline of the easement. The access track shall conform to the following:

- The track shall be suitable for access by vehicles under all weather conditions.
- The track shall have a maximum width of 5 metres on straight sections and 6 metres at bends. Fill, when required, shall consist of excavated hard material obtained from pits approved by CALM.
- Water courses shall be traversed by crossings which will have pipes installed and be gravelled in such a way as to minimise disturbance of banks.

Where the route traverses cleared farmland, no further grading for an access track will be required.

1.7 EROSION CONTROL AND ROUTE MAINTENANCE

Work is to be carried out in such a manner that disturbance to actual ground cover and land-form is minimised. Directions as to the methods to be adopted in the execution of the work to ensure this requirement is met will be issued by the Superintendent as the work proceeds.

The Contractor will, however, be required to instruct his staff, particularly plant operators, of the need for the utmost care to be exercised in carrying out all operations in order to avoid unnecessary damage. If such damage should occur and in the opinion of the Superintendent it could have been avoided, the Contractor is responsible for all costs involved in restoration of the damage.

1.8 PRESERVATION OF ROOT STOCK

Clearing of the easement through bushland shall be carried out in a manner that retains in situ, the maximum amount of root stock, by setting the bulldozer blade just above soil level. Retention of root stock is an essential element of the subsequent restoration programme. It is also important to minimise the risk of damage resulting from erosion to the transmission tower footings.

1.9 DUST SUPPRESSION

Special measures for dust control shall not be required unless dust becomes a nuisance. To alleviate the problem measures include:

- speed controls
- elimination of unnecessary vehicle movements
- water spraying (Treated water only)
- spreading of cut vegetation or woodchips.

1.10 CONTROL OF PLANTS ANIMALS AS REQUIRED BY THE AGRICULTURAL PROTECTION BOARD

The Contractor and his sub-contractors shall comply with regulations and requirements of the Agricultural Protection Board (APB) at all times during the performance of the work under the Contract, in order to maintain control of plants and animals that are declared under the provisions of the Agricultural and Related Resources Protection Act (1976 and amendments).

The minimum requirements with which the Contractor is to comply, are as follows:

- In order to control the spreading of infestations of declared plants and soil-borne diseases, maps showing the known areas of infestations will be provided to the Contractor by the Superintendent. The Contractor shall establish washing-down facilities along the route at the direction of the APB and these facilities shall enable the washing-down of vehicles and machinery with a high pressure water jet with water running into an open excavated pit which does not drain into a water system.

o Where there is a need to import construction plant, material, camp facilities and other such items from overseas or interstate, the Contractor shall notify the relevant APB officers 3 weeks in advance of the expected arrival of such goods. When interstate imports are concerned, the APB shall make arrangements at the appropriate checkpoint for a thorough inspection of all such constructional plant, material, camp facilities and other relevant items.

1.11 PROTECTION OF FLORA AND FAUNA

Flora: No flora shall be removed from the site except that necessary to undertake the works. The area trafficked to undertake the works shall be kept to a minimum. Exotic flora species shall not be introduced onto the site.

Fauna: No existing native species shall be trapped, killed or injured on the site or otherwise removed without prior to CALM. Firearms or other weapons shall not be brought onto the site. Exotic fauna species shall not be introduced onto the site.

Pets will not be permitted with contractors, or the workforce.

1.12 DISPOSAL OF WASTE MATERIALS

Waste fuels and lubricants shall be removed from the site by the Contractor to an approved disposal area.

Arrangements shall be made with the relevant Local Government Authority or a specialist contractor for the disposal of all garbage, refuse and waste fuels and lubricants.

1.13 STORAGE AND USE OF CONTAMINANTS

Storage of oil and other materials which would contaminate the soil if spilled, shall be confined to specially designed areas within the construction camp sites. The storage facility shall be designed to localise the effect of the spillage and prevent leakage into water courses and aquifers. Adequate quantities of suitable material shall be kept on hand to counteract spillages.

Maintenance of equipment involving the transfer of contaminants shall be conducted at specially designed facilities at the construction camp site. The maintenance facilities shall be such as to localise the effect of spillages as described above.

Maintenance of a minor nature may be carried out away from the facilities described above, provided that transfer of contaminants is not involved.

1.14 USE OF EXPLOSIVES

In addition to compliance with regulations regarding the use of explosives, the Contractor shall give due notice to adjacent landholders and users concerning his proposed use of explosives. The Contractor shall not unreasonably use explosives that will adversely affect the normal activities of the landholders or users.

Explosives shall not be used during declared fire bans.

1.15 CULVERT PREPARATION

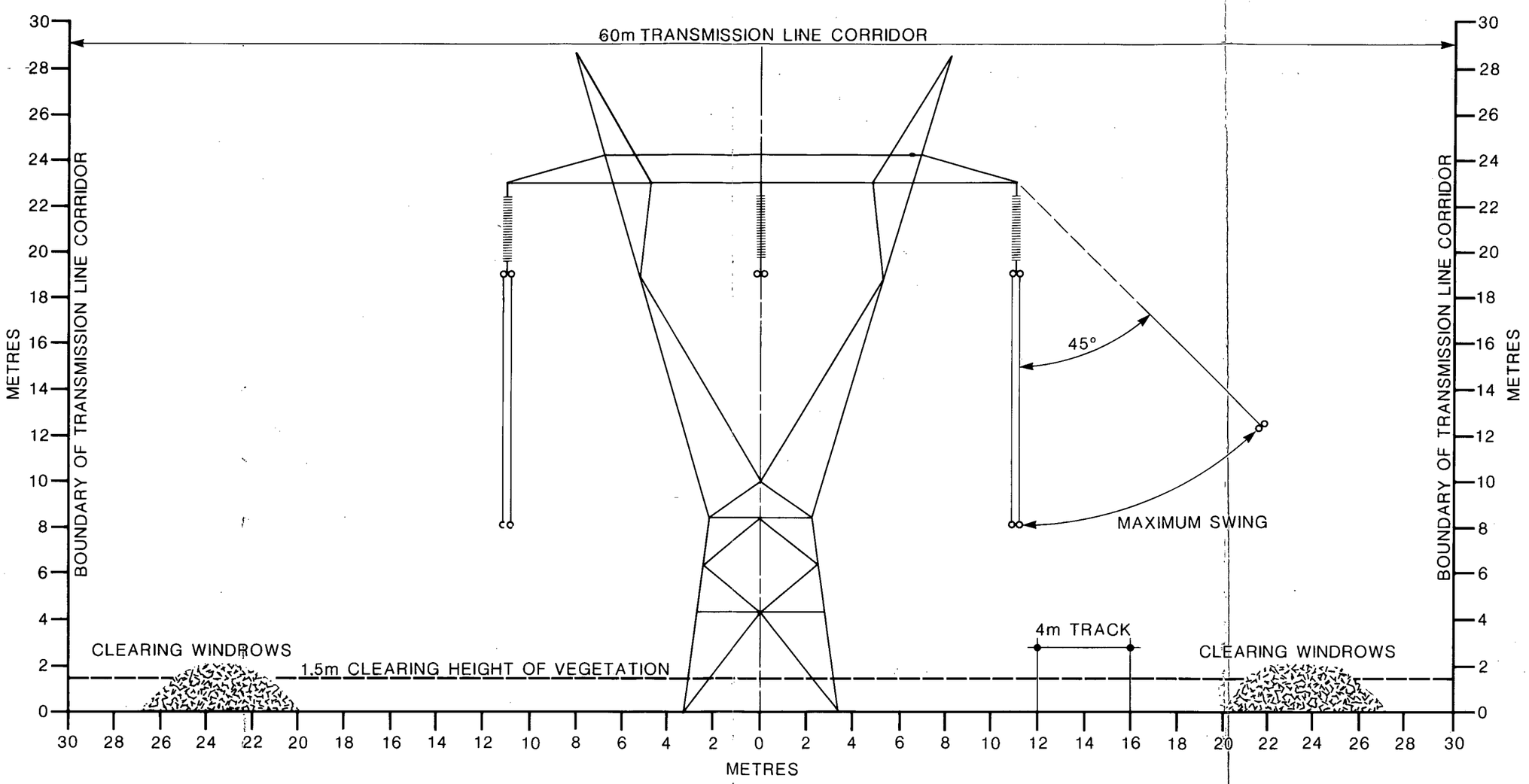
Pipes, concrete culverts or rock crossings may be installed at creeks and drainage channels.

The Contractor shall, however, clear across the creek or drainage channel removing all trees, undergrowth, and stumps, grading as close to the channel as possible to facilitate the later installation of pipes and culverts.

The creek or channel shall be left clear and tidy without obstruction to the natural flow of water.

2.0 BIBLIOGRAPHY

STATE ENERGY COMMISSION (1982). Specifications and General Conditions of Contract. Eastern Goldfields Project: Clearing for Transmission Line Route - Muja to Kalgoorlie, Specification CA162.



NOTE:

1.0 IN STATE FORESTS

1.1 ALL TREES WITHIN THE EASEMENT ARE TO BE MACHINE CLEARED OR, WHERE APPROPRIATE, FELLED.

1.2 REGROWTH AND SUCKERS WITHIN THE EASEMENT:

(a) 1.5m AND ABOVE - CUT AT GROUND LEVEL AND POISON STUMP.

(b) BELOW 1.5m - FOLIAGE SPRAY FOR SELECTED SPECIES WHICH ARE LIKELY TO CAUSE CLEARANCE PROBLEMS IF LEFT.

1.3 WHERE REGROWTH IS HEAVY, MACHINE CLEARANCE MAY BE USED:

(a) THE MARDEN ROLLER (GENERALLY).

(b) BULLDOZERS FOR STUMPS, ROCKS OR WHERE REGROWTH IS TOO HEAVY FOR THE MARDEN ROLLER.

(c) SPECIAL HEAVY GROWTH AREAS (NOTABLY TEA TREE, MELALEUCA SPP., KUNZEA SPP.) A HYDROAX (LARGE SLASHER MACHINE).

1.4 ALL TREES OUTSIDE THE EASEMENT WHICH COULD FALL ONTO THE LINE ARE TO BE TAKEN DOWN IN CONSULTATION WITH THE DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT

2.0 IN PRIVATE AREAS

2.1 SOME SELECTIVITY APPLIES AND STRAIGHT WINDOW CLEARING AS PER 1.0 TO BE CARRIED OUT WITH DISCRETION AFTER CONSULTATION WITH LAND OWNERS.

TYPICAL CLEARING PROFILE FOR 60m EASEMENT FOR 330kV SINGLE CIRCUIT LINE

APPENDIX C

APPENDIX C

ARCHAEOLOGY

report prepared by
Gary Quartermaine
August 1987

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ARCHAEOLOGY

1.0 INTRODUCTION

1.1 BACKGROUND TO SURVEY

An Aboriginal site survey of the Kemerton to Kwinana section of the Muja to Kwinana Proposed 330kV Transmission Line was commissioned by the State Energy Commission of Western Australia (SECWA) as part of a Public Environmental Report. Dames & Moore, Consulting Engineers, are preparing this report and have engaged Rory O'Connor and Gary Quartermaine to execute the ethnographic and archaeological components of the Aboriginal survey respectively.

Although the transmission line will run from Muja-Kwinana, these surveys were only carried out along the Kemerton to Kwinana section of the line as the route for the southern section of the line had not been finalised. It is envisaged that a similar, but briefer survey, will be carried for that section of the line in due course.

Discussions were conducted with Cliff Morris and Rudy Teh, of the SECWA, and Barry Muir and Neil Daetwyler, of Dames & Moore, who provided background information, maps and aerial photographs for the proposed route. Consultations were also held with members of the staff of the Department of Aboriginal Sites, W.A. Museum, prior to fieldwork.

Fieldwork was conducted in July 1987.

The objectives of this survey were as follows:

- The assembly of data from previous work in areas adjacent to the proposed route to form a predictive strategy, if possible, and to provide a framework for placing the results of the survey in context.
- A systematic sample survey of the corridor of the proposed route.
- An investigation of those areas considered the most likely to contain archaeological material, such as the margins of watercourses and swamps.
- The location and recording of archaeological sites within the designated survey area.

1.2 LOCATION

The proposed powerline route between Kemerton and Kwinana follows existing powerline easements between the proposed Harvey Substation and Kwinana with some slight deviations to avoid buildings. The route from Kemerton to the proposed Harvey Substation has a common easement with the existing powerline south to Leigh Road from where it deviates slightly to the west.

1.3 ENVIRONMENT

The proposed route runs north-south along the Swan Coastal Plain, at an approximate distance of 10km from the coastline, for a distance of approximately 110km.

The climate of this area is Mediterranean, which is characterised by a warm summer and winter rainfall. Annual average rainfall ranges between 800mm and 1,000mm and temperatures are moderate (Beard, 1979).

The coastal plain is part of the Perth Basin geological formation. The Perth Basin is a deep trough filled with Phanerozoic sedimentary rocks and with a surface mantle of Quaternary deposits (Playford et al., 1975).

The Swan Coastal Plain is a narrow (20 - 30km wide) strip which is generally of low relief. It is composed of Quaternary alluvial and aeolian sediments. The two main units in the survey area are the Pinjarra Plain, containing several alluvial units of different ages, and the Bassendean Dune system, characterised by highly leached siliceous sands and interdunal swamps (Seddon, 1972 : 7-11).

The vegetation of the coastal plain is classified in the South-western Botanical Province of Western Australia (Beard, 1979), and subdivided further into the Drummond Subdistrict. This is characterised mainly by Banksia low woodland on leached sands and Melaleuca and associated species where poorly drained.

Much of the powerline route passes through agricultural, industrial or residential areas. The original vegetation has been replaced by pasture and constructions. Some parts of the southern section contain native vegetation but this is partly disturbed by firebreaks, fencelines and tracks.

The main drainage system along the route in the Murray - Serpentine River system where permanent water flow occurs throughout the year. There is a series of lake-like swamps along the proposed route, some of which appear to be permanent sources of water. A lot of the survey area is drained by a series of agricultural drains or irrigation channels.

1.4 PREVIOUS ARCHAEOLOGICAL RESEARCH

As a result of previous surveys and independent research, 70 Aboriginal sites have been recorded and registered with the W.A. Museum (Novak, 1975; O'Connor et al., 1985; O'Connor and Quartermaine, 1986; Reynolds, 1985; Schwede, 1984; Pickering, 1982; Pearce and Mulvaney, 1983). These sites are adjacent to, or on, the proposed powerline route. Of these sites, 23 are ethnographic (some with an archaeological component) and 47 are archaeological sites (see Table C1).

The archaeological sites are all small (less than 100 pieces) artefact scatters. They are situated on either watercourse or swamp margins or in areas where vegetation is absent, due to sand quarrying, grading or natural blow-outs. Quartz is the main lithic material utilised for artefacts, with fossiliferous chert being the next most numerous lithic material. Quartzite, dolerite and calcrete are recorded at three of the sites as a minor part of the lithic assemblage.

Flakes and chips make up the major component of the artefact assemblages, where figures are available. Other artefacts recorded, in all low or single quantities, are a core and a micro-core, a grinding fragment, utilised flakes, adzes and a micro-adze, scrapers, fabricators and blades. The majority of sites contain less than 25 pieces, with only one (S1264) with 100 pieces and 6 others (S0336, S0760, S0814, S0816, S1263 and S1844) with more than 25 pieces, where artefact numbers are given.

TABLE C1

PREVIOUSLY RECORDED ARCHAEOLOGICAL SITES ADJACENT TO PROPOSED POWERLINE ROUTE

W.A. MUSEUM SITE NO.	1:250 000 GRID REF.	SITE TYPE	LANDFORM	LITHICS	NO. ARTEFACTS	SITE NAME
	S150-2					
S0185	377.980	A.S.	-	-	-	Stake Hill Bridge
S1266	378.015	A.S.	sand	calcrete	7	Natgas 127
S0814	380.004	A.S.	swamp	Q	30	Gas Piepline 82
S0757	381.009	A.S.	swamp	Q. F/C	-	Sixty Eight Road, Baldivis
S0758	382.007	A.S.	hill	Q. F/C	25	Baldivis Road, South
S0759	382.007	A.S.	-	Q. F/C	-	Baldivis Road, North
S0760	382.010	A.S.	-	Q. F/C	43	Wellard/Bertram Roads
S0772	382.018	A.S.	-	Q. F/C	21	Norkett Road
S2327	383.012	A.S.	-	-	-	Bellway Sand Quarry, Wellard
S0815	383.997	A.S.	drain	Q.	6	Gas Pipeline 83
S2306	385.011	A.S.	sand	Q. F/C	-	Mortimer/Woolcoot, Wellard
S1296	386.980	A.S.	sand	Q. F/C	-	Drain
S0186	38.02	K.P.	-	-	-	Thompson Lake
S1297	387.979	A.S.	swamp	Q.	-	Tortoise Swamp
S0201	388.973	A.S.	sandpit	Q.	-	Gibbs Sandpit
S0816	388.976	A.S.	creek margin	Q.	50	Gas Pipeline 84
S0497	389.930	A.S.	creek margin	Q.	-	Wagerup 3
S0187	38.96	A.S.	sand dune	-	-	Pinjarra
S1845	38.96	Burial	-	-	-	Pinjarra burial
S0496	390.931	A.S.	sand	Q.	2	Wagerup 2
S0498	390.931	A.S.	sand	Q.	-	Wagerup 4
S0499	390.931	A.S.	creek margin	Q.	-	Wagerup 5
	S150-6					
S0354	375.902	A.S.	sand	Q.	1	Harvey S55
S1844	377.894	A.S.	river margin	Q. F/C	30	Marriott Road
S0356	377.897	A.S.	sand	Q. F/C	3	Brunswick S57
S0357	377.897	A.S.	sand	Q.	1	Brunswick S58
S0235	377.913	A.S.	swamp	-	1	Harvey
S0349	377.910	A.S.	-	Q.	15	Harvey S50
S0347	378.913	A.S.	swamp	Q.	2	Harvey S48
S0355	379.897	A.S.	sand	Q. Qt	2	Brunswich S56
S0337	375.935	A.S.	sand	Q.	1	Plantation Road S38
S0338	375.935	A.S.	sand	Q.	2	Blackboy Site S39
S0335	375.937	A.S.	sand	Q.	3	Bushfire Site S36
S0336	375.937	A.S.	sandpit	Q. F/C	46	Harvey Bridge S37
S0184	375.976	A.S.	river margin	-	-	Barragup/Mandurah
S0340	376.931	A.S.	swamp	Q. F/C	9	Drain Site S41
S0342	378.926	A.S.	sand	Q. F/C	2	Harvey River Flats S43
S0343	378.926	A.S.	-	Q.	9	Harvey River Flats S44
S0341	378.930	A.S.	-	-	-	Harvey River Flats S42
S0258	379.973	A.S.	sand	Q.	-	Yunderup North
S0256	381.959	A.S.	sand	Q.	-	Pinjarra
S0257	381.971	A.S.	sand	Q.	-	Yunderup South
S1264	386.964	A.S.	sand	Q.	100	Natgas 125
S1263	387.957	A.S.	blow out	Q. F/C	30	Natgas 124
S0198	387.965	A.S.	-	-	-	Pinjarra Bridge
S0199	387.972	A.S.	sandpit	Q. F/C	-	Dandalup Camp

KEY: A.S. = Artefact scatter Q = quartz Qt = quartzite K.P. = Kangaroo pit
F/C = Fossiliferous Chert

The earliest evidence for prehistoric occupation of the South West of Australia is dated at 38,000 years ago, for a stratified site on the Upper Swan, located 25km north-east of Perth (Pearce and Barbetti, 1981). A number of Holocene sequences have yielded data on possible cultural/environmental changes during, and after, the recent transgression of the sea, about 5,000 years ago (Hallam, 1974; Clarke and Dortch, 1977; Pearce, 1978). This work postulates increased populations on the coastal plain, rising to a peak just before European contact. As part of a regional survey of the Metropolitan area, Hallam (1986 : 5) concludes that the majority of sites lie around the lakes and swamps of the coastal plain, and that site numbers double in the last few hundred years.

Anderson (1984) has proposed a land use model for prehistoric exploitation of the Swan Coastal Plain and its hinterland, based on regional research into the relative proportions of variously sized surface artefact scatters and their associated artefact densities. This model suggests that, due to the variation in resources available in the three environmental zones investigated, there was a more extensive use of the coastal plain than either the adjacent forest or open woodland plateau.

Prehistoric stone tool industries in the South West have been classified into earlier and later phases (Dortch, 1977). The early phase includes small, thick flake-denticulated pieces, flakes from discoidal cores, and single and multi-platform cores. These artefacts have been manufactured from a range of lithic materials, including a distinctive Eocene fossiliferous chert. It appears that access to this chert was lost after the last marine transgression (Glover, 1975; Dortch, 1977).

Later phase stone industries, generally found in archaeological contexts dating from 4,000 years ago, include the addition of geometric microliths, backed blades, and a variety of adze flakes, which are part of the Australian "small tool tradition" (Dortch, 1977; Mulvaney, 1975).

None of the previously recorded archaeological sites are within the proposed route easement, however, it passes through one (S2229) of a series of ethnographic sites along the Murray River. The Murray River is a significant Aboriginal area.

From the existing information, it is possible to make the following conclusions:

- Small, low density surface artefact scatters are the most numerous archaeological sites.
- Quartz is the dominant lithic material used for the manufacture of artefacts.
- Flakes and chips form the major class of artefact types in the artefact assemblages.
- River margins, swamp margins and areas of devegetated sand are the main site locations.

2.0 METHODS

2.1 OBLIGATIONS UNDER THE ACT

The Western Australian Aboriginal Heritage Act, 1972 - 1980, makes provision for the recording and preservation of places and objects customarily used by, or traditional to, the original settlers of Australia. The Act defines the obligations of the community relating to sites (Sections 15 - 18) see Addendum CII for details.

The archaeological survey should identify the effects of the proposed disturbance of the physical environment on any Aboriginal archaeological sites. In recognition of the significance of some areas along the route to living Aboriginal people, consultations with Aboriginal people, identified as having an interest in the area, were conducted by Rory O'Connor, in conjunction with the archaeological survey.

The consultants are obliged to submit site documentation for any newly recorded sites on appropriate forms for registration with the W.A. Museum.

2.2 SURVEY DESIGN

The survey design involved the following stages of operation:

- Background research - this involved familiarisation with previously recorded sites in the region the proposed powerline route passes through, plus maps, aerial photographs and environmental information for the area to be surveyed. Previously recorded Aboriginal sites, registered with the W.A. Museum, are listed in Table C1.
- Survey strategy - this consisted of a systematic sample survey of the proposed powerline route.

  The route is parallel to, and in a common easement with, existing 330kV and 132kV lines for much of the route. Small deviations are made because of existing buildings in several locations. Much of the route is through low, flat sandplain

with areas of swampy ground. As a result of agricultural activity and other disturbance, visibility varied along the route but was generally reasonable. Access was good, because the access tracks on existing lines could be used. The length of the route was driven, using a 4WD vehicle, and inspections were made at regular intervals and in areas of high site discovery potential, such as watercourse and swamp margins. These inspections were made on foot and included a buffer zone of 100m each side of the proposed centreline of the route.

2.3 SITE DEFINITIONS

For the purpose of this survey, a site was defined as three or more artefacts in close association. As no samples were collection in the field, it was important to standardise a recording format that would be of use for analysis and have relevance for other researchers. Categories under which site data was recorded are as follows:-

- o site dimensions - extent and type;
- o artefact assemblage - number, type, lithic material and dimensions of artefacts;
- o environmental setting - vegetation, soil, drainage and proximity to water, surface visibility and disturbance;
- o stratigraphy - assessment of potential.

3.0 RESULTS

Seven archaeological sites were located and recorded as a result of the archaeological survey. These area all small, low density quartz surface artefacts scatters. Six of these are situated on the margins of swamps and the other is on the northern bank of the Murray River (see Tables C2 and C3 and Figure C1 for summary and location).

Field sites 1-3 and 5-7 are situated on the grey/white sandy margins of low-lying swamps. All have been subject to some disturbance by vegetation clearance and firebreaks. The potential for the presence of stratified archaeological material is considered to be low at each of these sites. Vegetation consists of paperbark and reeds in and around the swamps with scattered gum trees on drier ground.

TABLE C2

DETAILS OF NEWLY RECORDED ARCHAEOLOGICAL SITES

FIELD SITE NO.	1:250 00 GRID REF S150-2	SITE TYPE	SITE DIMENSIONS (NS x EW)	LITHIC MATERIAL	EST. NO. ARTEFACTS	DENSITY (per sq.m)	LANDFORM	DISTANCE TO WATER	DISTANCE & DIRECTION TO CENTRELINE
1	386.984	Artefact scatter	5 x 10m	Quartz	30	0.6	Swamp Margin	5m	220mE
2	385.010	Artefact scatter	5 x 10m	Quartz	10	0.2	Swamp Margin	5m	60mE
3	384.015	Artefact scatter	50 x 10m	Quartz	10	0.02	Swamp Margin	5m	100mW
4	383.970	Artefact scatter	5 x 5m	Quartz	10	0.4	River Margin	50m	90mSE
5	384.970	Artefact scatter	10 x 10m	Quartz	20	0.2	Swamp Margin	20m	10mE
6	382.951	Artefact scatter	2 x 2m	Quartz	5	1.25	Swamp Margin	5m	210mE
7	380.927	Artefact scatter	20 x 5m	Quartz	10	0.1	Swamp Margin	5m	50mE

Field site 4 is situated on the alluvial terrace of the Murray River. The brown/yellow sandy alluvium has been graded and quarried near the artefact concentration. Vegetation consists of gum trees and annual grasses. Although the artefact scatter is of a small size and low density and there is some disturbance from quarrying for soil, it is considered that there is some potential for the presence of stratified archaeological material at this site.

The artefact assemblages at each of the newly recorded archaeological sites is dominated by quartz flakes and chips (see Table C3). Apart from some quartz core fragments, the only artefacts recorded were a quartz core and a quartz microscraper at Field Site 5.

TABLE C3

Field Site No.	Est. No. Artefacts	No. Recorded	QUARTZ ARTEFACT TYPES				
			Flakes	Chips	Core	Core Frags.	Scraper
1	30	19	3	14	-	2	-
2	10	8	1	7	-	-	-
3	10	4	3	1	-	-	-
4	10	5	2	3	-	-	-
5	20	13	-	10	1	1	1
6	5	3	2	1	-	-	-
7	40	5	4	1	-	-	-

Table C3: Details of artefact assemblages at newly recorded archaeological sites bases on total visible sample.

4.0 CONCLUSIONS

4.1 DISCUSSION

The proposed 330kV powerline route from Kemerton to the Kwinana Power Station is approximately 110km in length. The powerline will be constructed using steel-framed lattice towers to hold the cable. The majority of the route is on or near existing 132kV or 330kV line easements.

The archaeological investigation was designed to provide a systemic sample survey of the proposed powerline route and a suitable buffer zone.

Access and visibility varied along the route due to the nature of the terrain, vegetation, agricultural improvements and other forms of disturbance, and the presence of sheets of surface water. However, it is considered that a satisfactory cross-section was sampled.

Seven archaeological sites were located and recorded as a result of the archaeological survey. Six of these sites are outside the proposed easement. These sites are all small, low density quartz artefact scatters with less than 30 pieces present per site. The artefact assemblages are dominated by flakes and chips, with a few core fragments, and a core and microlithic scraper at Field Site 5. Their small size and low artefacts numbers make further analysis difficult. Only Field Site 5 appears likely to be affected by the construction of the powerline. [*Route alignment changes that postdate this report result in no sites being likely to be affected*].

Since no other lithic material suitable for artefact manufacture was noted along the proposed route, it is presumed that the source of the quartz lies to the east along the Darling Scarp.

The archaeological sites recorded as a result of this survey are similar to most other small, low density, quartz dominated surface artefact scatters previously recorded in the proximity of the route. The location of six of the seven sites on swamp margins fits the pattern of the metropolitan region, as described by Hallam (1986 :5). Field Site 4 on the Murray River alluvial terrace, although small, provides some possibility for the presence of stratified archaeological material.

4.2 SIGNIFICANCE OF SITES

Site significance in this report is based on recognising that a body of archaeological data can answer regional research questions, as well those concerning a particular site's attributes (c.f. Raab & Klinger, 1977 and Bowdler, 1981).

- Archaeological Field Sites 1-3, 6 and 7

These small low density, quartz surface artefact scatters are minor sites that may represent short-term, transient camp sites. They are considered to be of relatively low archaeological significance because:

- o Several similar sites have been recorded adjacent to the route, and
- o There is a limited potential for further archaeological information to be obtained.

- Archaeological Field Sites 4 and 5

Although these are minor sites, it is felt that they are more significant than the others because Field Site 4 may contain a stratified deposit and Field Site 5 contains a more varied artefact assemblage.

4.3 RECOMMENDATIONS

The recommendations which follow are based on field observations and knowledge of previously recorded sites in the vicinity of the proposed powerline route.

1. Archaeological Field Sites 1, 2, 3, 6 and 7 have been adequately recorded. They are outside the proposed easement and therefore are unlikely to be disturbed by the construction of the powerline. Permission to disturb these sites, should the necessity arise, could be given pursuant to application for site disturbance under the W.A. Aboriginal Heritage Act.

2. Archaeological Field Site 4 is also outside the proposed easement. It is recommended that no further disturbance occur on or near this site because of the potential for the presence of stratified archaeological material in the alluvial terrace of the Murray River.

3. Archaeological Field Site 5 has been adequately recorded. Because of its location 10m from the centreline of the proposed powerline route, it is likely to be disturbed by the construction of the powerline. Permission to disturb this site should the necessity arise, could be given pursuant to application for site disturbance under the W.A. Aboriginal Heritage Act. Alternatively, placement of towers and access tracks can be designed to avoid this site because of its recorded size (10m x 10m).

4. It is pointed out that human interference to Aboriginal sites is an offence (unless authorised under the Act) as outlined is Section 17 of the Western Australian Aboriginal Heritage Act, 1972-1980. Therefore it is recommended that the SECWA take adequate measures to inform any project personnel of this requirement.

ACKNOWLEDGEMENTS

The information and assistance provided by Cliff Morris, Rudy Teh, Neil Daetwyler, Barry Muir, Rory O'Connor, Vera Novak and Robert Reynolds is gratefully acknowledged.

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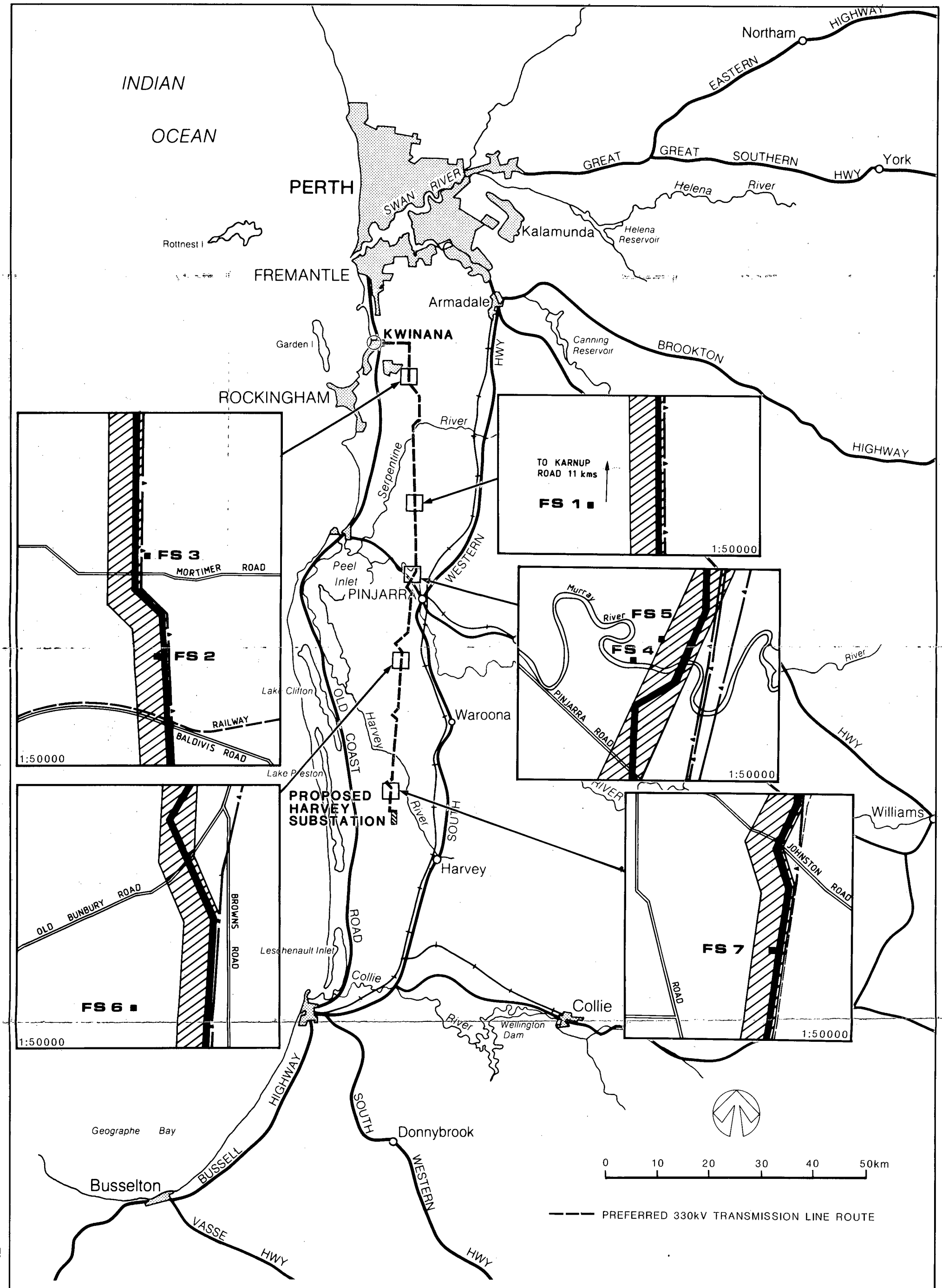

Figure C 1
Dames & Moore

ADDENDUM CI

GLOSSARY

Adze:	Stone tool used as a wood-making 'chisel', usually mounted in a handle.
Artefact:	Any object made by human agency.
Assemblage:	Set of artefacts found in close association with each other.
Back Point, Back Blade:	A point or blade with one margin deliberately blunted to form a penknife-like back.
Blade:	A parallel-sided flake, at least twice as long as it is wide.
Bladelet:	A smaller version of a blade.
Bulb of Precussion:	The rounded swelling left on the inner face of a flake or blade directly below the point of impact on the striking platform.
Chip:	A flake or fragment less than 1cm in length.
Chopper:	A large heavy core tool used for chopping.
Conchoidal Fracture:	Shell-like, curved surface with ripple marks formed in certain types of rock fracture.
Core:	A lump or nodule of stone from which flakes have been removed.
Flake:	A piece of stone detached by striking a core with a hammerstone.
Geometric Microlith:	A microlith of triangular, trapezoidal or other geometric shape, with an abruptly trimmed thick margin.

Grinding Stone: A millstone for grinding up ochre, seeds, fruits or other foodstuffs.

Hammerstone: A lump of stone or river pebble used in fashioning small stone tools.

Leilira Blade: Either a long, pointed blade triangular in section, or an elongated rectangular blade trapezoid in section.

Microlith: A small stone artefact, less than 3cm in its maximum dimension.

Pebble Tool: Chopping tool made by flaking one or both faces of a large river 'pebble' or cobble.

Retouch: Flaking or trimming of a stone artefact after detachment from a core, usually by trimming or re-sharpening the edges.

Scraper: Stone tool made on a flake, with one or more working edges, generally used for chiselling, cutting, gouging or planing wood. Hence, its various forms such as notched, nosed, steep, concave, end, side or flake.

Utilised Piece: Any other unaltered piece of stone that has at least, part of, one edge intentionally modified.

REFERENCE

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ADDENDUM CII

OBLIGATIONS RELATING TO SITES UNDER THE ABORIGINAL HERITAGE ACT, 1972 -1980

(Provided by the Western Australia Museum)

"Report of Findings

15. Any person who has knowledge of the existence of anything in the nature of Aboriginal burial grounds, symbols or objects of sacred, ritual or ceremonial significance, cave or rock paintings or engravings, stone structures or arranged stones, carved tress, or of any other place or thing to which this Act applied or to which this Act might reasonably be suspected to apply, shall report its existence to the Trustees, or to a police officer, unless he has reasonable cause to believe the existence of the thing or place in question already known to the Trustees.

Excavation of Aboriginal Sites

16. (1) Subject to Section 18, the right to excavate or to remove anything from an Aboriginal site is reserved to the Trustees.

(2) The Trustees may authorise the entry upon and excavating of an Aboriginal site and the examination or removal of any thing on or under the site in such manner and subject to such conditions as they may direct.

Offences relating to Aboriginal sites

17. A person who -

(a) excavates, destroys, damages, conceals or in any way alters any Aboriginal site, or

(b) in any way alters, damages, removes, destroys, conceals, or who deals with in a manner not sanctioned by relevant custom, or assumes the possession, custody or control of, any object on or under an Aboriginal site, commits an offence unless he is acting with the authorisation of the Trustees under Section 16 or the consent of the Minister under Section 18.

Consent to certain uses

18. (1) For the purposes of this section, the expression "the owner of any land" incudes a lessee from the Crown, and the holder of any mining tenement or mining privilege, or of any right or privilege under the Petroleum Act 1967, in relation to the land.

(2) Where the owner of any land gives to the Trustees notice in writing that he requires to use the land for a purpose which, unless the Minister gives his consent under this section, would be likely to result in a breach of Section 17 in respect of any Aboriginal site that might be on the land, the Trustees shall, as soon as they are reasonably able, form an opinion as to whether there is any Aboriginal site on the land, evaluate the importance and significance of any such site, and submit the notice to the Minister together with their recommendation in writing as to whether or not the Minister should consent to the use of the land for that purpose, and, where applicable, the extent to which and the conditions upon which his consent should be given.

(3) Where the Trustees submit a notice to the Minister under subsection (2) of this section he shall consider their recommendation and having regard to the general interest of the community shall either -

(a) consent to the use of the land the subject of the notice, or a specified part of the land, for the purpose required, subject to such conditions, if any, as he may specify; or

(b) wholly decline the consent to the use of the land, the subject of the notice for the purpose required, and shall forthwith inform the owner in writing of his decision.

(4) Where the owner of any land has given to the Trustees notice pursuant to subsection (2) of this section and the Trustees have not submitted it with their recommendation to the Minister in accordance with that subsection the Minister may require the Trustees to do so within a specified time, or may require the Trustees to take such other action as the Minister considers necessary in order to expedite the matter, and the Trustees shall comply with any such requirement.

(5) Where the owner of any land is aggrieved by a decision of the Minister made under subsection (3) of this section he may, within the time and in the manner prescribed by rules of court, appeal from the decision of the Minister to the Supreme Court which may hear and determine the appeal.

(6) In determining an appeal under subsection (5) of this section the Judge hearing the appeal may confirm or vary the decision of the Minister against which the appeal is made or quash the decision and substitute his own decision which shall have the effect as if it were the decision of the Minister, and may make such order as to the cost of the appeal as he sees fit.

(7) Where the owner of any land gives notice to the Trustees under subsection (2) of this section, the Trustees may, if they are satisfied that it is practicable to do so, direct the removal of any object to which this Act applies from the land to a place of safe custody.

(8) Where consent has been given under this section to a person to use any land for a particular purpose nothing done by or on behalf of that person pursuant to, and in accordance with any conditions attached to, the consent constitutes an offence against this Act".

ADDENDUM C-III

NOTES ON THE RECOGNITION OF ABORIGINAL SITES

(Provided by the Western Australian Museum)

There are various types of Aboriginal sites, and these notes have been prepared as a guide to the recognition of those types likely to be located in the survey area.

An Aboriginal site is defined in the Aboriginal Heritage Act, 1972 - 1980 in Section 5 as:

"(a) any place of importance and significance where persons of Aboriginal descent have, or appear to have, left any object, natural or artificial, used for, or made or adapted for use for, any purpose connection with the traditional cultural life of the Aboriginal people, past or present;

(b) any sacred, ritual or ceremonial site, which is of importance and special significance to persons of Aboriginal descent;

(c) any place which, in the opinion of the Trustees, is or was associated with the Aboriginal people and which is of historical, anthropological, archaeological or ethnographical interest and should be preserved because of its importance and significance to the cultural heritage of the State;

(d) any place where objects to which this Act applies are traditionally stored, or to which, under the provisions of this Act, such objects have been taken or removed."

Habitation Sites

These are commonly found throughout Western Australia and usually contain evidence of tool-making, seed grinding and other food processing, cooking, painting, engraving or numerous other activities. The archaeological evidence for some of these activities is discussed in detail under the appropriate heading below.

Habitation sites are usually found near an existing or former water source such as a gnamma hole, rock pool, spring or soak. They are generally in the open, but they sometimes occur in shallow rock shelters or caves. It is particularly important that

none of these sites be disturbed as the stratified deposits which may be found at such sites can yield valuable information about the inhabitants when excavated by archaeologists.

Seed Grinding

Polished or smoothed areas are sometimes noticed on/near horizontal rock surfaces. The smooth areas are usually 25cm wide and 40 or 50cm long. They are the result of seed grinding by the Aboriginal women and indicate aspects of the past economy.

Habitation Structures

Aboriginal people sheltered in simple ephemeral structures, generally made of branches and sometimes tussocks of grass. These sites are rarely preserved for more than one occupation period. Occasionally rocks were pushed aside or used to stabilise other building materials. When these rock patterns are located they provide evidence of former habitation sites.

Middens

When a localised source of shellfish and other foods has been exploited from a favoured camping place, the accumulated ashes, hearth stones, shells, bones and other refuse can form mounds at times several metres high and many metres in diameter. Occasionally these refuse mounds or middens contain stone, shell or bone tools. These are most common near the coast but examples on inland lake and river banks are not unknown.

Stone Artefacts Factory Sites

Pieces of rock from which artefacts could be made were often carried to camp sites or other places for final production. Such sites are usually easily recognisable because the manufacturing process produces quantities of flakes and waste material which are clearly out of context when compared with the surrounding rocks. All rocks found on the sandy coastal plain for example, must have been transported by human agencies. These sites are widely distributed throughout the State.

Quarries

When outcrops of rock suitable for the manufacture of stone tools were quarried by Aborigines, evidence of the flaking and chipping of the source material can usually be seen in situ and nearby. Ochre and other mineral pigments used in painting rock surfaces, artefacts and in body decoration are mined from naturally occurring seams, bands and other deposits. This activity can sometimes be recognised by the presence of wooden digging sticks or the marks made by these implements.

Marked Trees

Occasionally trees are located that have designs in the bark which have been incised by Aborigines. Toeholds, to assist the climber, were sometimes cut into the bark and sapwood of trees in the hollow limbs of which possums and other arboreal animals sheltered. Some tree trunks bear scars where sections of bark or wood have been removed and which would have been used to make dishes, shields, spearthrowers and other wooden artefacts. In some parts of the State, platforms were built in trees to accommodate a corpse during complex rituals following death.

Burials

In the north of the State it was formerly the custom to place the bones of the dead on a ledge in a cave after certain rituals were completed. The bones were wrapped in sheets of bark and the skull placed beside this. In other parts of Western Australia the dead were buried, the burial position varying according to the customs of the particular area and time. Natural erosion, or mechanical earthmoving equipment occasionally exposes these burial sites.

Stone Structures

If one or more stones are found partly buried or wedged into a position which is not likely to be the result of natural forces, then it is probably that the place is an Aboriginal site and that possibly there are other important areas nearby. There are several different types of stone arrangements ranging from simple cairns or piles of stone to more elaborate designs. Some were constructed in connection with food gathering. Low weirs which detain fish when tides fall are found in coastal areas.

Some rivers contain similar structures that trap fish against the current. It seems likely that low stone slab structures in the south-west jarrah forests were built to provide suitable environments in which to trap some small animals. Low walls or pits were sometimes made to provide a hide or shelter for a hunter.

Elongated rock fragments are occasionally erected as a sign or warning that a special area is being approached. Heaps of alignments of stones may be naturalistic or symbolic representations of animals, people or mythical figures.

Paintings

These usually occur in rock shelters, caves or other sheltered situations which offer a certain degree of protection from the weather. The best known examples in Western Australia occur in the Kimberley region but paintings are also found through most of the State. One or several coloured ochres as well as other coloured pigments may have been used at a site. Stencilling was a common painting technique used throughout the State. The negative image of an object was created by spraying pigment over the object which was held against the wall.

Engravings

This term describes designs which have been carved, pecked or pounded into a rock surface. They form the predominant art form of the Pilbara region but are known to occur from the Kimberleys in the north to about Toodyay in the south. Most engravings occur in the open, but some are situated in rock shelters.

Caches

It was the custom to hide ceremonial objects in niches and other secluded places. The removal of objects from these places, or photography of the place or objects or any other interference with these places is not permitted.

Ceremonial Grounds

At some sites the ground has been modified in some way by the removal of surface pebbles, or the modelling of the soil, or the digging of pits and trenches. In other places there is no noticeable alteration of the ground surface and Aborigines familiar with the site must be consulted concerning its location.

Mythological Sites

Most sites already described have a place in Aboriginal mythology. In addition there are many Aboriginal sites with no man-made features which enable them to be recognised. They are often natural features in the landscape linked to the Aboriginal account of the formation of the world during the creative 'Dreaming' period in the distant past. Many such sites are located at focal points in the creative journeys of mythical spirit beings of the Dreaming. Such sites can only be identified by the Aboriginal people who are familiar with the associated traditions.

APPENDIX D

APPENDIX D

ETHNOGRAPHY

report prepared by
Rory O'Connor
August 1987

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ETHNOGRAPHY

1.0 INTRODUCTION

1.1 BACKGROUND TO REPORT

This report, which is based on a period of field research carried out in July 1987, was commissioned on behalf of the State Energy Commission of Western Australia (SECWA) by Dames & Moore. The aim of the research was to identify and delineate areas of Aboriginal significance in the vicinity of that section of the proposed 330kV Muja-Kwinana overhead powerline route which lies between Kemerton and Kwinana (Figure D-1), and thus enable the SECWA to fulfil its obligations under the Western Australian Aboriginal Heritage Act. To this end, Aboriginal people from Medina, Armadale, Mandurah, Pinjarra and Harvey, all of whom have long-term association with the region in question, were consulted by the author. At the same time, and in recognition of the possible archaeological significance of the areas to be impacted by the proposed development, an archaeological survey was conducted by G. Quartermaine.

At the time when this field survey was conducted, the powerline route from Kemerton to Muja had not yet been finalised. It is envisaged that a similar, but briefer exercise will be carried out for that section of line in due course.

1.2 ACKNOWLEDGEMENTS

Mr P. Bennell acted as assistant to the field survey: his efforts were greatly appreciated. Ms L. Coomer, Mr J. Coomer, Mr J. Walley, Mr J. Bennell, Mr O. Little, Mrs E. Little, Ms V. Little, Mr V. Little, Mrs R. Wallam and Mr G. Wallam shared their considerable knowledge of parts of the South West with the author. Mr C. Morris advised regarding the Commission's needs and operations and Mr B. Muir co-ordinated the survey on behalf of Dames & Moore.

1.3 FORMAT OF REPORT

The conduct of the field survey and format of the report are based upon guidelines suggested by the Department of Aboriginal Sites, Western Australian Museum, and follow the procedure standardised by the author in some 60 similar exercises undertaken since 1980. Section 2.0, which follows, constructs a conceptual framework for the survey results. Section 3.0 describes methodology and details the results of the survey. Finally, Section 4.0 offers for consideration a series of recommendations arising from the survey results.

2.0 ABORIGINAL SITES IN SOUTH-WESTERN AUSTRALIA

2.1 ANTHROPOLOGICAL CONSIDERATIONS

The Aboriginal political geography of South-Western Australia has been described in O'Connor (1984 and 1985) and O'Connor and Quartermaine (1986 and 1987). The following summarised points are relevant to the present exercise.

- o South-Western Aborigines were a distinct sociocultural group in pre-contact items.
- o Dialectal variation occurred within a single South-Western language family.
- o A regional system of land tenure, based either on kinship or dialectal units existed.
- o As contemporary accounts of these systems are internally inconsistent and sometimes contradictory; it is now impossible to reconstruct the pre-contact political geography of the region.
- o Territorial separateness disappeared soon after European settlement, due to population movements, deaths and the development of fringe camps (and, later settlements and "missions").
- o The development of a widely-scattered population of mixed-ethnic background, who live in the South-west of this State, see themselves as sharing a common identity and refer to themselves as Nyungars.
- o Continuity with the traditional past, knowledge of regional mythology and knowledge of areas of religious significance passed to the present senior adult generation of Nyungars by a pivotal generation of culture transmitters. Among these, in the Metropolitan Region were Maitland Sandy, Chitty Hedland, Daglish Granny, Sam Broomhall, Herbert Dyson, Bulyil, Wandi, Nyinda Bropho, Lottie Harris and Ollie Worrell; and in the Murray River region were George Windjan, who settled in Mandurah, and Kitty, who settled in Pinjarra. The two last-named were survivors of the Battle of Pinjarra (see below).
- o A determination among the present senior adult generation to protect remaining areas of significance from development.

2.2 THE BATTLE OF PINJARRA

The single most important event in the history of Aboriginal - European contact in the survey region is undoubtedly the so-called Battle of Pinjarra, which took place in 1834 on the banks of the Murray River, where Pinjarra Hospital is now situated. Friction between settlers and Aborigines in the region had led to a punitive expedition being despatched under the command of Lieutenant Stirling. The one-sided battle, which resulted in heavy Aboriginal casualties, was the culminating point of this expedition - although historical sources vary, the Aboriginal account relates that up to 150 men, women and children died in this fight. The demoralised survivors offered no further active resistance to the settlers. On hundred and fifty years on; the site of the battle has become a symbol of resistance among Nyungars, thereby locating the Murray River as an area of potential conflicts. It is thus important that Aboriginal sites in that region be regarded with caution, as the ramification of any disturbance of these extend for beyond the immediate region.

2.3 REGIONAL FRAMEWORK

A regional analysis of ethnographic sites has been submitted to the SECWA by the author in the report on the Survey of Aboriginal Sites in the vicinity of the Proposed 132kV Overhead Powerline Route from the Northern Metropolitan Terminal to Wundowie.

3.0 THE SURVEY

3.1 METHODOLOGY

Four separate phases were involved in this work:

(i) examination of existing ethnographic data base;
(ii) consultation and discussions with key Aboriginal persons and organisations;
(iii) scouting powerline route with Aboriginal assistants;
(iv) report preparation.

3.2 PREVIOUSLY RECORDED SITES (See Figure D2)

Near the point where the powerline will cross the Murray River, a number of Aboriginal sites have been previously recorded by the author. These are as follows:

3.2.1 Waugal Cave Avoidance Area (W.A.M. Site S2228)

This site is located at Joweelingup, a bend in the Murray River, 1.6km upstream from Ravenswood Bridge. The site takes in the entire river bend, and 50m upstream and 50m therefrom. According to Pinjarra Aboriginal tradition, there is an underwater cave at this bend in the River, which is inhabited by the Waugal. The water is extremely cold here, and the area is avoided even today by Aboriginal people. The proposed river crossing was carefully investigated by the scouting party. The site dimensions previously recorded are correct: the crossing is thus acceptable, being outside the site area.

3.2.2 Adam Road Camping Areas (W.A. Sites S2229, S2230)

Approximately 750m north-east of the Pinjarra - Mandurah Road, Adam Road gives on to a sandy track which runs to skirt the southern bank of the Murray River. This was a favoured Aboriginal camping area, centred around a freshwater soak which drains into the river. The site extends 1.2km upstream along the southern bank of the

River from the bend in Adam Road. A further 1.1km upstream, at a prominent bend in the river, which is presently spanned by the power transmission lines, another soak is located near the southern bank. This also was a camping area, occupying the 225m between the existing power lines. As the proposed powerline passes through the first of these sites, it was specifically discussed by the scouting party, one member of which camped here in her youth. This matter is further discussed in the recommendation below.

3.2.3 Waugal Swan (W.A. Site S2231)

Five hundred metres upstream from the point where the Dandalup River empties into the Murray River, the land on the northern bank levels into an extensive swamp system measuring 700m by 200m. This swamp is a Waugal resting place and is avoided by local Aborigines. It is believed that a dangerous mudhole or quicksand deposit is located near its centre. The proposed powerline is a considerable distance form this site.

3.3 NEWLY RECORDED SITES (See Figure D2)

To the south of Buller Road and immediately east of the existing Muja to Southern Metropolitan Terminal powerline is an Aboriginal camping round. This was used in the 1930's and 1940's by the Michael family. The proposed transmission line is some 1.5km west of this site.

No other Aboriginal sites were recorded by the scouting party.

4.0 RECOMMENDATIONS

As the newly recorded site is outside the easement of the proposed powerline, no recommendations for its protection are included in this report. Its details will be registered at the WA Museum by the author in due course.

The proposed powerline passes over WA Museum Site S2229. It is therefore recommended that formal application be made through the Department of Aboriginal Sites to disturb this site (see Addendum D-I). Mrs Ernestine Little of Pinjarra is the senior surviving resident of this camp. Both she and her family were satisfied that permission to disturb this site should be granted on the ground that:

- an overhead powerline constitutes minimal disturbance
- the history of the area is amply preserved through registration and recording at the WA Museum.

5.0 REFERENCES

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INDIAN OCEAN

PERTH

SWAN RIVER

Rottnest I

FREMANTLE

Garden I

ROCKINGHAM

KWINANA

Armadale

HWY

Northam

HIGHWAY

EASTERN

GREAT

GREAT SOUTHERN HWY

York

Helena River

Helena Reservoir

Kalamunda

River

Serpentine

Mandurah

Peel Inlet

PINJARRA

WESTERN

Dwellingup

MURRAY

Hotham River

Lake Clifton

OLD COAST ROAD

Harvey

Waroona

Lake Preston

PROPOSED HARVEY SUBSTATION

River

SOUTH

Harvey

Leschenault Inlet

ROAD

Collie

BUNBURY

River

Wellington Dam

Collie

Williams

HWY

Geographe Bay

BUSSELL HIGHWAY

Busselton

VASSE HWY

SOUTH WESTERN HWY

Donnybrook

PREVIOUSLY RECORDED

OLD MANDURAH ROAD

Murray River

WAUGAL CAVE

PINJARRA

S2229

S2230

WAUGAL SWAMP

1:50000

NEWLY RECORDED

CORONATION ROAD

BULLER ROAD

ABORIGINAL CAMPING GROUND

1:50000

0 10 20 30 40 50km

PREFERRED 330kV TRANSMISSION LINE ROUTE

ETHNOGRAPHIC SITES

Figure D1
Dames & Moore

ADDENDUM D-I

OBLIGATIONS RELATING TO SITES UNDER THE ABORIGINAL HERITAGE ACT, 1972 -1980

(Provided by the Western Australia Museum)

"Report of Findings

15. Any person who has knowledge of the existence of anything in the nature of Aboriginal burial grounds, symbols or objects of sacred, ritual or ceremonial significance, cave or rock paintings or engravings, stone structures or arranged stones, carved trees, or of any other place or thing to which this Act applied or to which this Act might reasonably be suspected to apply, shall report its existence to the Trustees, or to a police officer, unless he has reasonable cause to believe the existence of the thing or place in question already known to the Trustees.

Excavation of Aboriginal Sites

16. (1) Subject to Section 18, the right to excavate or to remove anything from an Aboriginal site is reserved to the Trustees.

(2) The Trustees may authorise the entry upon and excavating of an Aboriginal site and the examination or removal of any thing on or under the site in such manner and subject to such conditions as they may direct.

Offences relating to Aboriginal sites

17. A person who -

(a) excavates, destroys, damages, conceals or in any way alters any Aboriginal site, or

(b) in any way alters, damages, removes, destroys, conceals, or who deals with in a manner not sanctioned by relevant custom, or assumes the possession, custody or control of, any object on or under an Aboriginal site, commits an offence unless he is acting with the authorisation of the Trustees under Section 16 or the consent of the Minister under Section 18.

Consent to certain uses

18. (1) For the purposes of this section, the expression "the owner of any land" includes a lessee from the Crown, and the holder of any mining tenement or mining privilege, or of any right or privilege under the Petroleum Act 1967, in relation to the land.

(2) Where the owner of any land gives to the Trustees notice in writing that he requires to use the land for a purpose which, unless the Minister gives his consent under this section, would be likely to result in a breach of Section 17 in respect of any Aboriginal site that might be on the land, the Trustees shall, as soon as they are reasonably able, form an opinion as to whether there is any Aboriginal site on the land, evaluate the importance and significance of any such site, and submit the notice to the Minister together with their recommendation in writing as to whether or not the Minister should consent to the use of the land for that purpose, and, where applicable, the extent to which and the conditions upon which his consent should be given.

(3) Where the Trustees submit a notice to the Minister under subsection (2) of this section he shall consider their recommendation and having regard to the general interest of the community shall either -

(a) consent to the use of the land the subject of the notice, or a specified part of the land, for the purpose required, subject to such conditions, if any, as he may specify; or

(b) wholly decline the consent to the use of the land, the subject of the notice for the purpose required, and shall forthwith inform the owner in writing of his decision.

(4) Where the owner of any land has given to the Trustees notice pursuant to subsection (2) of this section and the Trustees have not submitted it with their recommendation to the Minister in accordance with that subsection the Minister may require the Trustees to do so within a specified time, or may require the Trustees to take such other action as the Minister considers necessary in order to expedite the matter, and the Trustees shall comply with any such requirement.

(5) Where the owner of any land is aggrieved by a decision of the Minister made under subsection (3) of this section he may, within the time and in the manner prescribed by rules of court, appeal from the decision of the Minister to the Supreme Court which may hear and determine the appeal.

(6) In determining an appeal under subsection (5) of this section the Judge hearing the appeal may confirm or vary the decision of the Minister against which the appeal is made or quash the decision and substitute his own decision which shall have the effect as if it were the decision of the Minister, and may make such order as to the cost of the appeal as he sees fit.

(7) Where the owner of any land gives notice to the Trustees under subsection (2) of this section, the Trustees may, if they are satisfied that it is practicable to do so, direct the removal of any object to which this Act applies from the land to a place of safe custody.

(8) Where consent has been given under this section to a person to use any land for a particular purpose nothing done by or on behalf of that person pursuant to, and in accordance with any conditions attached to, the consent constitutes an offence against this Act".

APPENDIX E

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LIST OF ENVIRONMENTAL COMMITMENTS

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LIST OF ENVIRONMENTAL COMMITMENTS

(i) Various arrangements of tower heights and spans will be used to provide appropriate tower sitings consistent with minimum environmental disturbance and minimal visual intrusion on the landscape.

(ii) The SECWA's Properties Officers have established and will maintain contact with property owners and occupiers in order to ascertain individual requirements affecting the project.

(iii) Timing of construction activities will, where possible, take into account landholders' farming practices, so as to minimise disturbance to the farmers' use of land.

(iv) Compensation will be negotiated where farmers suffer loss of production brought about by establishment of an easement.

(v) Periodic line inspections will be undertaken in order to maintain the desired window-type "clearing profile" of the easement. (This is depicted on Figure B1 in Appendix B of this PER).

(vi) On average, every two years some vegetation maintenance work will be required along the transmission line. In these instances, the vegetation will be cut back to the minimum permissible height as defined in Appendix B in this PER.

(vii) Special attention will be given to minimal clearing through the System 6 recommended area to ensure revegetation of the easement and maintenance of vegetation within it.

(viii) Clearing activities will be restricted to tower positions, track access and vegetation which extends into the clearing profile.

(ix) Where the access track is orientated down steep gradients, precautions will be taken to divert runoff into vegetated, more stable areas while maintaining vehicle access.

(x) Steps will be taken to minimise clearing in areas of dense scrub vegetation and wetland communities.

(xi) Design studies will be aimed, where practicable, at maximising the height of the conductors in the dense scrub and wetland areas, so span lengths can be increased.

(xii) Permanent access tracks will be detoured to use existing wetland crossings, whenever practicable, enabling retention of scrub layers and other vegetation.

(xiii) The procedures to be adopted for easement clearing will result in the maximum retention of rootstock and seedstock of understorey species.

(xiv) Easement maintenance will be aimed at restricting/preventing vegetation growing into the required clearing profile.

(xv) Groundcover and a shrub layer under the transmission line will be permitted to a maximum height of 1.5m.

(xvi) Safeguards to control of P.c. dieback disease will be consistent with Appendix B of this PER.

(xvii) Staff of the SECWA will be adequately informed of their obligations under the Aboriginal Heritage Act (1972-1980) regarding disturbance of sites.

(xviii) Towers will, where possible, be located close to the edges of wooded areas and rows of trees in order to minimise the visual intrusion of structures located on cleared land.

(xix) Where road crossings occur, the following guidelines will be applied, where possible, to minimise visual impacts:

- o Ideally, the crossing will be effected at right angles, but where this is impracticable, the closest possible alignment to this will be achieved;
- o Towers will be located as far as practicable from the road;

- o A strip of understorey shrubs up to three metres high will, where possible and practicable, be maintained for at least 10m on either side of the road. This will depend to a large extent on the nature of the vegetation at the precise crossing location selected; and
- o If little or no vegetation occurs at the crossing, then appropriate roadside verge planting of local vegetation will assist in reducing the impact.

(xx) Gates will be established where transmission lines cross existing fences. Under normal circumstances, these will be kept locked.

(xxi) The construction and maintenance of access tracks will be to the minimum standard that is consistent with convenient four wheel drive access by the SECWA vehicles.