

PROPOSED NORTHERN TERMINAL — PINJAR TRANSMISSION LINE

PUBLIC ENVIRONMENTAL REPORT



Dames & Moore

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PUBLIC ENVIRONMENTAL REPORT
PROPOSED NORTHERN TERMINAL TO
PINJAR TRANSMISSION LINE

for

State Energy Commission of Western Australia

Dames & Moore Job No. 08038-114-071

28 February 1989

PREFACE

The SECWA proposal to construct a transmission line between Northern Terminal and Pinjar has involved a Corridor Selection Study and an investigation of the consequential environmental impacts of the preferred corridor option.

The Corridor Selection Study has been performed by Ken Adam & Associates et al. (1988).

The environmental impact assessment has been prepared by Dames & Moore and is presented here as a Public Environmental Report. The PER has been written as a self-contained document that refers extensively to the Adam & Associates Report. For this reason, the Adam & Associates Report has been reproduced in a separate volume as an Appendix to the PER.

PUBLIC ENVIRONMENTAL REPORT

NORTHERN TERMINAL — PINJAR TRANSMISSION LINE

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

The Public Environmental Report (PER) for the proposed Northern Terminal — Pinjar Transmission Line, has been prepared by Dames & Moore in accordance with the Western Australian Environmental Protection Act, 1986. The report will be available for comment for 8 weeks, commencing 4 March 1989 and closing on 28 April 1989.

Following receipt of comment from government agencies and the public, the EPA will discuss the issues 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 by the EPA will be acknowledged.

DEVELOPING A SUBMISSION

You may agree or disagree, or comment on, the general issues discussed in the PER. 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 environmentally more acceptable.

- clearly state your point of view.
- indicate the source of your information or argument if this is applicable; and
- 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 sections, chapter or recommendation in the PER. If you discuss different sections of the PER keep them distinct and separate, so 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.

Submissions will be treated as public documents unless confidentiality is requested.

REMEMBER TO INCLUDE:

YOUR NAME

ADDRESS

DATE

THE CLOSING DATE FOR SUBMISSION IS: 28 APRIL 1989

SUBMISSIONS SHOULD BE ADDRESSED TO:

The Chairman

Environmental Protection Authority

1 Mount Street

PERTH WA 6000

Attention: Mr R. Griffiths

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(Separate Volume)

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APPENDIX B	TRANSMISSION LINE CORRIDORS NORTHERN TERMINAL TO PINJAR; CORRIDOR AND LINE SELECTION K.A. ADAM & ASSOCIATES ET AL. (1988)

PUBLIC ENVIRONMENTAL REPORT
PROPOSED NORTHERN TERMINAL TO
PINJAR TRANSMISSION LINE

1.0 INTRODUCTION

1.1 BACKGROUND, OBJECTIVES AND SCOPE

The State Energy Commission of Western Australia (SECWA) proposes to construct a gas turbine power station at Pinjar, to supply electricity to the State grid via the Northern Terminal sub-station, located 40km to the south. The power station will be located near the point of divergence of the existing Muchea-Eneabba and Muchea-Yanchep 132kV sub-transmission lines (Figure 1).

The power station and the Northern Terminal sub-station will therefore need to be linked by a transmission line.

It is expected that construction for the line will commence in September 1989, and will be scheduled for completion in time for the commissioning of the Pinjar power station in 1990.

In July 1988, SECWA commissioned K.A. Adam & Associates to carry out the task of identifying corridors for one 132kV and two 330kV transmission lines between Northern Terminal and Pinjar. The brief was originally based upon the assumption that the Overseas Telecommunications Commission (OTC) radio communication facilities at Cullacubardee, about 5 kilometres north of Northern Terminal, was classified as a Category B facility in terms of its sensitivity to man-made noise. Subsequently, it became known to SECWA that the high-frequency receiving facility was regarded by OTC as requiring a much higher level of separation from sources of interference, including overhead electricity transmission lines.

Consequently, the brief was broadened to take in a much more extensive area of investigation in order to minimise any violation of OTC's separation requirements. The regional context of the expanded study area is shown on Figure 1.

The objectives given to K.A. Adam & Associates were essentially to:

- o recommend the methodology, design criteria and principles for corridor and route selection appropriate to the region north of Perth;

- o recommend a transmission line corridor and route for the 132kV line between Northern Terminal and Pinjar; and
- o prepare and evaluate options for two 330kV transmission line corridors from Northern Terminal to the coastal plain north of Perth.

For practical purposes the 330kV corridors were taken as linking Northern Terminal and Pinjar.

The SECWA commissioned Dames & Moore to prepare the Public Environmental Report for the proposed transmission line, on the understanding that it would present a summary of the main features of the Adam & Associates Report, and an evaluation of the environmental impact of the proposal, prepared in accordance with the guidelines issued for the project by the Environmental Protection Authority (EPA) (Appendix A). The Adam & Associates report therefore represents the major source of information for the PER, and sections relevant to the environment assessment process have been reproduced in this document. The full text of the Adam & Associates report is reproduced as Appendix B. Appendix A and B are presented as a separate volume to this PER.

1.2 RELEVANT LEGISLATION

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

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

1.3 THE ENVIRONMENTAL IMPACT ASSESSMENT PROCESS

The Environmental Impact Assessment procedure is a formalised process designed to provide information to the 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 Northern Terminal-Pinjar transmission line proposal, the EPA required that a PER be produced.

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

2.1 RATIONALE FOR THE PROJECT

Demand for electricity in the South West of the State has increased substantially in the last three years, and this has led SECWA to conclude that demand is likely to exceed supply during the early to mid 1990's, unless additional electrical generating capacity is established in the near future. In the short term, it is proposed to establish a gas turbine power generating station at Pinjar, north of Perth. This facility will use North West Shelf gas and is scheduled to commence operation in 1990.

It will also be necessary to construct an additional coal-fired power station to meet the State's projected energy demand, but since the lead time for such a facility is 5-6 years, the gas turbine station represents the only viable option to meet the predicted short term demand.

Electricity generated by the Pinjar gas turbines will need to be connected to the power system via the Northern Terminal sub-station located at Ballajura. This connection will require a double circuit transmission line, operating at 132kV. The configuration will comprise three conductors, vertically arranged, each side of the tower.

There are no realistic alternatives to a strong, direct interconnection between Northern Terminal and Pinjar.

2.2 COSTS AND BENEFITS TO THE PROPONENT, AND THE COMMUNITY

2.2.1 Costs and Benefits to the Proponent

Distance is the basic determining factor of cost in powerline construction, varied further by difficulties encountered in construction. As a guide, the approximate cost for the line is \$315,000 per km. The preferred route W2B (Section 4.3) will therefore cost in the order of \$13 million.

The main benefit of the project will be for SECWA to improve its capacity to maintain power supplies to the community.

2.2.2 Costs and Benefits to the Community

Funding for the project represents a cost to SECWA which will form a component of its electricity tariffs, and therefore becomes a cost to the community. Other less-tangible costs are reduction in scenic value, and perhaps a reduction in some future land-use options. These are likely to occur as a consequence of increasing urbanisation.

The benefits to the community lie in improved servicing. The increasing urbanisation on the northern Swan Coastal Plain, together with the general economic development of the South West of the State, is placing increasing demand on existing power supplies. This demand is already being reflected in reduced generation margins and other early warnings of overload of supplies.

The community should clearly recognise that it is community demand, not SECWA, that is promoting the powerline construction. SECWA's role is to fulfill that demand

while taking every practical effort to protect the social and natural environment and minimise cost to the community.

Further considerations of community benefit are the employment, goods and services and other flow-ons which occur as a result of planning, construction and maintenance of the line.

3.0 THE PROPOSAL

3.1 GENERAL

The proposal is to construct a power transmission line operating at 132kV between the existing Northern Terminal sub-station and a proposed gas turbine power station to be constructed near Pinjar.

Consideration of long term needs have indicated that two double circuit 330kV power lines could be required to bring power from a possible coal-fired power station to the north, south to the interconnected system at Northern Terminal.

An assessment of all possible routes between the Northern Terminal and Pinjar has been made, taking account of environmental, social, economic and other constraints.

Power system optimisation shows that it would be advantageous for the proposed Northern Terminal-Pinjar line to be of 330kV construction, operating at 132kV until the long term need for increased power supply arises.

3.2 CONSTRUCTION AND OPERATION

The 132kV interconnection between Pinjar and Northern Terminal will be constructed on double-circuit structures capable of supporting 330kV lines. The structures will be of the lattice steel tower type. Towers will be spaced at up to about 400m centres, and between 35m and 42m in height.

In certain situations where it is necessary to reduce the height of the towers - for example in the vicinity of aircraft take-off and landing approach areas - it is possible to reduce the tower height by about 4.5m or 5.0m by deleting the overhead earthwire.

In extreme cases, a double-circuit 330kV line could be split into two separate single-circuit lines of about 25m height, but this would greatly increase the cost.

Construction of the lines will be undertaken by contractors under SECWA supervision, and will be operated by SECWA. The main components of the construction process involves the laying of foundations for the towers, and the installation of the power lines.

4.0 ROUTE SELECTION

4.1 GENERAL

Adam & Associates undertook the detailed examination of alternative routes for the power line. Criteria used in route selection, and the degree of importance given to them, are listed below in Table 1 and are discussed in detail in their report (Appendix B).

TABLE 1
ROUTE SELECTION DETERMINANTS AND ALLOCATED DEGREE OF IMPORTANCE

SELECTION DETERMINANTS	IMPORTANCE VALUE
Disruption to human settlements	H
Disruption to agricultural practices	L
Disruption to forestry practices	H
Disruption to extractive practices	H
Disruption to recreational uses	H
Disruption to natural systems	H
Visual impact	M
Impact upon projected uses	H
Financial investment	H
Utilisation of rights-of-way	M
Systems reliability	H
Accessibility	M

H High
M Medium
L Low
N Negligible

4.2 OBJECTIVES AND CRITERIA FOR EVALUATION

The objectives and criteria used to evaluate the preferred corridor have been defined by Adam & Associates (Appendix B). They cover a range of issues that emphasise the need to:

- o minimise the costs of constructing, operating and maintaining the transmission line, whilst at the same time, ensuring reliability of supply; and
- o minimising the social, economic and biophysical impact of the project on the local and regional community.

4.3 RESULTS OF THE ADAM & ASSOCIATES STUDY

The Adam & Associates study made two recommendations for lines constructed at 330kV, and they were:

- o Corridor W2B (for a single double circuit line), and
- o Corridor W3 (for a second double circuit line).

SECWA propose to adopt the first recommendation (W2B) as the preferred option because it does not compromise the construction of a second 330kV line, should the need arise in the future (Figure 1). This situation would occur if the shorter W2 corridor option shown on Figure 1 were adopted for the first line, since a second line constructed east of Whiteman Park would need to cross over the first line south of Lake Pinjar, in order to proceed along the western side of the Lake to the proposed power station.

5.0 THE EXISTING ENVIRONMENT

5.1 REGIONAL CONTEXT

Figure 1 shows the regional metropolitan setting of the study area. It shows how the proposed site of the Pinjar gas turbine power station relates to the Northern Terminal sub-station, major transmission lines and other sub-stations and power stations, and the spread of existing urban development in the Region.

Figure 1 also identifies the location of some of the major constraints on transmission line development, notably the OTC installation, the RAAF Pearce base at Bullsbrook, the RAAF receiving installation (3TU) and some major regional reserves.

The western boundary of the area of investigation is determined primarily by existing and committed urban development, as reflected in the Metropolitan Region Scheme (MRS). The southern boundary is determined by existing urban development and the fact that the transmission lines must run north from Northern Terminal. The northern extremity was determined essentially by the need to ensure that lines approaching Pinjar from the east could provide sufficient clearance for aircraft in the vicinity of RAAF Pearce.

The eastern extent of the study area has been determined by the constraint sought to be imposed by OTC. In brief, when the Adam & Associates study was commissioned, OTC was believed to require a relatively small radius of exclusion around it, which would have confined the investigation to potential corridors aligned between OTC and 3TU. Subsequently, OTC gave notice that a much larger zone of exclusion would be required, and the area of investigation had to be extended to allow for consideration of corridors east of RAAF Pearce. The presence of the Walyunga National Park and Darling Scarp has required that the study area extend sufficiently far east to ensure viable corridors along the Darling Plateau.

5.2 LANDFORMS

In broad terms, the study area can be considered to include two physiographic units: the topographically subdued Swan Coastal Plain and the heavily dissected Darling Plateau. The division between these units is marked topographically, geologically and geomorphologically. For convenience, the study area has been broken into three sectors for description:

The **Western Sector** includes those areas that lie entirely in dune and sandplain terrain of the Swan Coastal Plain;

The **Central Sector** includes those areas that lie between sandplain terrain and the base of the Darling Scarp and contain landforms and soils associated with alluvial processes; and

The Eastern Sector includes those areas that lie within the Darling Plateau and Darling Scarp.

5.3 VEGETATION AND FLORA

The western sector has been substantially cleared for agriculture and forestry. The central-western and south-western parts of the study area, in particular, have mostly been cleared. The north-western area still contains relatively large tracts of native vegetation in good condition.

The range of vegetation complexes found within the central parts of the study area reflect the presence of alluvial soils and landforms along the boundary between the Swan Coastal Plain and the Darling Scarp. The inherent suitability of the alluvial soils for agriculture, particularly viticulture and grazing, has resulted in large scale clearing within these areas, such that for the most part, only remnant patches of the indigenous vegetation complexes remain. The vegetation of the sandplains and dunes has been less extensively cleared.

The eastern part of the study area, nominally considered to be those parts east of the base of the Darling Scarp, has vegetation that is dominated by jarrah-marri forest and wandoo woodland. The distribution of vegetation complexes and plant communities is strongly related to landforms and soils, and on this basis, a number of complexes can be readily recognised. Agricultural development has resulted in widespread clearing, particularly within valley landforms. However, there are good stands of vegetation within uncleared blocks of farmland, on ridges that have latritic duricrust, on the sides of valleys where the slope is very steep, and within the Walyunga and Avon National Parks.

There are several locations within the study area where populations of gazetted rare or high priority plants are known to exist. As it is CALM policy not to publish the precise location of these populations, only a general indication of their occurrence has been given in the Adam & Associates report. That information has been used to define exclusion zones for transmission lines.

CALM has also advised that pre-construction transmission line route surveys should include a flora survey for relevant species to augment existing surveys.

5.4 FAUNA

Investigation of the presence of gazetted rare or geographically restricted fauna within the study area necessarily referred to the location of relevant habitats, rather than to the locations of populations. The preservation of habitat through the establishment of appropriate conservation reserves has been adopted by State Government regulatory authorities to ensure the protection of relevant fauna species. Therefore, the location of the statutory conservation reserves (for example, the Ellen Brook Nature Reserve which supports the Western Swamp Tortoise Pseudomydra umbrina), are the relevant constraints to transmission that have been observed by the corridor identification process.

5.5 CULTURAL HERITAGE

5.5.1 Aboriginal Sites

Discussions with the Aboriginal Sites Department of the WA Museum indicate that there are no comprehensive data on Aboriginal sites occurring within the study area. Sites are generally small enough to avoid interference and hence the potential for Aboriginal sites to constrain the selection of line transmission corridors is regarded as low.

At the time of route design it will be necessary to obtain detailed advice from the Museum, and subsequently to undertake surveys and discussions with Aboriginal people to identify any sites of ethnographic or archaeological significance.

5.5.2 European Heritage

There are a number of buildings and places listed by the National Trust that occur within the study area. These were taken into account during the route selection phase. Further details are provided in Appendix B.

5.6 CONSERVATION AREAS

The regional extent of the study area is such that it includes remnant bushland areas surrounded by agricultural and urban land uses. Many of these have been recognised

for their conservation value, including Whiteman Park, Wanneroo Wetlands, Melaleuca Park, Ridges Management Priority Area, Ellen Brook and Twin Swamp Nature Reserves and Walyunga National Park. A complete listing is provided in Appendix B, together with location maps.

5.7 SOCIAL AND LAND USE CONSTRAINTS

5.7.1 Forestry, Agriculture and Water

A large proportion of the study area is occupied by State Forest 65 (the Gngangara and Pinjar Pine Plantations; Figure 1).

State Forest 65 consists primarily of plantations of the coniferous tree Pinus pinaster that have been established on low fertility soils of the Bassendean and Southern Rivers landforms. The plantation contains stands of various stature and density (and therefore economic value) as determined by age and previous management (such as thinning). There are also areas that have been recently harvested as well as areas that have never been planted and still support native vegetation, principally Banksia and Jarrah-Banksia woodland or open forest.

Most of the cleared and partly cleared land within the study area is used for agricultural purposes including:

- o grazing of beef cattle, sheep and horses agistment;
- o orchards and market gardens;
- o viticulture; and
- o hobby farming.

Land use for grazing is most common on the heavier alluvial soils along the base of the Darling Scarp and within the valleys of the Darling and Dandaragan Plateaux.

Orchards are also largely confined to the heavier soils within these areas, whilst market gardens are common within the sandy soil areas along the western fringes of State Forest 65.

Viticultural activity is intensive within the alluvial plains and river terraces associated with the Swan River, at various locations along the base of the Darling Scarp and on sandy loam soils on the Reagan Scarp.

The study area contains a number of areas where the production of potable water is either a current or potential land use.

A number of statutory reserves for the purpose of "water" have been declared by State and local government statutory authorities, to protect the beneficial uses of these resources.

5.7.2 Urban Development

Existing

Most of the land in the immediate vicinity of Northern Terminal is either developed or zoned for industrial purposes.

Land in the area to the north as far as Hepburn Avenue and east as far as Tonkin Highway is also committed for urban (largely residential) development. Much of this land is covered by the Ballajura (North) Outline Development Plans Nos. 10, 11, and 12 of the Shire of Swan.

The area immediately east of Northern Terminal - Ballajura South - has been the subject of an Outline Development plan of the Shire of Swan. The plan covers the area bounded by Tonkin Highway, Hepburn Avenue, Ballajura North, Northern Terminal and Marshall Road.

Potential

In November 1987 the report "Planning for the Future of the Perth Metropolitan Region" (Review Group to the State Planning Commission) was published. The report contains a Preferred Strategy for future metropolitan growth, to replace the Corridor Plan as a basis for future amendments to the Metropolitan Region Scheme.

The Preferred Strategy outlines three major urban development areas within the study area. The first is a substantial area bounded by Wanneroo Road on the west, State Forest 65 on the east, Hepburn Avenue on the south, and Lake Adams to the north. Part of this land would be a major industrial area, linking two existing industrial areas on Wanneroo Road and Gnangara Road.

The second comprises two parcels of land east of Tonkin Highway, between Whiteman Park and Swan Valley proper, separated by the RAAF communications base at Caversham (formerly Caversham airfield), and running generally north-south. Existing 330kV lines pass through part of this land.

The third area lies along the foothills of the Darling Scarp between Toodyay Road and Walyunga National Park. This area at present consists of highly fragmented holdings, with a mixture of intensive rural activities.

In addition to the areas outlined in the Review Group's Preferred Strategy, there are at least two other major areas of land which are currently the subject of serious investigation or proposals for urban development. These are:

- o the Santa Maria Estate; and
- o the Ellenbrook proposals.

The Santa Maria Estate area is owned substantially by the Crown and is currently under investigation by Landcorp. It includes a substantial proportion of the OTC site, allowing, however, for continued use and expansion of the OTC operations, and for a 1km buffer against residential development around the reduced OTC site. The Landcorp study allows for extension of the Tonkin Highway, forking just south of Gnangara Road, to the north east and south west. It also allows for a 200m wide transmission line corridor immediately to the east of Tonkin Highway.

The Ellenbrook proposals have been prepared by private sector interests. They cover an extensive area west and south from The Vines Estate to Upper Swan. The area takes in large sections of Whiteman Park and the Gnangara Pine Plantation (State Forest 65). The proposals envisage substantial residential development, together with a town centre, golf resort, regional sporting venues incorporating Whiteman Park facilities, and a nature conservation area.

The Ellenbrook proposals do not have any formal status. Although they are likely to proceed to some degree, they do not represent a significant constraint to transmission line development.

In the long term, it is likely that urbanisation will overtake other parts of the study area.

Tonkin Highway Extension

There have been numerous proposals to extend the Tonkin Highway north, but none has been implemented.

Existing and Committed Rural-Residential Areas

Three rural-residential areas exist within the Swan Valley - Henley Brook, Whiteman, and The Vines-Belhus Estate.

There are three rural-residential areas located at the foothills of the Darling Scarp: the Brigadoon Estate, a second area adjoining the northern edge of Walyunga National Park, and another near Bullsbrook.

Other rural-residential areas occur in the west part of the study area, in the Shire of Wanneroo.

5.7.3 Land Ownership

There are large areas of land in the study area which are in public ownership; most are committed to specific uses. Those of regional, state or national interest include:

- o State Forest 65;
- o Whiteman Park;
- o Walyunga National Park;
- o Pearce Air Base and its installations at Caversham and 3TU;
- o The RAAF bombing range (leased by the State to the Commonwealth);
- o Avon Valley National Park;
- o Lake Pinjar; and
- o Melaleuca Park.

Because of its extent, location and use, as well as its ownership, State Forest 65 has been viewed as a desirable location for transmission line corridors.

5.7.4 Recreation and Tourism

Existing reserves that serve as recreation and tourism resources are:

- o Whiteman Park;
- o Walyunga National Park and its Swan River extensions, including an isolated section south of Belhus; and
- o John Forrest National Park.

Other major recreation areas include;

- o Avon Valley National Park;
- o Melaleuca Park; and
- o The Swan River environs.

Most of these areas have been developed for recreation areas because of their natural attributes - for example landscape, water, flora and fauna resources. Each would be sensitive to visual impact created by transmission lines, although sections of the extensive Whiteman Park, for example, do not rate highly.

5.7.5 Mining and Extractive Industries

Mining activity on private land is referred to as extractive industry and is administered by local authorities. Extractive industry sites have been identified from inspection of aerial photography and local knowledge.

There are two active mines administered by the Mines Department that occur within the study area and at least ten active extractive industry sites. The active mines are:

- o a sand mine for silica and aggregate sand at Gngangara (Silica Sales Pty Ltd); and
- o a sand mine at Gngangara (Bell Brothers Pty Ltd).

Active extractive industry sites within the study area include:

- o Granite quarry at Redhill (Pioneer Concrete);
- o Clay and gravel pits and small granite quarries at Redhill (Midland Brick);
- o Sand quarries at Gngara Road (Monier, Homeswest);
- o Clay pits at Muchea (Midland Brick);
- o Clay pits at Middle Swan (IBT Pty Ltd); and
- o Clay pits at Upper Swan (Bristle Pty Ltd, IBT Pty Ltd, Midland Brick, Pilsey Investments).

A number of additional extractive industry sites such as gravel pits that are too small to be reliably located from the aerial photography, may also be present. These sites would be identified during detailed route planning. Mines and extractive industries are only a minor constraint to powerline routing.

5.7.6 Radio Communications

Radio communication facilities, particularly high frequency (HF) receiving facilities, are very sensitive to background noise factors, including high voltage transmission lines.

Australian Standard AS3516.1 (1988) sets out three categories of HF long-distance receiving stations - A, B, and C - according to the primary purpose of the receiving system and in ascending order of level of tolerance to man-made noise. The Standard sets out generally acceptable levels of man-made noise for each category and defines appropriate separation distances from common sources of electronic noise, including roads and transmission lines.

In terms of Category A and B facilities the Standard nominates a separation distance from 330kV transmission lines of 9.6km and 2km respectively.

The OTC Station

OTC has a major communications facility located approximately 5km north of Northern Terminal, at Cullacubardee. The facility includes:

- o two separate satellite earth station operations;
- o the control centre for the Australian end of the Australian/Indonesian/Singapore (A.I.S.) cable and associated microwave facilities; and,
- o high frequency radio operations between Australia and marine craft, including the 24-hour-a-day monitoring of maritime distress frequencies - the Safety of Life at Sea (S.O.L.A.S.) Service.

The appropriate category of OTC is uncertain, however, at the present time, Northern Terminal has several 330kV transmission lines within 5-6km of the receiving facilities at OTC. There are also three 132kV transmission lines within 1 to 2km of the receiving facilities. Thus, the requirements for Category B facility are barely met at present, and those for a Category A facility are substantially violated.

Additionally, urban growth has theoretically led to an increase in background radio interference levels in the vicinity of the OTC facility, due to 22kV overhead distribution lines (which run to the OTC site boundary), as well as to increased road traffic and consequent ignition interference.

The satellite tracking operation requires clear line of sight within a 2° elevation of the horizon, in a northern aspect, and this presents further constraints to locating structures in the vicinity of OTC.

The overall situation poses a considerable dilemma in terms of assessing the level of constraint which the presence of the OTC facility realistically imposes on transmission lines out of Northern Terminal. SECWA and OTC recognise this difficulty, and have agreed to undertake a range of actions directed towards the identification and mitigation of radio interference effects, e.g.:

- o field surveys are being conducted in the vicinity of the OTC facility to establish existing levels of background interference and an ongoing monitoring program is under consideration; and
- o field surveys of other SECWA lines (not near OTC) have been conducted for reference purposes.

3TU (RAAF Pearce)

The Royal Australian Air Force operates a major radio receiving facility about 5km west of the air base itself. 3TU has long been recognised by SECWA as a sensitive facility, and its status as a Category A facility is accepted without question.

As a Category A facility, the zones of exclusion around 3TU would be 6.5km and 9.6km for 132kV and 330kV lines respectively. RAAF Pearce has requested a blanket 13km radius zone of exclusion around 3TU based on a 43m high 330kV line.

It should be noted that the existing Northern Terminal - Muchea 132kV wood pole line passes within 4km of 3TU, that is, well inside the separation distance recommended by AS3516.1.

Caversham Facility and Microwave Links (RAAF)

The RAAF also operates a radio communication facility at Caversham, on the former airfield. It has requested a 1.4km zone of exclusion around the site. The technical basis of this request has not been given, and hence it is not possible to evaluate whether it is reasonable.

In addition to the HF radio receiving and transmitting installations, RAAF operates microwave links between Caversham and Pearce, and Pearce and the Kalamunda Telecom Tower. A 200m radius clearance around these links is requested. The existing 132kV line to Northam intersects both these links, apparently without detriment, so it is assumed that the microwave links do not pose a constraint on further corridors.

5.7.7 Aircraft Movement

The RAAF Air Base at Pearce is one of the two busiest RAAF bases in Australia. The Air Base consists of airstrips at Bullsbrook and Gingin. It is also a major training base, hence, its requirements for air safety - including clearance from transmission lines - are more stringent than might otherwise be the case.

Height restrictions are imposed on structures located in the vicinity of Gingin and Pearce airstrips, and a tower 30m high, would encompass an exclusion area extending along a 13km radius from the airstrip. This distance does not take account of the actual flight approach and take-off paths and is considered to be conservative.

5.7.8 Separation of Transmission Lines

Where feasible, transmission lines should be well separated from one another, for line security reasons. Where transmission lines share a common easement, there is an increased risk of more than one line being rendered inoperative due to unforeseen events such as wildfire and lightning strike.

6.0 ENVIRONMENTAL IMPACTS

6.1 VISUAL IMPACTS

There are differences of opinion concerning whether it is best to combine or separate transmission lines to minimise visual impact. This is partly influenced by the subjective nature of visual impact, and partly affected by the nature of the land through which the transmission lines pass.

In open, flat terrain, any transmission line will be highly visible. However, a single line of towers is likely to have significantly less impact than two lines of towers grouped together. Also, for dual lines, the regularity of the tower spacing will vary with changing viewpoint, with neighbouring towers at times appearing closer and at other times further apart. The result is likely to be more visually chaotic and hence noticeable than if the lines were separated by a considerable distance. It is stressed that the separation of towers must be sufficient to ensure that the lines are not seen to have a combined impact.

In vegetated country, the visual impact of two separate, cleared easements will be much greater than that created by a single easement, not only for the obvious reason of a doubling of the loss of trees, but also because of the creation of two separate scars through the landscape. The visual impact would be accentuated in rugged or hilly terrain, however this only occurs in the eastern region of the study area. The preferred corridor is largely confined to State Forest 65, which is located on undulating sandplain country.

From a forest management point of view, it would be desirable to minimise the number of easements crossing the pine plantation (Section 6.8.1) and for that reason, it is likely that the line will be constructed, where possible, on the western edge of the State Forest leading northwards to Lake Pinjar, and then on the lake side of the Forest for the Pinjar and Ziatius Road segments of Corridors W2 and W2B (Figure 1). The visual impact along these segments will be minimal because the State Forest forms an effective backdrop and restricts the visibility of the line from either the east or the west, depending upon the particular segment concerned and the location of the viewpoint.

6.2 HISTORIC ARCHAEOLOGICAL AND ETHNOGRAPHIC SITES

The tower will not, as far as can be determined, impact on any known archaeological site or location of historic interest to living Aborigines. Similarly, no buildings or structures listed by the National Trust or Australian Heritage Commission will be affected. If such a site were found during detailed route selection, the line could be varied slightly to protect heritage values.

6.3 PHYSICALLY VULNERABLE LANDSCAPES

Construction of power lines is potentially damaging to the landscape, with the need to take heavy equipment on to the site of every tower, and to install large foundations. In rugged country the scars can remain for a long period.

In cleared areas, with established pasture, the only long term physical impact is the "footprint" of the individual towers. In less accessible areas, there is a need for a permanent maintenance track along the line route, and in uncleared areas, there is the need for a permanent clearance to ensure continuity of supply and maintenance. Within the area of study, the most favourable landscapes from this viewpoint are therefore the flat open pastures on the coastal plain and perhaps also the flatter slopes of the dune landscape to the west. Route W2B alignment conforms well with these requirements. The wetter areas, which will be avoided where possible for other reasons, also need to be treated with caution. It is necessary in such areas to construct access tracks for the construction equipment and to ensure access for maintenance purposes. The tracks and the construction pads at the tower base are therefore left in place.

6.4 IMPACT ON NATIVE VEGETATION

The degree of disturbance to native vegetation depends in part on the structural form of the vegetation. Transmission line easements are cleared to remove all vegetation that is higher than 1.5m. Therefore, tall forest vegetation with little understorey will undergo greater structural disturbance from clearing than heath formations or low open woodland with a species-rich understorey.

Much of the W2B corridor is through or adjacent to pine forest and therefore, the impact on native vegetation will be minimal.

It is assumed that any occurrences of gazetted rare or geographically restricted flora can be avoided by sensitive transmission route planning. A desk-top investigation of the location of gazetted rare plant populations indicated that there is no population of rare flora within the W2B Corridor, however, pre-construction vegetation and flora surveys would need to be conducted to confirm these results.

6.5 DIEBACK DISEASES

CALM has developed comprehensive procedures to minimise the risk of spreading dieback infection and these will be incorporated in the SECWA's transmission line installation procedures. The impact of the construction and operation of the line is therefore not expected to cause any significant increase in the spread of dieback.

6.6 SALINITY

The area of land required to be cleared for transmission lines is very small compared with areas cleared for agriculture. Further, powerline impacts will be spread over a number of localised catchments, thus diffusing the potential for increases in groundwater level and stream salinity. In any case, salinity increases are not a major environmental factor on the well drained soils that characterise the Swan Coastal Plain.

6.7 IMPACTS ON FAUNA

From available information, there is unlikely to be any specific impact on native fauna. The only disturbance will be the towers and the semi-cleared areas beneath the powerlines. When put in context of current land clearing, forestry activities and urban expansion, these impacts will be negligible. The faunal species currently present in the area will be those able to tolerate the existing disturbance levels, and therefore are highly likely to tolerate the powerline as well.

6.8 IMPACT ON RESOURCES

6.8.1 Forestry

The transmission line corridor has been selected to minimise impacts on the forestry operations of the area. Further negotiations during final routing of the powerline within the corridor will fine-tune the process to reduce to the greatest possible extent, any disruption to forestry management.

The potential impacts of transmission lines on State Forest 65 are:

- o premature harvesting of crop trees;
- o loss of production area;
- o decreased maintenance efficiency due to realignment of existing roads and firebreaks and possible creation of sub-optimal areas for management;
- o loss of aircraft landing areas; and
- o adverse impact on management practices and hence on economics of the forestry operations.

The most significant and enduring effects are likely to be on management practices. The economics of the forest depend heavily on aerial operations for fertilisation, fire-spotting and burning-off. The presence of a transmission line itself reduces potential for aerial operations. In addition, restrictions on flight paths may affect the location and number of aircraft landing areas, and hence the potential for aerial burning-off and fertilisation.

Further, the danger of "flashover" from transmission lines (ionisation and arcing through atmospheric carbon) would restrict the type of burning-off for fire control in the vicinity of the line. This would be most acutely felt in the case of wildfire.

6.8.2 Agriculture

In general, the W2B corridor does not cross agricultural land. Where it does so, the only disruption will be caused by the permanent location of the pylon bases and the need for occasional SECWA access. Neither will constitute a major disadvantage to land holders.

6.8.3 Water Supplies

The construction and operation of the proposed transmission line is not expected to affect Perth's water supply from the Gnangara Mound. SECWA is aware of the need to strictly control the use of fuel oils and other contaminants when operating within the catchment of the Mound, and will liaise with the Water Authority of Western Australia to ensure that appropriate control measures are implemented.

The use of land within the catchments should not be significantly affected by the establishment of a transmission line and therefore water production should not be considered to be a constraint to corridor identification. However, in delineating a transmission line route, the presence of capital works associated with water production, for example production bores and pipelines, needs to be considered, especially in relation to tower placement. Parallel routing of transmission lines beside water supply pipelines is normally avoided where possible. In instances where parallel routing cannot be avoided, cathodic protection devices are normally fitted to the pipeline creating additional costs to transmission line installation.

6.8.4 Electromagnetic Fields

There is some public and scientific controversy over the extent, if any, to which the health of individuals is affected by prolonged exposure (through residence, principally) to electric and magnetic fields surrounding transmission line conductors.

The Public Environmental Report for the Proposed Harvey-Kwinana 330kV transmission line, prepared by Dames & Moore for SECWA in 1988, also explored the question of field effects. Their report refers to proposed limits to be set by the World Health Organisation that are more conservative than those currently regarded as acceptable.

For the Harvey-Kwinana single circuit 330kV transmission line, the highest magnetic field that could occur within the easement under emergency conditions was estimated to be less than 30% of the proposed limit. Under normal conditions, it would be less than 10%. The highest magnetic fields at the edges of the easement would be 2.5% of the limit. The highest electric field within the easement would be 80% of the recommended limit, while at the edges it would be less than 10%. The present proposal is for a double circuit line constructed at 330kV. The effect of the extra circuit on the electric and magnetic fields associated with the line is unlikely to be significant.

It is important to note that the above estimates are levels within or at the edges of easements. Since neither dwellings nor activities involving a prolonged presence within an easement will be permitted, exposure levels to people will be negligible.

6.8.5 Telecommunications and the OTC Station

The selection of potential corridors has ultimately been determined by reference to three basic options for OTC, and to adoption of a particular rationale in relation to the requirements of RAAF Pearce.

The three options considered in relation to OTC, and their consequences for transmission line corridors, are:

- (1) Acceptance of OTC as a Category A facility, (notwithstanding Northern Terminal's present violation of that status). This entails corridors taking the shortest possible path away from OTC, and skirting RAAF Pearce to the east.
- (2) Consideration of OTC as having something below a Category A rating, in view of the proximity of Northern Terminal and existing transmission lines. This basically entails identifying corridors for one or both 330kV lines to pass between OTC and Pearce, with significant separation from OTC.

- (3) Acceptance of OTC as a Category B facility. This entails finding corridors passing between OTC and Pearce, possibly quite close to OTC.

The rationale adopted in respect of RAAF Pearce and its various facilities is:

- (1) Acceptance of 3TU as a Category A facility, with only negligible violation of its area of exclusion tolerated.
- (2) Acceptance of Civil Aviation Authority standards, with a considerable safety margin, in relation to aircraft take-off and approach areas.
- (3) In the absence of technical standards, no particular clearance around Caversham.
- (4) In the absence of technical standards, a generally conservative approach to the low flying area around the bombing range.
- (5) In the absence of technical standards and the apparent non-viability of take-off and approach across the scarp east of Pearce, no particular requirements for height limitations in that location.

In the case of items 3, 4, and 5, above, it is expected that negotiations with the Air Force Office would occur in due course, if necessary.

6.8.6 Requirements for Clearing of Vegetation

The line will require complete removal of all trees for a distance of 30m either side of the centre line of the easement. Provision will also be made to allow access to the route by four wheel drive vehicle. Because the proposed corridor largely passes through State Forest, SECWA will work closely with CALM to ensure that the clearing requirements can be incorporated within the necessary forest management plans. Issues that will require special consideration include the timing of forest cutting practices and fire management.

6.8.7 Impacts During Construction

The main impact during construction will involve the physical clearing of the vegetation. The corridor selection process has attempted to use existing corridors and cleared land to minimise the impacts during construction.

An additional possible impact is the introduction of dieback disease by heavy earthmoving equipment. Full dieback precautions and disease risk mitigation procedures will be applied throughout the operations (Section 6.5).

6.8.8 Long Term Impacts

Long-term impacts associated with the project, whilst not considered significant, include:

- o ongoing dieback monitoring and disease risk minimisation,
- o occasional maintenance of the easement clearing, and
- o the need to consider carefully any future developments which may be affected by, or impinge upon, the powerline after it is in place.

7.0 ENVIRONMENTAL MANAGEMENT

7.1 INTRODUCTION

The installation and operation of the proposed transmission line between Northern Terminal and Pinjar will generally only result in low-level environmental impacts. Most of these will be associated with the construction phase of the project, and hence will be of short term duration. Impacts occurring during the operation and maintenance phases of the project will require ongoing environmental management.

The following discussion provides a description of the environmental management commitments that SECWA is prepared to make to ensure that the level of impact during both phases of the project is within acceptable limits.

7.2 MANAGEMENT COMMITMENTS

A detailed study has been carried out to identify the location of suitable corridors between Northern Terminal and Pinjar on the basis of a range of economic, biophysical and social criteria. SECWA is willing to make the following commitment to ensure that the selected corridor causes the least environmental disruption:

o **Commitment 1:**

The preferred corridor option will be examined in detail and the exact alignment of the powerline selected to take into account the economic, biophysical and social criteria referred to above. Specifically, the route alignment will be selected to minimise the clearing of vegetation, and avoid contact with rare plants and historic, Aboriginal, or other localised natural or cultural features of significance.

The major land use along the preferred corridor is State Forest which consists mainly of pine plantations. The visual impact of the segments of the preferred corridor that pass through the State Forest will be minimal. The backdrop provided by the Forest when the line emerges south of Lake Pinjar will help minimise visual intrusion outside the forest. SECWA is willing to make the following commitment to reduce visual intrusion:

o **Commitment 2:**

SECWA will ensure that the spacing of towers and their levels will be given special attention during detailed design in order to minimise visual intrusion on the landscape, particularly where the line emerges from the State Forest.

The construction phase of the project can potentially lead to localised, physical damage to the landscape. This can occur as a consequence of moving heavy equipment at the site of each tower, prior to the installation of large foundations. SECWA is prepared to make the following commitment to ensure that there are no long term physical effects caused by the installation of the towers:

o **Commitment 3:**

SECWA will make every effort to ensure that the physical disturbance to each tower site, the access road leading to the site, and land either side of the corridor will be kept to a minimum, and rehabilitated where necessary.

The preferred corridor is characterised by generally flat terrain and porous sands, hence runoff is unlikely to be a major problem. Vegetation surrounding each tower will be left undisturbed where possible, to minimise localised erosion. SECWA is willing to make the following commitment in respect of erosion:

- o Commitment 4:

Each tower site will be periodically inspected to ensure that runoff is not causing localised erosion.

- o Commitment 5:

Should these inspections indicate erosion, the SECWA will notify the EPA and carry out remedial action. This would include recontouring and vegetation rehabilitation.

A desk-top investigation has been performed to ensure that the preferred corridor does not interfere with any known population of gazetted rare or geographically restricted flora. SECWA is willing to make the following commitment to ensure that rare flora are not impacted:

- o Commitment 6:

SECWA will undertake pre-construction vegetation and flora surveys once the alignment of the line within the preferred corridor has been finalised.

- o Commitment 7:

The results of this survey will be forwarded to the EPA.

- o Commitment 8:

If any gazetted rare or geographically restricted flora are encountered during the pre-construction vegetation survey, the towers and access roads will be located so as not to cause any disturbance.

During the operation of the line, maintenance crews will require periodic access to the towers. Similarly, SECWA staff inspecting for erosion and vegetation growth under and near to the transmission lines, will require access. SECWA realises that such movements could increase the spread of dieback disease, and is therefore willing to make the following commitment:

- o Commitment 9

SECWA will ensure that all maintenance and observation crews requiring access to the transmission line will strictly observe the comprehensive procedures developed by CALM, to minimise the risk of spreading dieback.

The transmission line corridor will result in some disruption to forest management practices in State Forest 65. SECWA recognise the importance of these practices, particularly from the point of view of forest productivity, aerial operations and fire management. They are therefore prepared to make the following commitment:

o **Commitment 10:**

SECWA will continue to consult with CALM to ensure that routing and operation of transmission lines through the State Forest will cause as little disruption to forest management practices as is practicable. SECWA will inform CALM of the centre line of the route as soon as this has been determined, so that appropriate modifications can be made to forest clearing and fire management plans.

The preferred corridor traverses the Gngangara Groundwater Mound which is a major source of water for Perth. SECWA is willing to make the following commitment to ensure that their activities do not adversely affect the quality of groundwater

o **Commitment 11:**

Any fuel oils or potential groundwater contaminants that are used during the construction phase of the project will be strictly controlled. None will be disposed of on-site.

SECWA recognise that there is a need for an ongoing management programme to ensure that the commitments outlined above are addressed systematically, and that the results of the programme are referred to the EPA. The following commitment is given:

o **Commitment 12:**

SECWA will prepare an Environmental Monitoring Programme (EMP) that will formalise the Environmental Commitments described above. The EMP will be prepared annually for three years, at which time the results of the Programme will be reviewed, and the form of ongoing monitoring re-assessed.

8.0 CONCLUSIONS

The proposed transmission line is seen by SECWA as an essential component of the State's plans to extend and improve urban development to the north of Perth, and meet the growing economic development needs of the State.

This PER has briefly examined the methodology and conclusions of a study carried out by K.A. Adam & Associates, to determine the location of transmission corridors between Northern Terminal and Pinjar. It has also summarised the alternatives and the reasons for selecting the proposed corridor, and examined the possible impacts that would be associated with the preferred option.

It is considered that the W2B option offers the most acceptable corridor, in terms of the long term needs of SECWA and a range of environmental factors.

SECWA is prepared to make twelve commitments to ensure that the construction and operation of the transmission line will not result in any unacceptable environmental impacts.

9.0 REFERENCES

Adam, K.A. & Associates (1988). Transmission Line Corridors. Northern Terminal to Pinjar. Corridor and Line Selection. Report to the State Energy Commission of Western Australia.

Dames & Moore (1988). Proposed Harvey-Kwinana 330kV Transmission Line Public Environmental Report.

