PROPOSED CHLORIDE PROCESS TITANIUM DIOXIDE PLANT AT KEMERTON

SCM CHEMICALS LTD

Report and Recommendations
of the
Environmental Protection Authority

Environmental Protection Authority
Perth, Western Australia
Bulletin 283 July 1987

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LOCATION TERMS

Reference is made at various points throughout this Assessment Report to several specific areas and sites relating to the location of the proposed titanium dioxide plant, and to various considerations being either on site or off-site. These locations are described in the following terms:

1. Plant site: the 55 hectare area on which the proposed plant would be sited. The NOI refers to this as the Kemerton site.

2. Plant location: the 1-2 hectare area within the plant site where the plant would be located.

3. Kemerton area/Buffer zone/Buffer area: the area within the boundaries of the Conceptual Land Management Plan - Kemerton Community Park.

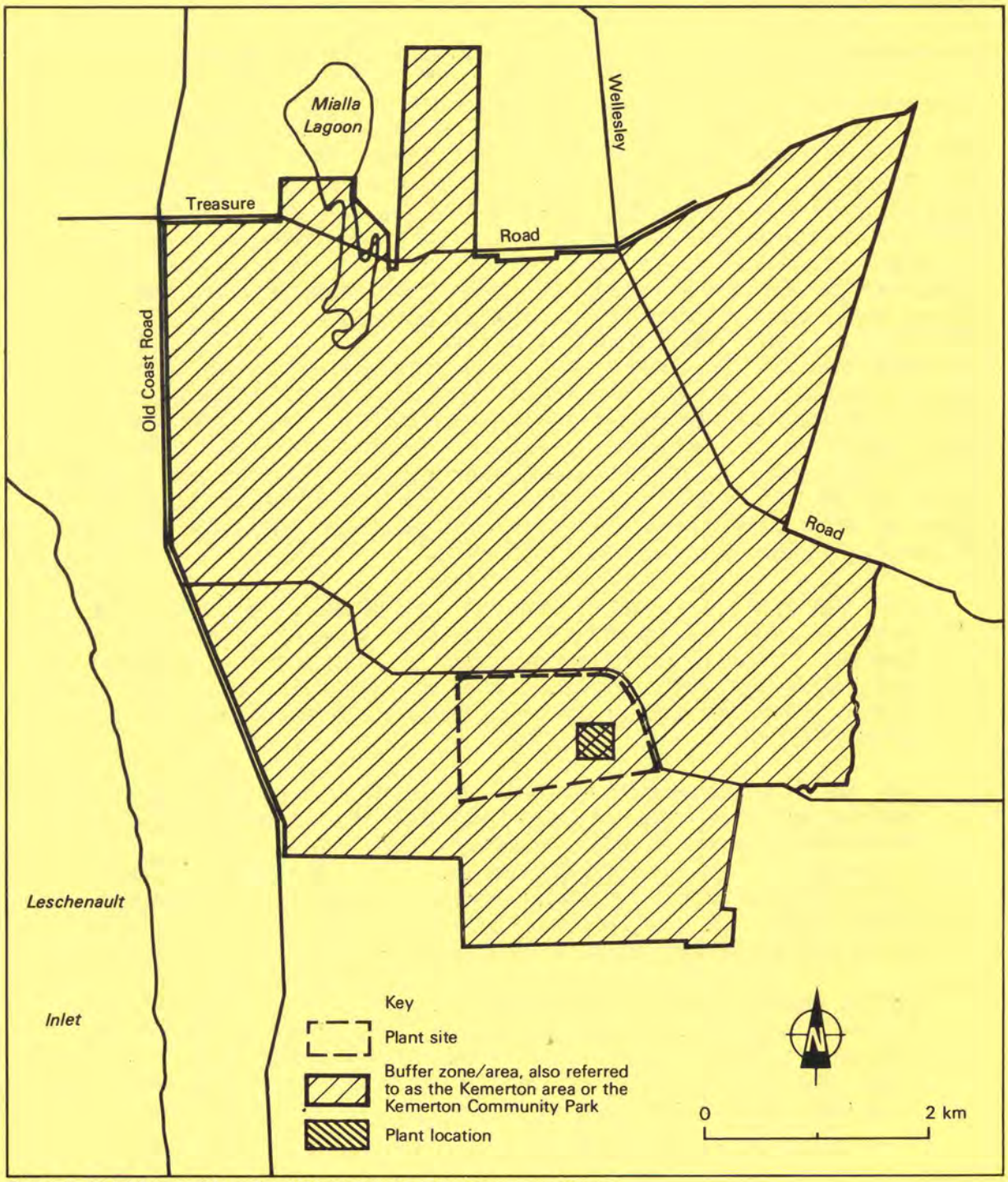

Figure 1. Aerial Extent of Locational Terms Used in This Assessment Report.

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

The Environmental Protection Authority (EPA) has assessed the proposal by SCM Chemicals Ltd (the proponent or the Company) presented in the Notice of Intent (NOI) and submitted to the EPA by the Company. The proponent proposes to convert, enlarge and relocate its existing 36 000 tonne per annum (tpa) sulphate-process titanium dioxide raw pigment plant at Australind to a chloride-process plant within the Kemerton area, producing 70 000 tpa of unfinished titanium dioxide pigment slurry.

This material would be transported by road to the Company's Australind site where it would be finished before the bulk of the material is exported either interstate or overseas. Kemerton is approximately 9 km north of the existing Australind plant site.

A proposal for a 50 000 tpa chloride-process plant at the Australind Site was recently assessed by the EPA following the release of an ERMP Stage II document (Kinhill Stearns 1986). The EPA concluded (EPA Bulletin 275 May 1987) that, while the Australind proposal could be made environmentally acceptable, the EPA would prefer the plant to be relocated to another site. In its assessment of the Australind proposal the Authority noted that "However, if this were to happen then the new proposal at an alternative site would require further environmental assessment" (EPA Bulletin 275 p21).

Following the EPA assessment of the Australind proposal, further negotiations were held between the Government and the Company which resulted in the Company submitting on the 10 June 1987 a Notice of Intent (NOI) for the proposal at Kemerton to the EPA. The Minister for the Environment notified the EPA that he would require the EPA's advice by 16 July 1987. The Authority then determined that the degree of assessment appropriate for this proposal should be at the NOI level, especially given the facts that:

- the EPA had previously examined in detail the Australind proposal for a 50 000 t/a titanium dioxide plant. The Kemerton proposal is an augmentation of the previous proposal and hence the Authority is familiar with the environmental issues which are likely to arise during its assessment of the proposal;

- the EPA has previously assessed a proposal for an aluminium smelter at the Kemerton site and has presented a detailed Assessment Report (EPA Bulletin 214, June 1985). The Authority is familiar with the Kemerton site and has been involved in a number of environmental studies for the Kemerton buffer area and is familiar with the environmental issues which are likely to arise at this site; and

- public comments have already been sought and received on both the original SCM proposal for the Australind site and on the proposed aluminium smelter at Kemerton. Furthermore, public input could be obtained on the NOI itself, by direct contact with the affected communities.

The EPA undertook the following steps as part of its environmental impact assessment process for public input:

- consulted Harvey Shire Council on the best means of obtaining public input;
- provided input to the summary of the Company's NOI which the Council made available to all residents of the surrounding area;
- made copies of the Company's NOI available at all local public libraries and at the Council chambers;
- in conjunction with the Council, organised a public meeting at the Australind Hall for 2 July 1987. The proceedings of this public meeting were taped and the transcripts used as submissions to identify environmental issues and local concerns; and
- forwarded copies of the Company's NOI to all relevant government agencies within the State for their comments.

The EPA believes that this procedure has been constructive and has provided adequate information to the Authority to undertake its assessment.

The EPA has identified the following matters and questions which it believes need assessment:

- Is Kemerton an environmentally acceptable site to locate the proposed plant?
- Would the risk from the proposed 70 000 tpa titanium dioxide plant at Kemerton, be acceptable to the Authority? In order to assist the Authority, the NSW Department of Environment and Planning (DEP) was commissioned to undertake computer modelling on the Company's proposal associated with plant hazards as outlined in the NOI.
- Would there be adequate fresh water available for the SCM plant at Kemerton without detrimentally affecting the local users and having adverse impact on the environment? The Authority directed this matter to the Department of Resources Development and the Water Authority of Western Australia for advice.
- Could the saline wastewater be discharged into the Wellesley River as proposed in the NOI without detrimentally affecting the beneficial uses of the river? The Authority believes that these beneficial uses include:

- the conservation values of the river ecosystem including fauna and flora;

- the aesthetic and recreational values of the river; and

- the riparian rights of the local users including use of river water for irrigation.

In order to determine the potential impacts on these beneficial uses of the Wellesley River, the EPA initiated a number of studies and investigations on the hydrology and ecology of the Wellesley River including the impact of discharged saline wastewater on the river and surrounding environment. The EPA also sought expert advice from a number of organisations and individuals.

Finally, the Authority sought independent advice on a number of alternative wastewater disposal options including piping from Kemerton to Australind, to Leschenault Inlet, or to the ocean, as well as for deep-well injection.

After undertaking its assessment, the Authority makes the following conclusions:

. The Kemerton site for a 70 000 tpa chloride-process plant can be made environmentally acceptable.

. The risk levels for 100 tonne storage of chlorine is unacceptable to the Authority. However, the risk levels for 50 tonne storage is acceptable if stored in 25 tonne storage vessels.

. The EPA has been informed by the Water Authority of Western Australia (WAWA) that it can make available sufficient water for the Company without detrimentally affecting the existing users. The EPA does not have sufficient detail to give advice on the environmental acceptability of supplying the proponent's water requirements at Kemerton.

. The EPA's requirements in terms of safeguards for the Kemerton proposal should be the same as those required for chlorine production at Kwinana.

. The Authority's investigations have shown that the Company's saline wastewater discharge into the Wellesley River would be environmentally unacceptable.

. On the basis of preliminary investigation of alternative wastewater disposal options, the Authority concludes that piping of the treated saline wastewater in the ocean could be made environmentally acceptable.

Given the above, the Authority believes that the proposed plant at Kemerton can be made environmentally acceptable.

The Authority has reiterated its earlier recommendation that the existing sulphuric acid and sulphate-process plants should not operate beyond 30 June 1990 (or at an extension of time under the Pigment Factory (Australind) Agreement Act 1986).

During the period of concurrent operations of the sulphate-process plant (Australind) and the chloride-process plant (Kemerton), the EPA has recommended environmental performance guidelines for air emissions at Australind. This will enable the Government, should it so wish, to consider the merits of operation of the sulphuric acid and the redundant sulphate process plants at Australind beyond 30 June 1990 in the context of the Company's overall environmental performance.

The Authority has also made recommendations on the management of the waste disposal on the Leschenault Peninsula until the termination of the current disposal practice.

There are a number of other issues which have been assessed and discussed in this Assessment Report, including the issue of titanium tetrachloride transportation from Kemerton to Australind. The general conclusion is that these can be managed in an environmentally acceptable manner.

The Authority would require regular reporting from the proponent on the Company's management and monitoring programme for both the Kemerton and Australind sites.

The Environmental Protection Authority has made the following recommendations and conclusions:

(1) **The Environmental Protection Authority concludes that the proposal is environmentally acceptable and recommends that it could proceed subject to:**

- **the relevant commitments made by proponent for the titanium dioxide plant and listed in Appendix 2 of this Report;**
- **the EPA's conclusions and recommendations in this Assessment Report.**

(2) **The Environmental Protection Authority concludes that the Kemerton site is an acceptable area to locate the chloride-process titanium dioxide plant.**

(3) The Environmental Protection Authority recommends that a condition of approval should be the preparation in stages of a comprehensive and integrated hazard and risk management strategy, to the Authority's satisfaction.

This should consist of the following with the results being forwarded to the Environmental Protection Authority:

- the HAZOP study to be completed and submitted before construction commences and to be conducted in a manner approved by the EPA. This HAZOP study should especially discuss the risk effects of the safeguards removed due to the plant being located at Kemerton;

- a final risk analysis report incorporating the plant design after HAZOP and (taking into consideration any additional safeguards/modifications arising out of the HAZOP analysis), to be submitted soon after construction;

- a hazard analysis update (including a fire safety study, and a study detailing the management of the commissioning stage and a study of emergency procedures) to be submitted before plant commissioning; and

- an audit of risk and hazards to be submitted to the EPA upon request.

(4) The Environmental Protection Authority recommends that no more than 50 tonnes of chlorine should be stored at the Kemerton plant location in containers not exceeding 25 tonnes capacity.

(5) The Environmental Protection Authority recommends that there be no sale of chlorine from the Kemerton site without a further specific assessment by the EPA and that the management of the transport of chlorine for commissioning should be discussed with the relevant Government agencies prior to commissioning.

(6) The Environmental Protection Authority recommends that its requirements in terms of safeguards for the Kemerton proposal should be the same as those required for the chlor-alkali plant at Kwinana (EPA Bulletin 216). In addition the Authority endorses the commitment, made by the proponent, to install the following at Kemerton:

- full height concrete bunding;

- insulation tiles in the bunds;

- a foam suppression system; and

- isolating valves on the main storage tanks and process items. Storage tank isolation valves require two actuation points.

(7) The Environmental Protection Authority notes that the proponent is investigating sub-contracting the chlor-alkali plant. While the Authority approves of this procedure, it recommends that the proponent be held responsible for the environmental performance of the chlor-alkali plant, regardless of the operating company.

(8) The Environmental Protection Authority recommends that the proponent's emergency plan and procedures be integrated with the proposed State Emergency Services' Bunbury Regional Counter Disaster Plan.

It is understood that the Regional Counter Disaster Plan will cover contingencies for chemical release emergencies as well as natural emergencies such as floods and fire.

In addition, the EPA recommends that the proponent participate in the development of a fire management strategy for the Kemerton region and contributes towards its implementation.

(9) The Environmental Protection Authority recommends that the underflow from the thickener at the Kemerton site be treated in such a manner so as to prevent the likelihood of groundwater contamination at the Kemerton site.

(10) The Environmental Protection Authority concludes that the proposal to discharge wastewater into the Wellesley River would be environmentally unacceptable.

The Authority recommends that the proponent investigates alternative approaches to the management of wastewater discharge (eg: ocean discharge or deepwell injection). In this regard the Authority considers that a properly designed and managed ocean outfall could be environmentally acceptable. The proposal for wastewater discharge would need to be submitted to the EPA for its assessment.

(11) The Environmental Protection Authority recommends that the proponent should install a chlorine scrubbing system on the chlor-alkali plant with sufficient back-up capacity to be able to absorb all of the chlorine produced at the full production rate for one hour.

(12) The Environmental Protection Authority recommends that the Company's proposal for solid waste management and disposal from both sites be submitted to the EPA for assessment prior to completion of construction of the Kemerton plant.

(13) The Environmental Protection Authority recommends that the disposal site(s) for solid waste, including that generated during concurrent operation of both plants, should be approved by appropriate Government agencies including the Radiological Council.

(14) The Environmental Protection Authority recommends that a radiation management programme should be developed by the proponent for the commissioning and operation of the proposed plant to the satisfaction of the Radiological Council.

(15) The Environmental Protection Authority has been informed by the Water Authority of Western Australia (WAWA) that there is adequate fresh water available for the proposed plant at Kemerton.

However, the EPA concludes that insufficient detail has been provided to enable the Authority to provide advice and make recommendations on water supply.

Accordingly the EPA recommends that the detailed water supply proposal be referred to EPA for assessment.

(16) The Environmental Protection Authority concludes that the transport of reagents, especially titanium tetrachloride, should be undertaken in a safe manner and recommends that the proponent undertakes appropriate transport safeguards and prepares a contingency plan to the satisfaction of the relevant Government agencies.

(17) The Environmental Protection Authority recommends that the safeguards required for the storage of titanium tetrachloride at the Australind site should be discussed with the relevant Government agencies and be taken into consideration into the HAZOP analysis.

(18) The Environmental Protection Authority recommends that the wastewater discharge to the Collie River from the Australind site conforms with the marine and estuarine water quality criteria in 7(2) of the DCE Bulletin 103 (1981) for the maintenance and preservation of aquatic ecosystems.

(19) The Environmental Protection Authority recommends that the proponent undertakes periodic wastewater monitoring including:

- temperature of the wastewater discharge and of the surface waters of the Collie River an appropriate distance upstream and downstream from the point of discharge;
- pH, total dissolved solids, level of radioactivity, levels of chromium and manganese, and total suspended solids of the effluent;
- baseline (that is pre-discharge) and post-discharge characterisation of the benthos of the Collie River in the vicinity of the outfall; and
- volume and velocity of flow of the Collie River under low flow conditions.

The proponent should develop a monitoring programme in consultation with the Leschenault Inlet Management Authority and for the approval of the EPA.

(20) The Environmental Protection Authority recommends that the proponent prepare a contingency plan at both the Australind and the Kemerton sites in consultation with the Leschenault Inlet Management Authority and to the satisfaction of the EPA, which addresses the management actions to be taken in the event of failure of any part of the effluent management or chemical containment and handling systems of the proposed plant as they may impact upon the Collie River or the Leschenault Inlet, or the ocean.

(21) The Environmental Protection Authority recommends that the pipeline across Leschenault Peninsula be maintained until monitoring results of wastewater effluent discharge to the Collie River demonstrate to the Authority's satisfaction that unacceptable environmental impacts have not occurred.

(22) The Environmental Protection Authority recommends that the existing sulphuric acid plant and the existing sulphate-process plant (as described redundant in the ERMP) at Australind should not operate beyond 30 June 1990 (or at an extension of time determined under the Pigment Factory (Australind) Agreement 1986). Up until this time the EPA recommends the following guidelines apply to these plants:

- Until 30 December 1987, the sulphur dioxide emissions from the Australind plant should not exceed 1 000 micrograms per cubic metres averaged hourly; and
- from the 1 January 1988, and until the cessation of the concurrent operating period, the sulphur dioxide emissions from the combined Australind plant should not exceed 1 000 micrograms per cubic metres at any time in any residential area.

(23) The Environmental Protection Authority recommends that the management strategy for liquid effluent disposal on the Peninsula until 30 June 1990 (or an extension of time determined under the Pigment Factory (Australind) Agreement Act 1986) should maximise the use of existing lagoons and the reactivation of old lagoons so as to avoid further degradation of the northern end of the Peninsula.

(24) The Environmental Protection Authority concludes that the existing Australind plant site is an inappropriate location for heavy industry.

(25) The Environmental Protection Authority recommends that the proponent liaises with the Department of Conservation and Land Management to ensure that the Company's operation and Management Programme for the Kemerton plant site is compatible with the Management objectives developed for the Kemerton Community Park concept.

(26) The Environmental Protection Authority recommends that the proponent be required to meet the reasonable costs associated with monitoring the environmental performance of the construction and operational phases of the Australind and Kemerton plants.

1. INTRODUCTION

The proponent, SCM Chemicals Ltd (previously Laporte Pty Ltd), proposes to convert, enlarge and relocate its existing 36 000 tonne per annum (tpa) sulphate-process titanium dioxide raw pigment plant at Australind to a chloride-process plant within the Kemerton area, (Figure 1) producing 70 000 tpa of unfinished titanium dioxide pigment slurry.

This material would be transported by road to the Company's Australind site where it would be finished in an augmented finishing plant before the bulk of the material is exported either interstate or overseas. Kemerton is approximately 9 km north of the existingplant site at Australind as shown in Figure 2.

The main raw materials for the proposed plant would be titanium-rich ore (either rutile or synthetic rutile), chlorine, oxygen, carbon and nitrogen. The plant's main products would be titanium dioxide pigment and caustic soda. Titanium dioxide pigment is predominantly used in the paint and plastic industries.

The total cost of the proposal is estimated to be approximately $150 million.

A proposal for a 50 000 tpa chloride-process plant was recently assessed by the Environmental Protection Authority (EPA) for the Australind site following the release of ERMP Stage II document (Kinhill Stearns 1986). The EPA concluded (EPA, May 1987) that while the Australind proposal could be made environmentally acceptable, the EPA would prefer the plant to be relocated to another site. The Authority noted: "However, if this were to happen then the new proposal at an alternative site would require further environmental assessment" (EPA 1987, p21).

Following the EPA's assessment of the Australind proposal, further negotiations held between the Government and the Company resulted in the company submitting a Notice of Intent (NOI) for the proposal at Kemerton to the EPA. The EPA was advised by the Minister for the Environment that he required the Authority's Assessment, on this project, by the 16 July 1987.

The Authority determined that the degree of assessment required for this proposal should be at the NOI level, since:

- the EPA had previously examined in detail the Australind proposal. The Kemerton proposal is only an augmentation of the previous proposal and hence the Authority was familiar with the environmental issues which are likely to arise; and

- the EPA had previously assessed a proposal for an aluminium smelter at the Australind site and had presented a detailed Assessment Report (EPA June 1985). The Authority is familiar with the Kemerton site and is currently involved in a number of environmental studies for the Kemerton area. Given this fact, the Authority believes that it is familiar with environmental issues which are likely to arise at the Kemerton site.

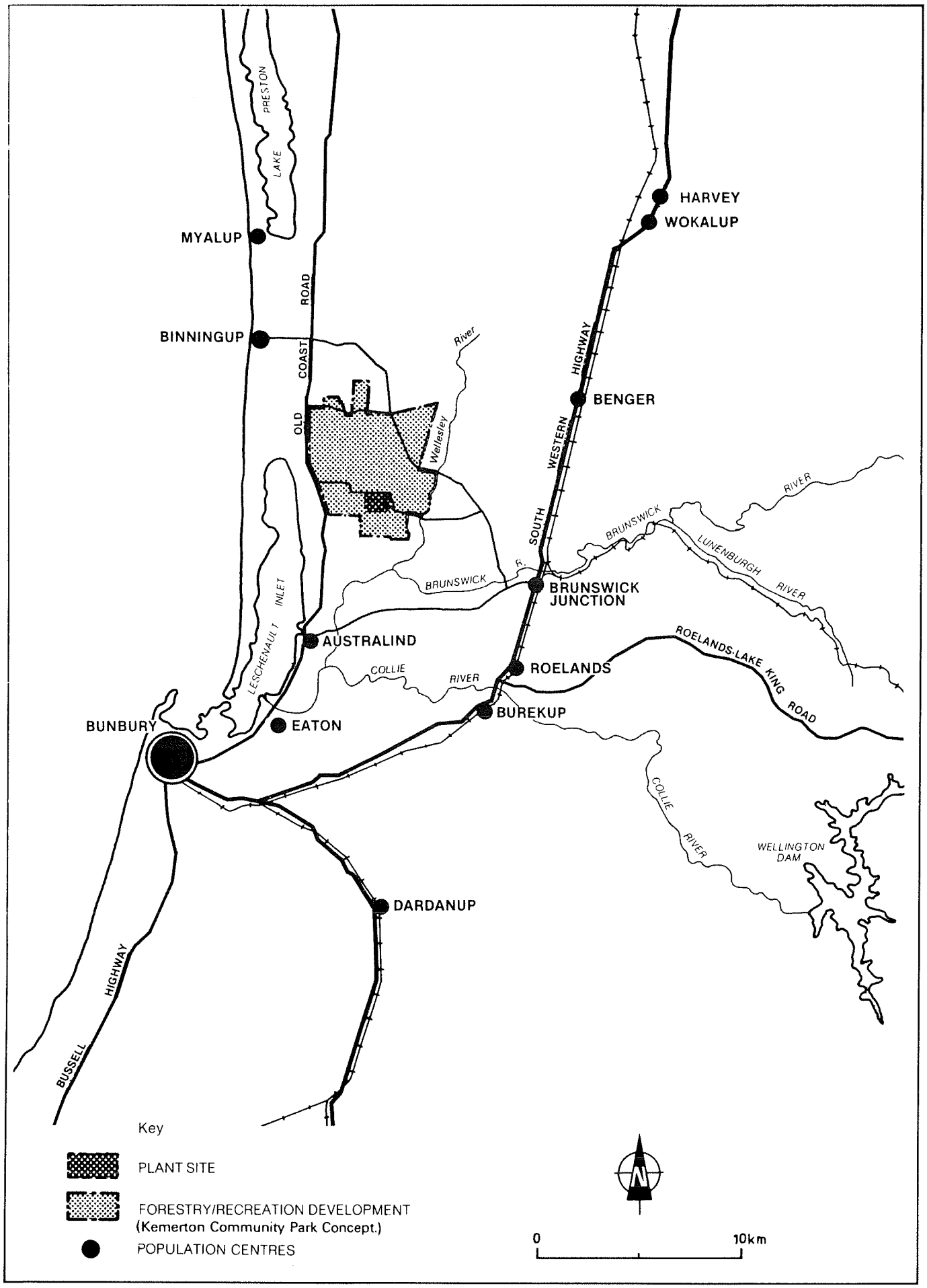

Figure 2 Regional Location Map and Infrastructure

In order to undertake its assessment, the EPA undertook the following steps as part of its environmental impact assessment (EIA) process:

- consulted Harvey Shire Council on the best means of obtaining public input;

- provided input to the summary of the Company's NOI which the Council made available to all residents of the surrounding area;

- made copies of the Company's NOI available at all local public libraries and at the Council chambers;

- in conjunction with the Council, organised a public meeting at the Australind Hall for 2 July 1987. The proceedings of this public meeting were taped and the transcripts used as submissions to identify environmental issues and local concerns; and

- forwarded copies of the Company's NOI to all relevent government agencies within the State for their comments.

The EPA believes that this EIA procedure has been very constructive and has provided adequate information to the Authority to undertake its assessment. The EPA received 38 written submissions on this proposal, 14 from government agencies and 24 from individuals or groups.

The EPA has identified the following matters and questions which it believes needed assessment on the SCM's Kemerton proposal:

- Is Kemerton an environmentally acceptable site to locate the proposed plant?

- Would the risk from a 70 000 tpa titanium dioxide plant at Kemerton, including 100 tonne chlorine storage as well as the proposed removal of safeguards, be acceptable to the Authority as per its guidelines in Bulletin 278 (EPA May 1987)? In order to assist the Authority, the NSW Department of Environment and Planning (DEP) was commissioned to undertake computer modelling on the Company's proposal associated with plant hazards as outlined in the NOI. The DEP's independent verification and calculations show that likely risk from the plant would be manageable (see Chapter 7 for details).

- Would there be enough fresh water available for the SCM plant at Kemerton without detrimentally affecting the local users? The Authority directed this matter to the Department of Resources Development and the Water Authority of Western Australia for advice.

- Could the saline wastewater be discharged into the Wellesley River as proposed in the NOI without detrimentally affecting the beneficial uses of the river? The Authority believes that these beneficial uses include:

  - the protection of the river ecosystem including fauna and flora;

- the preservation of the aesthetic and recreational values of the river; and

- the riparian rights of the local users and use of river water for irrigation.

In order to determine the potential impacts on these beneficial uses of the Wellesley River, the EPA initiated a number of studies and investigations on the hydrology and ecology of the river including the impact of saline water on the river and surrounding environment. The EPA sought advice from a number of organisations and experts, including Waterways Commission, Water Authority, CALM, Department of Mines, Department of Agriculture and the Harvey Shire Council.

. Finally, the Authority sought independent advice on the costing of a number of alternative wastewater disposal options including piping from Kemerton to Australind, to Leschenault Inlet, or to the ocean, as well as for deepwell injection.

The EPA has assessed the environmental aspects of the project discussed in this Assessment Report using information provided in the ERMP Stage II documents; public and government agencies; submissions on the Australind proposal; the Notice of Intent for the Kemerton proposal; the public and government agencies submissions, on the Kemerton proposal including the input through the public meetings; the proponent's response to the Authority's questions; and the Authority's own investigations. The Authority acknowledges the expert advice on risk analysis provided by the NSW Department of Environment and Planning and has incorporated this advice in this Assessment Report. The Authority also acknowledges the expert assistance provided by Mr Geoff Dimmock on investigating the potential impact of saline wastewater disposal on the Wellesley River and its environment.

The Authority concludes that the proposed plant at Kemerton is environmentally acceptable and makes the following recommendation.

(1) **The Environmental Protection Authority concludes that the proposal is environmentally acceptable and recommends that it could proceed subject to:**

- **the relevant commitments made by proponent for the titanium dioxide plant and listed in Appendix 2 of this Report;**

- **the EPA's conclusions and recommendations in this Assessment Report.**

2. BACKGROUND

2.1 INTRODUCTION

The purpose of this section of the Assessment Report is to provide a summary of the EPA assessments undertaken for the Aluminium Smelter at the Kemerton site in 1985 as well as providing a synopsis of the EPA assessment of the chloride-process plant proposed at Australind.

2.2 PROPOSED ALUMINIUM SMELTER AT KEMERTON: SUMMARY OF EPA ASSESSMENT REPORT

In June 1985, the EPA concluded its review of the Environmental Review and Management Programme (ERMP) and other documents prepared on the Kemerton aluminium smelter proposal.The Authority concluded that the Kemerton area was an acceptable location for an aluminium smelter subject to a series of recommendations including the following:

- the development and implementation of a land management plan for the buffer zone;
- the adoption of the Authority's major recommendations; and
- the development of an appropriate Environmental Management Programme (EMP).

The Authority also recommended that the Study Programme then in progress should continue as planned, stating that the results obtained would be valuable in the preparation of the EMP.

On the matter of solid waste, the Authority stated that the proponent should provide details to the EPA on the interim storage and disposal of all solid waste. Any method of storage should be designed so as to prevent the formation and escape of leachate.

The Authority recommended that proposals for long-term treatment, storage, or disposal of contaminated waste should be provided to the Authority for assessment within two years of the commencement of operation.

Finally with regard to wastewater disposal, the EPA stated that the EMP should provide a comprehensive account of liquid waste disposal methods as proposed. The management of the proposed disposal methods would need to be subjected to environmental assessment, and included in the EMP.

2.3 TITANIUM DIOXIDE PLANT PROPOSAL AT AUSTRALIND: SUMMARY OF EPA ASSESSMENT REPORT

In May 1987 the EPA assessed the proposal by SCM Chemicals Ltd presented in the ERMP Stage II and submitted to the EPA by the Company. The proponent had proposed to convert its existing sulphate-process titanium dioxide plant at Australind to a chloride-process plant producing 50 000 tpa of unfinished titanium dioxide pigment.

In its Assessment Report (May 1987) the EPA stated that the Laporte/SCM plant's waste emissions and their disposal has been a prominent environmental issue in Western Australia since the plant started operations in 1964. The initial Agreement between the Company and the State was made before environmental legislation in the State was enacted.

The Authority also stated that initial public concerns about ocean discharge led to disposal of the acidic waste in the dunes on Leschenault Peninsula. However, the need to restrict public access to the Peninsula, periodic breakdowns of the pipe, and lagoon overflow with discharge staining the local beaches have meant that effluent disposal has remained a prominent matter requiring resolution.

After investigating the history of the sulphate-process plant's operations over the last 21 years, including aspects such as wastewater disposal, air and noise emissions, groundwater contamination and visual impact, the Authority's conclusions were that:

- from an environmental viewpoint (and on today's standards), it would have been inappropriate to initially locate the plant at Australind;
- however, given the location, from an environmental planning perspective the residential development in proximity to the plant was unfortunate;
- if there was a simple environmental choice, the Authority would prefer the existing and the proposed plant to be relocated elsewhere; and
- the Authority believed that the ongoing environmental management of the existing plant, initially by Laporte Pty Ltd and subsequently by SCM Chemicals Ltd, has been inadequate and therefore does not provide the Authority with a basis for confidence in future environmental management of the proposal at the Australind site without strict control conditions. Until December 1986, these problems had been exacerbated because the Company was effectively outside the environmental laws applying to other industries in the State.

As part of an ongoing assessment process, and arising out of the public release of the 1984 ERMP Stage I, an ERMP Stage II was prepared by the proponent and released for public review for 10 weeks. A total of 51 submissions were received by the EPA on that proposal.

During the Authority's assessment of the Australind proposal, it became apparent that a number of questions required detailed evaluation.

After undertaking a comprehensive assessment, the Authority made the following conclusions:

- the Australind site for the chloride-process plant could be made environmentally acceptable;

- after reviewing the Cremer & Warner study (ERMP Volume 2) and seeking independent expert advice the Authority concluded that the consultant's analysis had been undertaken in an appropriate manner and accepted the risk results presented in the ERMP and shown in Figure 8 of that Assessment Report (EPA May 1987);

- that if the proponent's proposed safeguards and the Authority's recommendations on the risk and hazard assessment were implemented, and if the plant was operated in a responsible manner, then the likely risks generated from the plant at Australind would be low enough to be acceptable to the EPA;

- that additional safeguards were required and recommended a number of these in its Assessment Report;

- that provided that EPA monitored all stages of construction and management, the environmental and risk management of the proposed plant could be satisfactory; and

- that with appropriate conditions, wastewater discharge from the plant could be managed in an environmentally acceptable manner.

Given the above, the Authority believed that the proposed plant at Australind could be made environmentally acceptable. However, the Authority stated that it would prefer the proposed plant to be relocated on an alternative site.

The Authority recommended in its Assessment Report that as a condition of approval the existing sulphuric acid plant should cease production. In addition, the Authority stated that it would prefer that the redundant sulphate-process equipment (excluding the finishing plant) not be utilised for any purpose at the Australind site.

In addition, the Authority made recommendations on the management of the waste disposal on the Leschenault Peninsula until the termination of the current disposal practice.

3. ASSESSMENT OF THE PROPONENT'S PREFERRED SITE AT KEMERTON

3.1 SITE SELECTION PROCESS PRESENTED BY THE COMPANY

The Company proposes to locate the plant at Kemerton because it believes it is the best alternative location to Australind.

The plant's location within the Kemerton area would be on 55 ha of land south of Marriott Road as shown in Figure 2. The NOI states that the exact plant location within the 55 ha site will be determined after completing adequate topographic surveys, soil mechanics testing and further discussions with appropriate Government departments. However, the general plant location would be as shown in Figure 1.

3.2 EPA ASSESSMENT OF PROPONENT'S PREFERRED SITE

In its assessment of the proposed 70 000 tpa chloride-process titanium dioxide plant at the proponent's now preferred site at Kemerton, the EPA makes the following comments:

- The Authority has reviewed the regional site selection process presented in the NOI and finds this process, including the site selection criteria, to be adequate and acceptable.

- The EPA's assessment on the suitability of the Kemerton site is based on the following:

  - given the 2-3 km buffer zone surrounding the proposed site within Kemerton, the Authority believes that risks and hazards from the proposed plant can be made so low as to be acceptable;

  - the proponent has proposed that the saline wastewater be discharged into the Wellesley River. This disposal option is environmentally unacceptable (see Section 7.4.1). There are, however, a number of alternative options for wastewater disposal including discharge by pipe to the ocean and deepwell injection. The Authority believes that one of these wastewater disposal options could be made environmentally acceptable;

  - the proposed plant at Kemerton would require approximately 4 500 kilolitres per day (4.5 ML/day) of process water. The NOI mentions a number of options but does not identify a preferred option in terms of where this water would be obtained. The Water Authority of Western Australia has informed the EPA that an adequate water supply can be made available, and without detrimental impact on the environment. While this proposal will require further environmental assessment, it does not preclude the location of the proposed plant at Kemerton; and

- the Authority's investigations have not identified any critical or major constraints which would make the proposal to locate the plant at Kemerton environmentally unacceptable or.

Given the above, the Authority finds the Kemerton area an acceptable site to relocate the proposed 70 000 tpa chloride-process titanium dioxide plant.

(2) **The Environmental Protection Authority concludes that the Kemerton site is an acceptable area to locate the chloride-process titanium dioxide plant.**

The Authority's assessment of the risk and environmental impacts of the proposed plant at Kemerton area are discussed in Chapter 7 of this Assessment Report.

4. DESCRIPTION OF THE PROPOSAL

4.1 THE PROPOSAL AS PUT FORWARD BY THE PROPONENT

The proposal as put forward by the proponent in the NOI, consists of the following:

- construction of a 70 000 tpa titanium dioxide manufacturing plant at Kemerton based upon the chloride-process;
- construction of a 12 000 tpa chlor-alkali plant at Kemerton with 100 tonne refrigerated chlorine storage in three 50 tonne tanks (one tank is on standby);
- construction of an air separation plant at Kemerton to supply 42 000 tpa of oxygen and 60 000 tpa of nitrogen;
- approximate doubling of the existing finishing plant at Australind;
- decommissioning of the existing sulphate-process plant at Australind which would be investigated for alternative process use in the future;
- continuation of the existing sulphuric acid plant at Australind;
- disposal of 4 800 kl/day of treated wastewater by discharge into the Collie River;
- disposal of 2 700 kl/day of treated saline wastewater into the Wellesley River;
- disposal of 40 tonne/day of material to be removed with 30% solids for burial offsite from Australind;
- 226 tonne/day of material to be removed from Kemerton with 30% solids for burial either at Capel or at an area east of the Wellesley River; and
- disposal of a small quantity of mildly radioactive waste from Kemerton by burial offsite.

The proposal's major inputs and outputs are estimated in Table 1.

Table 1 Estimated major inputs and outputs of the proposal (in tonnes per year)

MAJOR INPUTS		MAJOR OUTPUTS	
Titanium-rich feedstock	75 000 tonne/a	Titanium dioxide pigment	70 000 tonne/a
Process water	Approx 10-12 ML/day	Caustic soda (30%)	42 000 tonne/a
Salt (NaCl)	20 000 tonne/a	Solid wastes**	266 tonne/day
Oxygen	42 000 tonne/a	Wastewater*	7.5 ML/day
Carbon	12 000 tonne/a	Gaseous wastes:	
		. carbon monoxide and dioxide	34 000 tonne/a
Nitrogen	60 000 tonne/a	. nitrogen	60 000 tonne/a
		. hydrogen	300 tonne/a

* Includes 657 000 tonnes per annum from the contaminant recovery programme at Australind

** At 30% solid

An Artist's impression of the titanium dioxide plant is shown in Figure 3

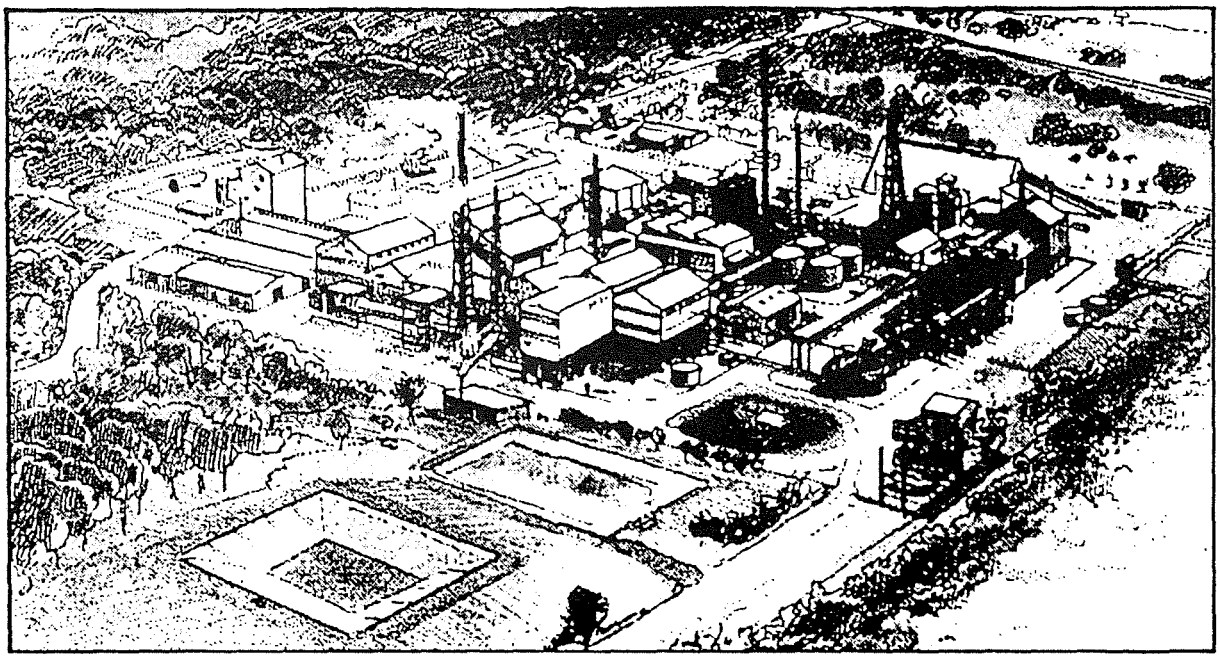

Figure 3. An artist's impression of the Titanium Dioxide Plant;

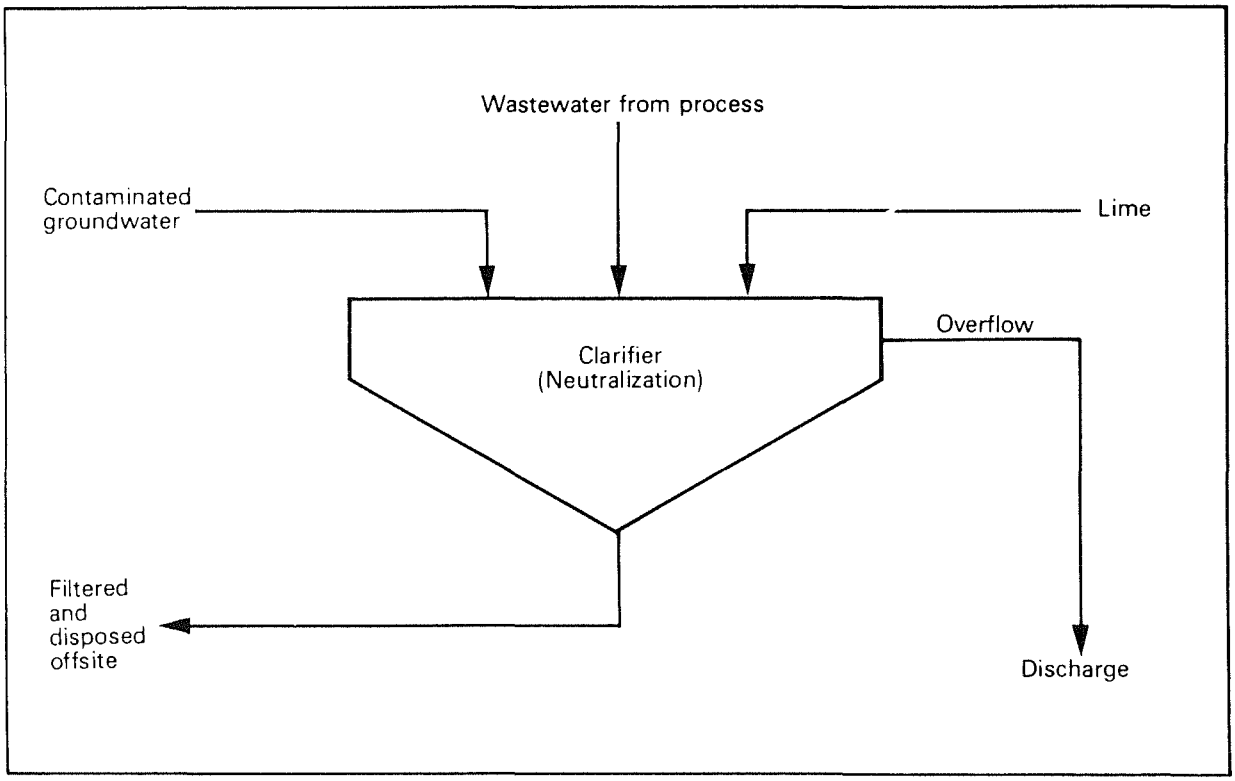

Figure 4. Modified wastewater disposal system.

4.2 THE PROCESS

4.2.1 The Chloride-Process

The chloride-process for producing titanium dioxide pigment (see Figure 5) consists of the following stages:

- Chlorination: titanium-rich feedstock is reacted with chlorine to produce titanium tetrachloride.
- Purification: impurities are separated from the titanium tetrachloride.
- Oxidation: titanium tetrachloride is reacted with oxygen to produce titanium dioxide.
- Pigment separation: produces solid pigment through filtration.

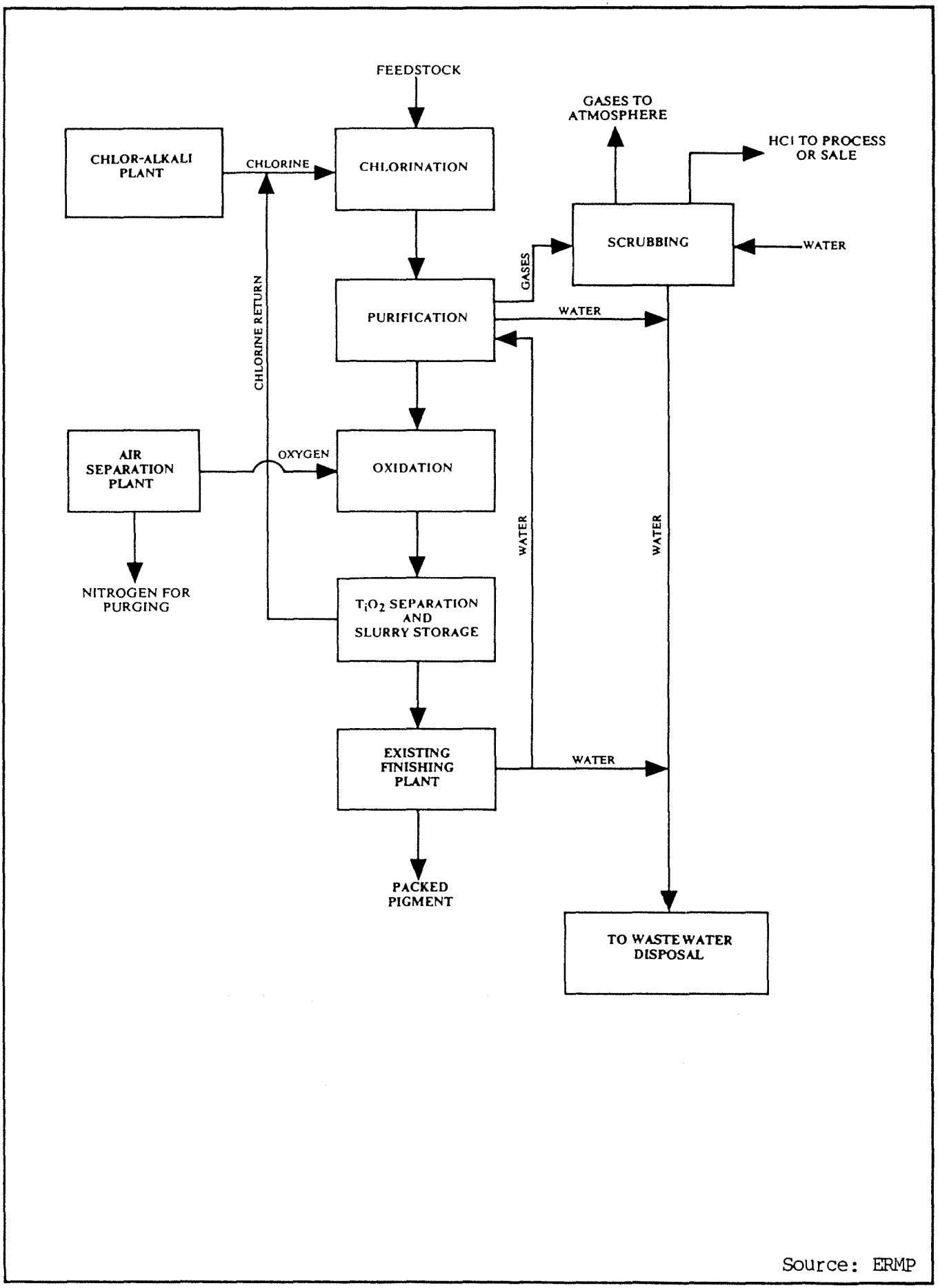

Figure 5. Chloride process and ancillary support processes

4.2.2 The Chlor-alkali Plant Process

Chlorine is produced through membrane technology which separates the chlorine and sodium chloride solution (anolyte) from hydrogen and caustic soda (catholyte) through electrolysis (see Figure 6).

The hot chlorine gas from the membrane cells is cooled then dried with concentrated sulphuric acid. The dry chlorine is compressed and condensed in a liquefaction unit, with the liquid chlorine flowing by gravity, at a temperature of about -34°C, either to chlorine storage tanks or for use in process.

The NOI states that a total chlorine storage capacity of 100 tonnes is required as intermediate storage between the two processing plants. The storage system proposed comprises two refrigerated tanks, each of 50 tonnes capacity, and a further refrigerated tank of 50 tonnes capacity which acts as a standby and emergency receiving tank. The NOI states that these would be maintained at -34°C and atmospheric pressure.

4.2.3 Air Separation Plant Process

The air separation process involves the extraction and separation of specific gases from the atmosphere. Repeated compression and expansion allow the controlled refrigeration of the air stream to temperatures sufficiently low that the oxygen and nitrogen would be successively liquefied and removed for storage. Remaining unwanted gases would be returned to the atmosphere.

4.3 WASTE PRODUCTS AND DISPOSAL

The NOI states that waste products would be discharged as below.

4.3.1 Air Emissions

The following gas would be discharged from the plant under normal operations:

- carbon monoxide and carbon dioxide: 34 000 tpa from the purification section;
- 1-5 parts per million of chlorine from the discharge of the chlor-alkali scrubber system; and
- atmospheric gas emissions from the air separation plant.

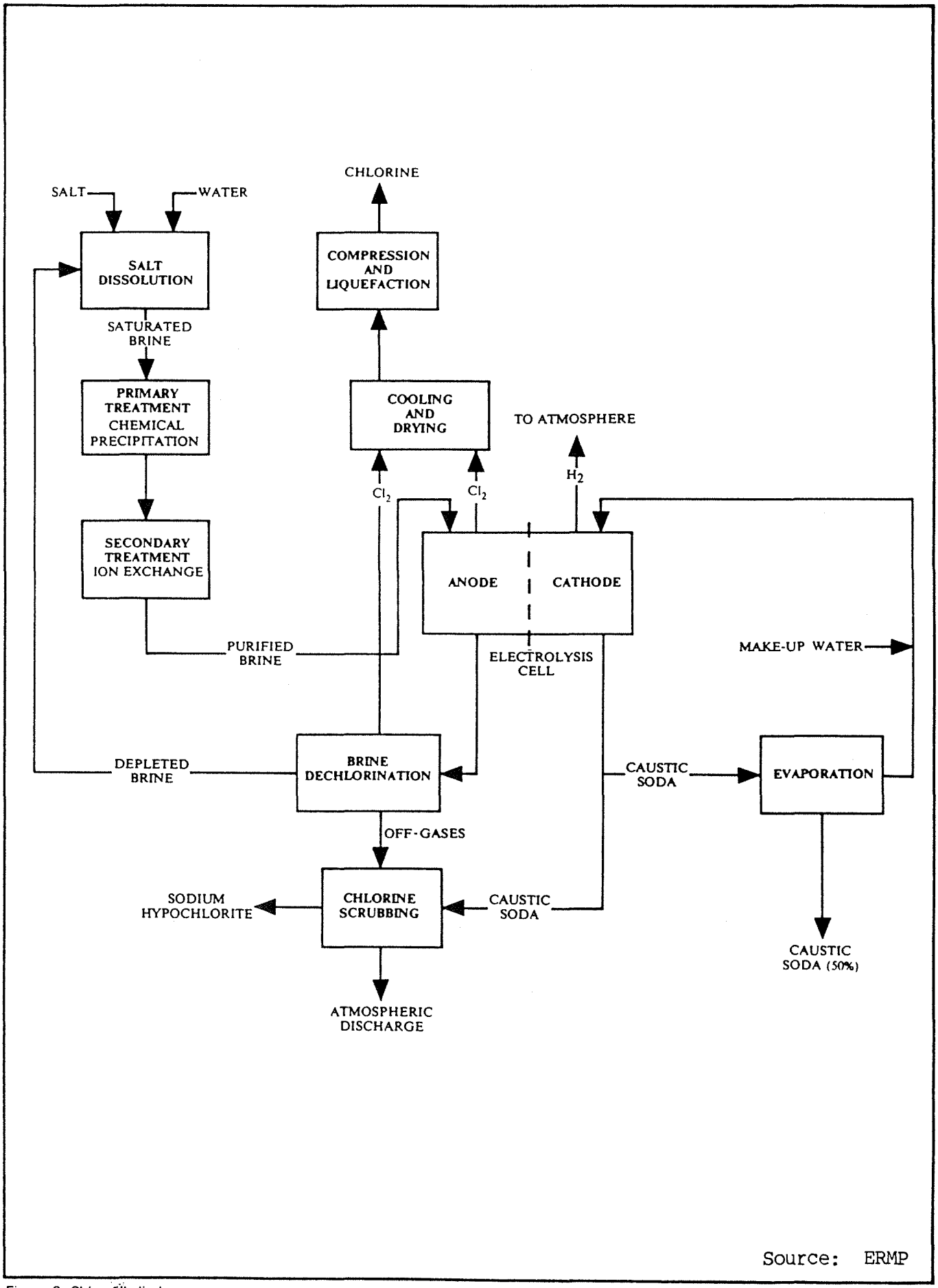

Figure 6. Chlor-Alkali plant process.

4.3.2 Wastewater Products and Disposal

4.3.2.1 Wastewater Products

The liquid wastes produced by the plant at Kemerton would be 2 700 kL of wastewater/day from the titanium dioxide pigment plant. This wastewater processing plant would contain chlorides of iron, manganese and vanadium, unreacted ore, unreacted coke and sodium salts. This would also include 60 kL/day of acidic and alkaline liquors produced during the regeneration of ion exchange columns in the brine purification section of the chlor-alkali plant.

4.3.2.2 Wastewater Treatment and Disposal System

The proposed wastewater treatment system is shown schematically in Figure 4. This consists of collection, lime-dosing for precipitation, and neutralisation through clarification.

The temperature of the wastewater stream would be up to 40°C. The composition of the overflow would be as shown in Table 2.

The clarifier overflow is proposed to be discharged by pipeline into a drain from where it would flow into the Wellesley River.

4.3.3 Solid Wastes

The modified proposal would now produce the following solid wastes:

- 226 tonne/day of material to be removed from Kemerton with 30% solid content;
- 40 tonne/day of material to be removed from the Australind site;
- a small quantity of mildly radioactive waste; and
- domestic solid waste from the plant.

The NOI states that this solid waste may be disposed of either at Capel or at a site east of the Wellesley River.

4.3.4 Noise Emissions

The proponent has made a commitment to restrict the maximum noise level from any item of equipment in the plant to 85 decibels (A-weighted) at a distance of one metre.

The major noise sources estimated for the chlor-alkali plant are as shown in Table 3.

Table 2 Composition of clarifier overflow, Kemerton site

ION		CONCENTRATION (parts per million)
Chloride	(CL^-)	11 200
Sodium	(Na^+)	1 600
Calcium	(Ca^{++})	5 260
Sulphate	(SO_4^-)	800
Magnesium	(Mg^{++})	425
Manganese	(Mn^{++})	2
Aluminium	(Al^{+++})	5
Chromium	(Cr^{+++})	1
Iron	(Fe^{+++})	1
Vanadium	(V)	1
Other Constituents		
Temperature		40°C
pH		7

Source: NOI

Table 3 Estimated major noise sources within the chlor-alkali plant

SOURCE	NOISE LEVEL (decibels [A-weighted] at one metre)
Chlorine compressor	80-85
Instrument air compressors	83 (two)
Refrigerator compressor	80-85
Transformer rectifier	Less than 75
Evaporator ejector	85

Source: ERMP

4.4 OTHER RELEVANT INFORMATION ON THE PROPOSAL

The plant would employ a permanent workforce of approximately 300 persons. The plant would be operated on a continuous basis.

If approval is given then the plant would be constructed in approximately 18 months and would be commissioned in late 1988.

If the proposal proceeds then the State has given approval for the Company to operate concurrently the existing sulphate-process plant and the proposed chloride-process plant until 30 June 1990. This would mean that the pumping of sulphate effluent on the Peninsula could be terminated at the end of the concurrent period.

5. DESCRIPTION OF THE EXISTING ENVIRONMENT AT KEMERTON

A detailed description of the existing environment of Kemerton area has been presented by the EPA in its Assessment Report on the Aluminium Smelter (EPA June 1985). This Chapter summarises the relevant information from that report, applicable to the assessment of the proposal for a titanium dioxide plant as outlined in the NOI.

5.1 SITE LOCATION

The proposed location of the plant is within the Kemerton area (see Figure 1). The plant site is approximately 9 km north of the existing plant site at Australind and 150 km south of Perth (see Figure 2).

5.2 LOCAL LAND USES AND POPULATION DISTRIBUTION

Agricultural pursuits are the dominant land use in the Kemerton area. The following are the main agricultural practices in the area:

- dairying on irrigated pastures, primarily east of the Wellesley River and west of the Old Coast Road;
- dryland grazing west of the Wellesley River and to the north and west of the site;
- irrigated fodder crops, market gardens and orchards to the west and north-west of the site; and
- irrigated beef cattle grazing on some properties adjacent to the Wellesley River.

In recent years Special Rural Zone subdivisions have been established to the north and east of the Kemerton area. They also lie within the Kemerton area, to the west of the plant site. Figure 12 shows the extent of the various types of agricultural land uses practised in the Kemerton area as well as the distribution of dwellings in the surrounding area.

5.3 METEOROLOGY

The wind climate and other meterorological data from the Kemerton area have been previously monitored by Alcoa at Kemerton, and this record has been supplemented by detailed measurements by EPA, from Glen Iris, near Bunbury. A full comparative analysis of these data is given in Department of Conservation and Environment (DCE) Bulletin 203, "Dispersion Modelling of a Proposed Aluminium Smelter at Kemerton, Western Australia".

The summer wind pattern is dominated by the local sea breeze - land breeze system, with light south-easterlies (which are the dominant winds) in the early morning and at night, followed by stronger south-westerlies during the day.

The wider wind pattern is dominated by the eastward progression of synoptic systems (cold fronts), with rain-bearing depressions and north-westerly storms, resulting in more variable winds. Annual wind roses are given in Department of Conservation and Environment Bulletin 203.

5.4 SURFACE WATER RESOURCES

The surface water resources of the proposed smelter site and buffer zone, and the water level contours of the surficial aquifer are shown in Figure 7.

The Wellesley River to the east of the site is a tributary of the Brunswick River, which flows to Leschenault Inlet. The Wellesley River flows almost all year round, supplemented in summer by discharge irrigation water. Peak flows occur in winter and early spring.

The Brunswick River downstream from Brunswick Junction, and the Wellesley River from about 1 km north of the Wellesley Road Bridge are the subject of a System 6 recommendation because of their high conservation values and proximity to populated areas (EPA 1983).

There are several permanent and ephermeral lakes and swamps to the north and south-east of the site, known collectively as the Kemerton wetlands.

These wetlands are surface expressions of the surficial unconfined acquifers on the site. Although many have been degraded by agricultural land clearing and encroachment by stock.

5.5 GROUNDWATER RESOURCES

The regional groundwater system has been generally described by Sanders (1974), Commander (1982), and by the Geological Survey of WA (1985).

The groundwater contours of the surficial aquifers of the Bassendean and Karrakatta Sands are shown in Figure 7. A groundwater divide running north-east to south-west roughly bisects the site. On the western side of this divide, groundwater flows west towards Leschenault Inlet and the sea; some of it via the western Kemerton wetlands.

To the east of the divide, groundwater flows towards the Wellesley River, some of it via the south-eastern wetlands.

The sands containing the surficial aquifer are fairly permeable, and groundwater flows are probably of the order of 15 to 50 metres per year, or the order of 50 to 100 metres.

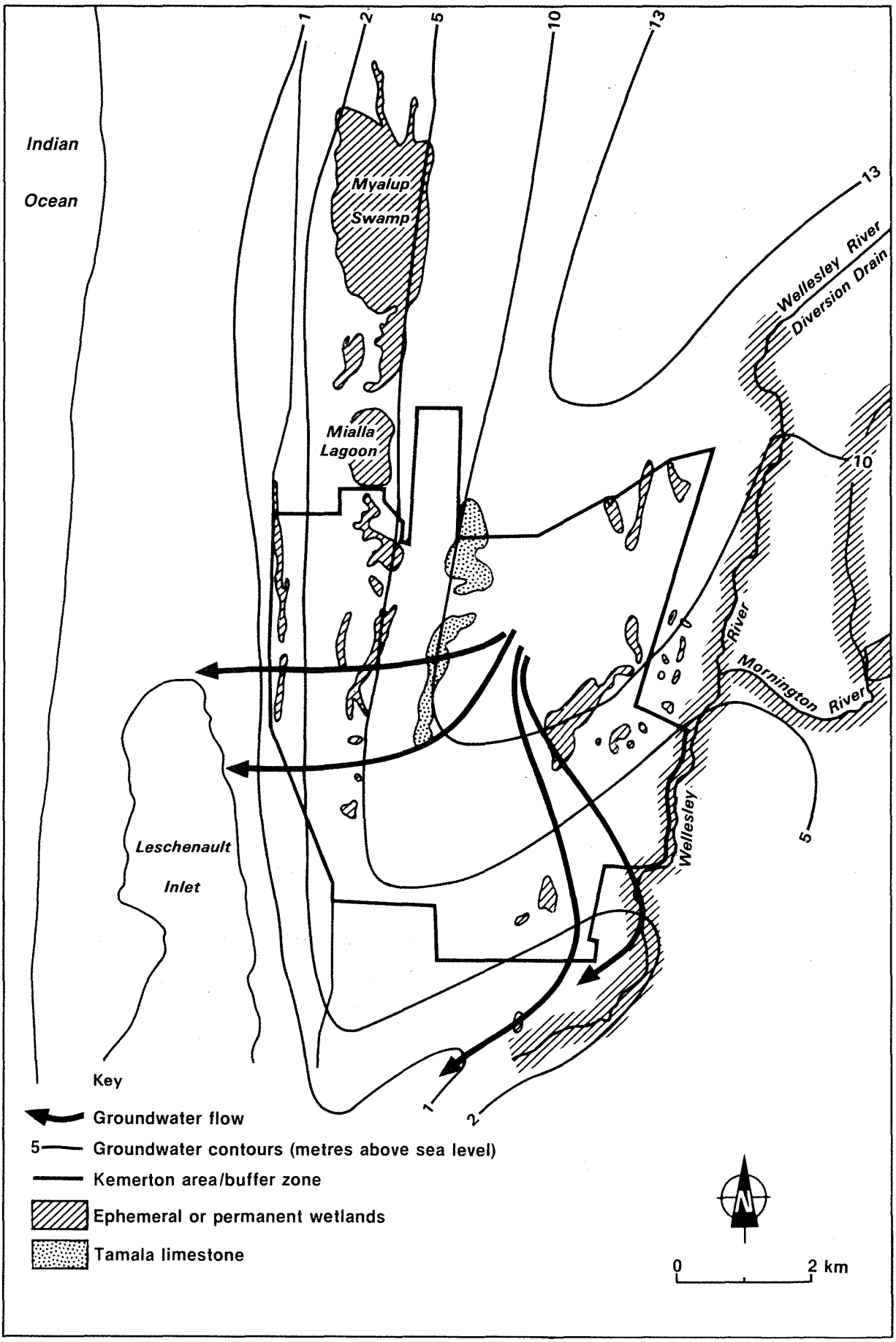

Figure 7. Surficial Watertable Contours and Inferred Direction of Groundwater Flow

From a soil survey of the Kemerton area, Dimmock (1985) determined that the water table in the Bassendean Sands occurs on average at about 2 m depth in summer, though it is considerably less than this for the low-lying Joel series soils. The water table rises following winter rains, and progressively falls during summer and autumn, reflecting the markedly seasonal rainfall regime.

The salinity of the unconfined groundwater is variable, mostly in the range of 500-1000 milligrams per litre (mg/L) and high levels of iron and carbonations (Commander 1982).

The unconfined aquifier may leak downwards to the semi-confined aquifers of the Leederville and Yarragadee Formations, and there may be some localised upward leakage of the Leederville Formation groundwater into the unconfined acquifer.

The salinity of the Leederville Formation groundwater is about 1000-1200 mg/L, and the concentrations of iron and other dissolved minerals tend to increase with depth. Both semi-confined groundwater sources are exploited for urban agricultural and industrial use in the wider region, and low-yield bores tap the surficial aquifers for irrigation water (Geological Survey of WA 1982).

The groundwater resources of the site are within the South West Coastal Groundwater Area, and groundwater extraction is controlled by the Water Authority of Western Australia.

5.6 GEOLOGY, SOILS AND LANDFORMS

The Kemerton site is on the western edge of the Swan Coastal Plain, the soils of which have resulted from marine, riverine or aeolian processes. The general regional pattern of soils and landforms has been mapped at a scale of 1:250 000 by Churchward and McArthur (1980). A detailed mapping for the site has been carried out by Dimmock (1985). Dimmock's map is reproduced as Figure 8.

The area lies within the Spearwood and Bassendean Dune Systems of the Swan Coastal Plain (McArthur and Bettenay 1974), and is generally described by Dimmock (1985) as follows:

"The Spearwood System, to the west, consists of a series of sand dunes of rolling topography aligned roughly parallel to the present coastline and reaching an altitude of at least 40 metres. The highest of these dunes tend to be cored with limestone and few scattered outcrops occur within the surveyed area. Occupying a central low-lying belt within the Spearwood System is a chain of permanent wetlands, the largest of which are fringed by narrow terraces, 1 to 2 metres above water level.

The Bassendean Dune System, to the east, forms a gently undulating to easy rolling landscape, in which the dune elements are generally subdued, randomly oriented and seldom more than 20 m above sea-level. Much of the landscape consists of broad very low rises with intervening low-lying poorly-drained areas, particularly in the zone immediately westwards from the Wellesley River where there is an extensive mosaic of seasonal wetlands."

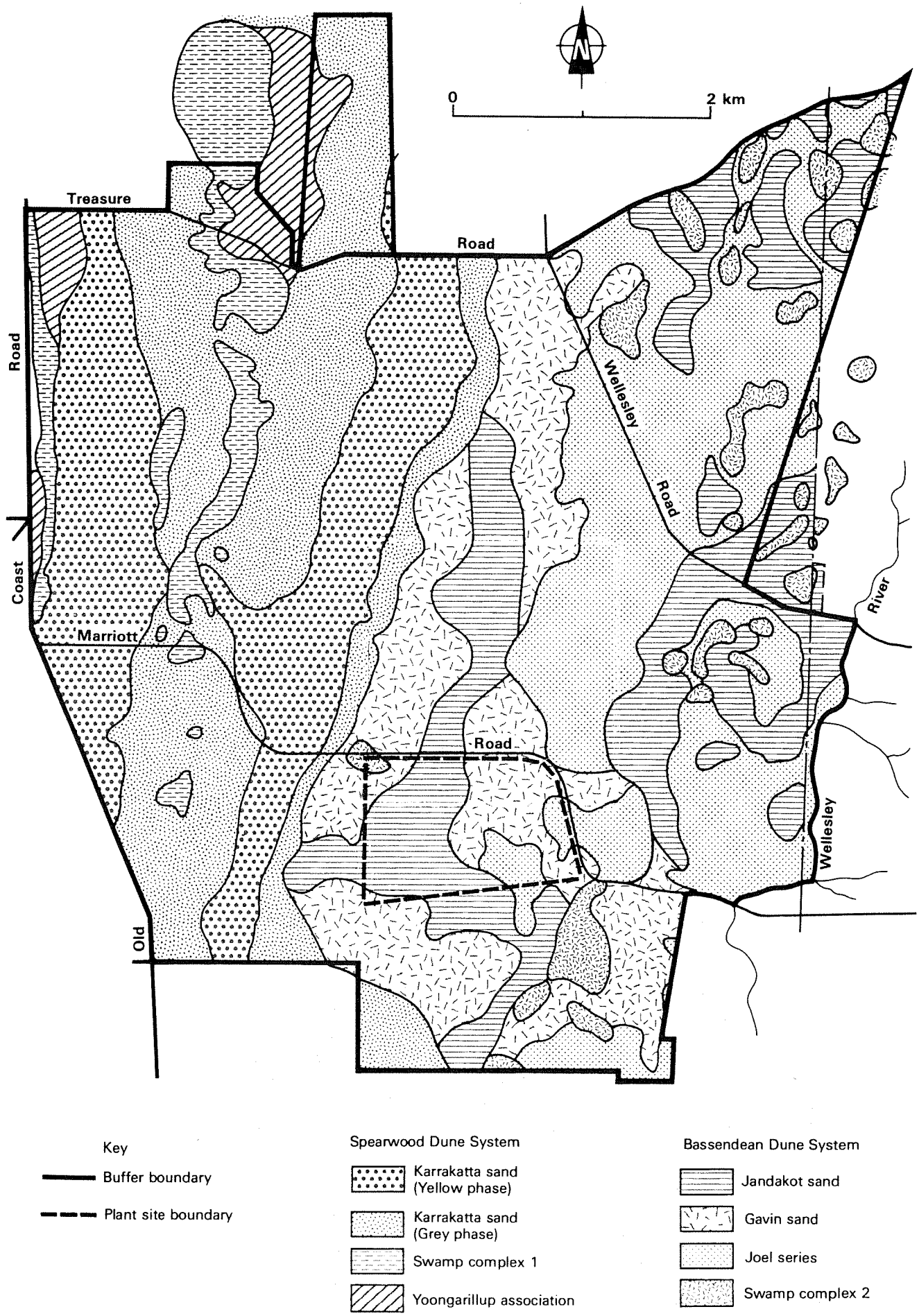

Figure 8. Soil Units in the Kemerton Area

The soils of the site have low natural fertility and a small capacity to fix nutriants.

The major soil units are Karrakatta Sands (yellow and grey phases) of the Spearwood Dune System and the Joel Series, Gavin and Jandakot Sands of the Bassendean Dune System. The minor units comprise the Yoongarillup Association and two swamp complexes designated Swamp Complex 1 and Swamp Complex 2 of the Spearwood and Bassendean Systems respectively.

5.7 VEGETATION

Much of the proposed plant site and surrounding buffer zone has been cleared for agricultural purposes. The remaining native vegetation has been mostly degraded to some extent, but each community retains recognisable remnants of some of its original structure and species composition (Figure 9).

The native vegetation is closely related to soil type, and its composition and distribution has been described by Dimmock (1985).

The vegation of the Spearwood Dune System is a eucalypt woodland of two main types:

- Tuart (Eucalyptus gomphocephala) with an understorey of peppermint (Agonis flexuosa and bull banksia (Banksia grandis) occurs on Karrakatta yellow sands.

- Jarrah (E marginata) with an understorey dominated by narrow-leaved banksia (B. attenuata), holly-leaved banksia (B. ilicifolia) and woody pear (Xylomelum occidentale) occurs on the Karrakatta grey sands.

The Spearwood System wetlands support a fringing woodland of paperbarks (Melaleuca rhaphiophylla and M. preissiana), flooded gum (E. rudis) and river banksia (B. littoralis).

The soils of the Bassendean Dune System support a jarrah-banksia woodland on the higher sand ridges, while the wetlands have similar vegetation to those of the Spearwood System.

The central areas of most wetlands support dense reedbeds of Baumea sp and Typha sp or sedges, though several retain areas of open water. They range from permanent waterbodies to drained swamps which retain surface water for only limited periods. The wetlands, which elsewhere on the Swan Coastal Plain are increasingly being developed for agriculture, contain a range of habitats and are considered to be of importance for conservation (Bamford and Watkins 1983).

In recognition of their conservation and recreation values, the lower reaches of the Wellesley River, Leschenault Inlet, Myalup Swamp and Mialla Lagoon are subject to System 6 recommendations (EPA 1983).

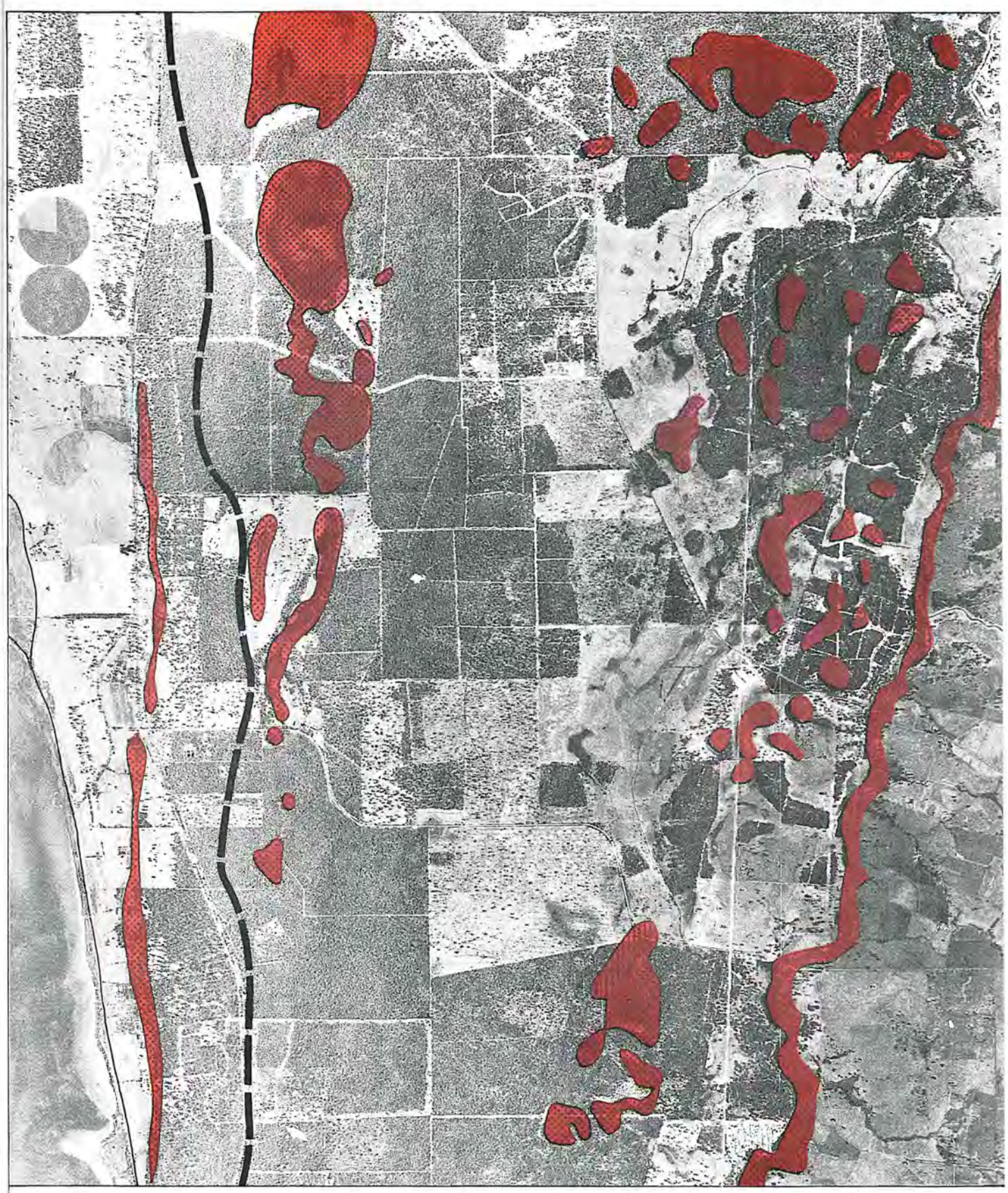

Figure 9. Native Vegetation Communities and wetlands within the Kemerton Area

Eight plant species with restricted distributions have been recorded from the site, including a population of Pultenaea skinneri, recorded from the woodland bordering the south-eastern wetland, which comprises the largest population of this species yet discovered (Weston 1985).

5.8 VEGETATION AT THE PLANT SITE

The following description of the vegetation at the plant site is presented by the proponent's consultant Kinhill Engineering Pty Ltd (see Appendix 3 of this Assessment Report).

"Natural vegetation at the proposed site for the plant has been previously cleared and is now regenerating. It was most likely originally a mixture of woodlands including Jarrah (E. marginata), Banksia spp and Blackboy (Xanthorrhoea praissii). Allocasuarina fraerina was possibly also present at the western end of the site. Some of the many shrub species regenerating since the removal of stock include Kunzea vesita, Jacksonia furcellata, Hibbertia vaginata, Pericalymma ellipticum and Hibbertia hypericoides. Regrowth of Jarrah Blackboy and some Marri (Eucalyptus calophylla) has also occurred. Since vegetation of the site has already been considerably disturbed, the siting of the plant in this area has a very reduced impact on the vegetation. However, as the natural vegetation is regenerating rapidly, it is apparent that many root stocks still remain in the soil.

No gazetted rare or geographically restricted plants were observed on the site, but a well documented population of Pultaneae skinneri occurs on the southern side of the corner of Marriott Road adjoining, and just north of the large swampland." (Kinhill 1987).

5.9 KEMERTON COMMUNITY PARK

The Kemerton Community Park concept (see Figure 10) has been outlined in a draft land use and management plan (SWDA November 1985) which integrates the smelter activities proposed for the buffer zone with forestry pine production and recreation and conservation. In May 1987, the Government adopted this concept plan as the basis for the preparation of a landuse and management plan.

5.10 WELLESLEY RIVER AND ITS ENVIRONMENT

Wellesley River and its environment is shown in Figure 11.

The proponent has provided the following information on the Wellesley River:

"The Wellesley River drains the Kemerton site and a large portion of the Harvey irrigation area (together with the Harvey River and the Harvey diversion drain). It forms a tributary of the Brunswick River which is a further tributary of the Collie River.

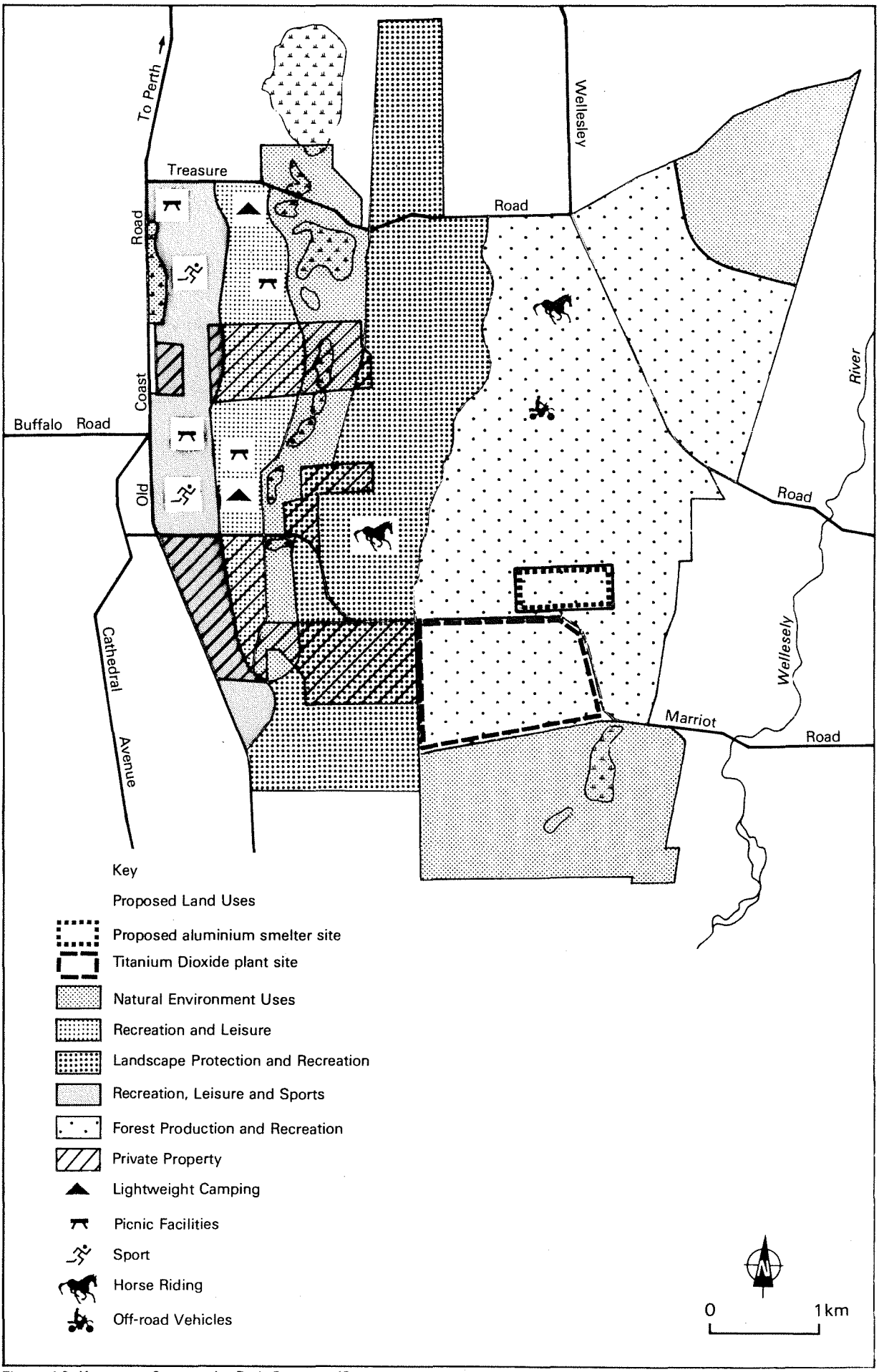

Figure 10. Kemerton Community Park Concept. (Source SWDA)

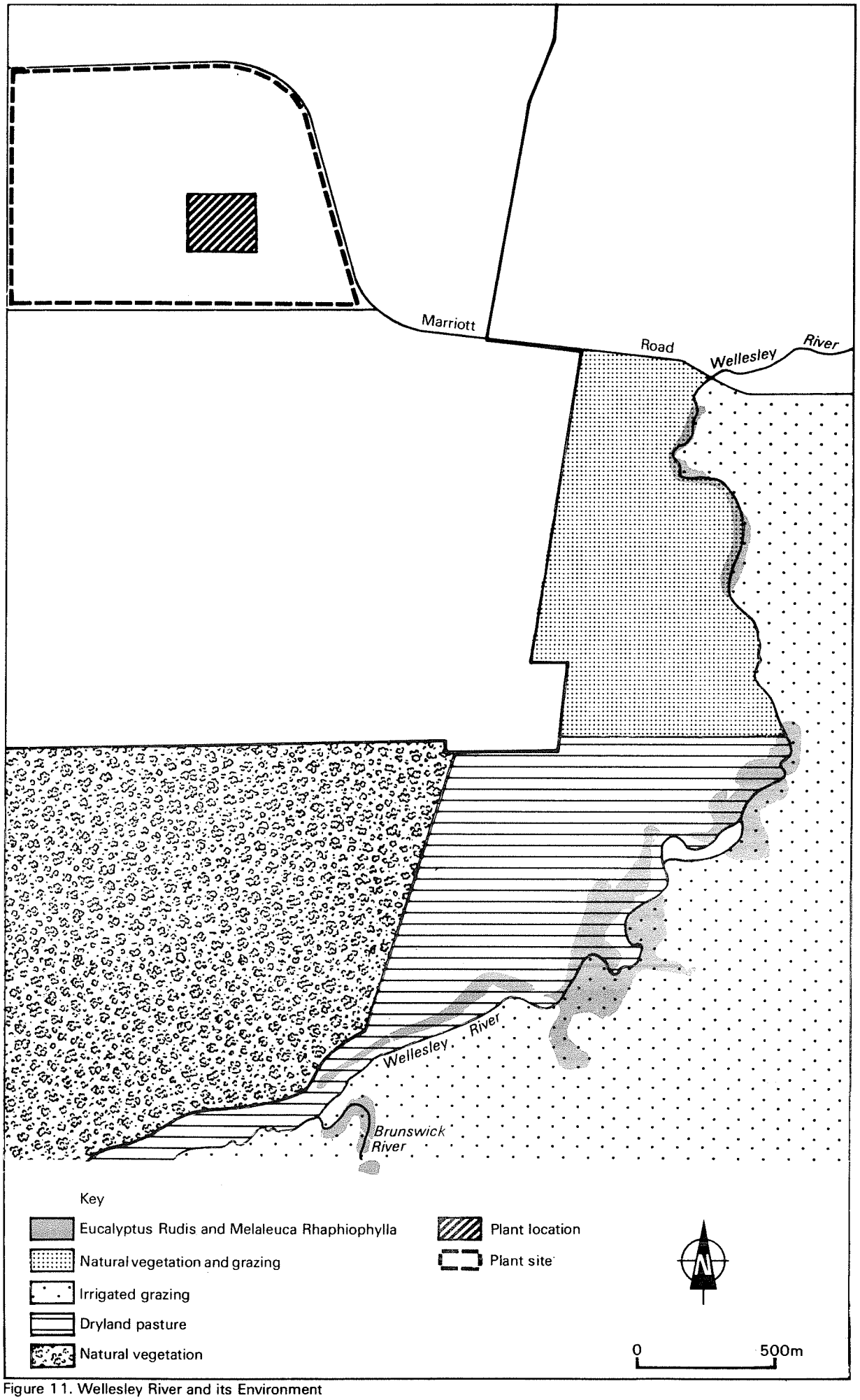

Figure 11. Wellesley River and its Environment

Streamflow records for the Wellesley River are not readily available. However, experience with other rivers draining irrigation areas has shown that flows are highly seasonal, varying from reliably high winter (April-October) flows to low summer flows resulting from the release of irrigation water.

Typically, the lowest flows occur at the start of the irrigation season (October-November) or at the finish of the irrigation season (late April).

It is reasonable to assume that low flows in the Wellesley River would average about 0.36 m^3/s and would occassionally (for periods of 1 to 3 weeks) be as low as about 0.12 m^3/s.

Detailed salinity records for the Wellesley River are also not available. However, as most of the catchment comprises irrigated pasture, it would be reasonable to assume that winter flows would be of good quality (less than 500 ppm TDS). It is evident (from a sample) that the water quality deteriorates during low flows, particularly in relation to salt." (NOI p19-20).

6. REVIEW OF SUBMISSIONS

The Notice of Intent document was released to the public and Government departments for comment: the period for which ended on 7 July 1987.

A total of 28 submissions were received on the proposed chloride-process titanium dioxide plant at Kemerton; 14 from Government agencies and 24 public submissions.

In addition, the EPA taped the proceedings of the public meeting held on 2 July and used the transcripts as submissions to further determine the concerns of the local residents.

All of the submissions have been analysed and the main issues summarised below. Government departments and others making submissions are listed in Appendix 1 of this Assessment Report.

The issues that received most frequent comment related to the following concerns:

6.1 RISK AND HAZARDS

The issues raised regardisng risk and hazards at Kemerton due to the proposed plant were as below:

. Risk management strategy

Some submissions argued that an appropriate risk management strategy needs to be developed to manage the following:

- design construction and commissioning of the plant;
- the Company has withdrawn the commitment to implement a number of safeguards previously proposed at Australind. Given this situation it has been questioned whether the plant will be 'less safe' at Kemerton, which of these safeguards can be removed and which are needed to make the plant safe enough;
- the Kemerton plant should have the same safety features as the Kwinana chlor-alkali plant given the similar buffer zones;
- appropriate training of plant operators and a strategy by which human error due to inadequate training, irresponsibility due to intoxication etc, is prevented or managed; and
- methods for ensuring that the plant is appropriately maintained and that risks do not increase due to the ageing of the plant.

- Chlorine storage

  The main concern at the plant expressed in the submissions is the 100 tonne refrigerated storage of chlorine given that the risk analysis presented in the NOI is only for 50 tonne storage of chlorine.

- Management of plant operations

  This issue concerns the chlor-alkali plant operator chosen by the Company. It is believed that this operator needs to be experienced in the management of such plants.

- Emergency planning

  It has been commented that:

  - the Company needs to prepare a plan in the event of fire;
  - the Company needs to develop an emergency plan for all contingencies especially those involving a loss of containment of toxic gases; and
  - the Company's plan should be integrated with a Bunbury Regional Counter Disaster Plan.

6.2 WASTEWATER DISCHARGE INTO THE WELLESLEY RIVER

The issues raised regarding the wastewater treatment and disposal outlined in NOI were as follows:

- total opposition to discharge into the Wellesley River;
- concern about the adequacy and appropriateness of wastewater treatment proposed for the liquid discharge;
- safeguards to be undertaken to prevent accidental spillage or discharge of untreated wastewater;
- level of upgrading required on the drain into which wastewater is proposed to be discharged into the Wellesley River. A number of submissions stated that to prevent groundwater contamination, this discharge should be through a pipe or a lined drain;
- concern was raised on the adequacy of dilution which is likely to be achieved during summer low flow situation. It was pointed out that the wastewater entering the river would likely travel as a plug flow and would stratify into differential lenses due to differing density of fresh and salt water;

- a number of submissions from government departments including the Water Authority of Western Australia, Department of Agriculture and the Waterways Commission have pointed out that the likely salinity in terms of TDS of the wastewater being discharged would be higher than 14 500 ppm, and would most likely be 20 000ppm;

- the Water Authority of Western Australia has pointed out that while detailed flow data is not available for the Wellesley River, it is likely that low flow levels being experienced during low periods of summer may be lower than those used for the proponent's calculations;

- the Department of Agriculture's submission has pointed out that even when using the proponent's flow figures, the likely salinity of the river in the 'low flow' situation may be between 4 000 - 6 000 ppm.

- concern has been raised on the effect of increased river salinity on the flora in the proximity of the river ecosystem. This is due to:

  - a lower salt tolerance for a native vegetation species under discussion than that put forward by the proponent's consultant;

  - possibility of salt build up in soil in surrounding areas to the river due to flash floods in summer and river overflow; and

  - cummulative effect of heavy metals discharge;

- a number of submissions discussed the detrimental impact of the higher river salinity on river fauna including fish, birds, kangaroos, etc;

- concern about radio-nuclides being discharged into the river and accumulating over time;

- concern is expressed on the loss of riparian rights on river water extraction including water for irrigation. Some local residents have stated that legal action may be taken to prevent the Company's discharge on the matter of the loss of riparian rights; and

- concern has been expressed about the long-term build up of salt levels and other constituents within and in the surrounds of the river.

6.3 FRESHWATER AVAILABILITY AND EXTRACTION

Three matters of concern relating to this issue are:

- the question of whether adequate fresh water is available for the proposed plant at Kemerton;

- whether this water can be obtained in a manner such that adverse environmental impacts would not be experienced; and
- whether this water can be obtained such that the local existing and potential users of this resource are not unreasonably disadvantaged.

6.4 AIR EMISSIONS (both at Kemerton and Australind)

- Concern about air emissions under normal conditions; and
- Concern about fugitive emissions and nuisance odours.

6.5 RADIOLOGICAL ASPECTS

- Feedstock and plant waters;
- Radioactivity in the plant; and
- Concern regarding discharge of radioactivity in the Wellesley River.

6.6 OCCUPATIONAL HEALTH AND SAFETY

- Concern about worker safety;
- Medical health of employees; and
- Risk analysis report does not discuss worker safety.

6.7 SOLID WASTE DISPOSAL

- Solid waste disposal site for (both Kemerton and Australind sites) not adequately discussed;
- Disposal methodology, safeguards and potential impacts; and
- Disposal of mildly radioactive solid waste.

6.8 OTHER ISSUES

- Acid plant: concern that the acid plant would continue at Australind;
- Monitoring proposed in NOI inadequate: more monitoring needed;

- NOI documentation inadequate;
- Put unbearable strain on the resources of the local bushfire brigade which needs to be upgraded;
- Australind site should be closed and the finishing plant be transferred to the Kemerton site within a set period;
- No further heavy industry be allowed at the Australind site;
- Monitoring systems to be installed to measure air emissions;
- All monitoring done by the EPA and records maintained;
- Concern about the adequacy of the holding ponds to prevent groundwater contamination;
- Emissions from smoke stack may affect ground mist; and
- Power lines to site need environmental consideration.

7. ASSESSMENT OF ENVIRONMENTAL IMPACTS AT THE KEMERTON SITE

7.1 INTRODUCTION

In Section 3.2 of this Assessment Report, the Authority concluded that the Kemerton area is an acceptable site to locate the proposed chloride-process titanium dioxide plant.

The development of a chloride-process plant at the Kemerton site will generate environmental impacts which include:

- construction phase impacts;
- impacts of risk and hazards;
- other environmental impacts due to the emission of wastes;
- environmental impacts due to water resource extraction; and
- occupational health, and traffic impacts.

The Company is cognisant of the need to have in place an acceptable level of management controls and safeguards and to generate a minimum impact in the Kemerton area, and has made a number of commitments to ensure that these objectives should be met (see Appendix 2 of this Assessment Report for a list of the proponent's management commitments). Under the Environmental Protection Act 1986, these will form the basis of legally-binding conditions of approval.

The environmental impacts of the proposal at the Australind site are discussed in Chapter 9 of this Assessment Report while the environmental impacts of the concurrent operation period (one year period when the Kemerton and the Australand plants will both be operating) are discussed in Chapter 10.

7.2 CONSTRUCTION STAGE IMPACTS

The construction of the project, over approximately an 18 month period, would have the following impacts on the Kemerton area:

- the generation of dust;
- discharge of contaminated stormwater (especially grease and oils from construction equipment); and
- possible impacts due to the loss of vegetation caused by excessive site clearance.

The Authority believes that the proponent needs to liaise closely with the relevant control agencies, including the Harvey Shire Council and the Leschenault Inlet Management Authority (LIMA), during the construction phase to ensure that no issues arise during that period which could adversely affect the environment or inconvenience the local population. In particular the proponent needs to ensure that:

- stormwater runoff is properly filtered for grease and oil before discharge to the Wellesley River;
- dust generation is suppressed by sprinkler watering practices;
- site clearance is kept to the minimum; and
- appropriate landscaping and tree planting is undertaken at an early stage to minimise the visual impact of the plant.

7.3 RISK AND HAZARD IMPACTS

7.3.1 Introduction

The manufacture of titanium dioxide generates risk and hazards. The major hazard identified for the proposal relates to the loss of containment of toxic chemicals, namely chlorine and titanium tetrachloride.

The Authority has discussed its position on the issues of risk and hazards from industrial projects previously (see DCE Bulletin 257; and EPA Risk and Hazard Statement in Bulletin 278, May 1987).

The Authority believes that the quantitative assessment of risk to the community is an important part of the environmental evaluation of such proposals. Historical records show that industrial accidents occur, and that technical safeguards have their limitations. However, with proper planning, review and controls during the plant design, commissioning and operational stages, risks and hazards can, in most cases, be reduced to a level that the community is prepared to tolerate.

The term 'hazard' is used to describe a set of conditions that could lead to a harmful accident. 'Risk' is defined in terms of both the likelihood of a hazard, and the consequences of that hazard, ie: "the probability that a hazard, in terms of a specific level of loss or injury to people or property, will occur in a specific period of time" (Pomeroy 1982).

Risk assessment methodology consists of the following elements:

- HAZARD IDENTIFICATION OR DEFINITION: ie: identification of potential hazards of hazard events;
- RISK ESTIMATION: ie: determination of the likely severity of the consequences of the event and its products with the likely frequency of the event; and
- EVALUATION OF RISK AND HAZARDS: ie: guidelines or standards of assessment and an evaluation of the risk.

There has been a preliminary quantitative assessment of risk for the proposed titanium dioxide plant by Cremer & Warner Ltd for the 50 tonnes (as 2 x 25 tonnes storage units) storage of chlorine at Kemerton. The Authority subsequently initiated a detailed preliminary risk analysis of the plant's raw material inputs and processes, including the chlorine process, operation and storage, by the NSW Department of Environment and Planning (DEP). On the basis of Cremer & Warner's credentials and from advice provided by DEP, the Authority accepts the preliminary analysis presented in the NOI as an acceptable and appropriate assessment of the risks and hazards associated with the proposed plant including 50 tonne storage of chlorine at the Kemerton site.

7.3.2 Hazard Identification

The ERMP Volume 2 identifies the major hazards associated with chloride-process plant, including the associated chlor-alkali plant, to be those which arise if there were loss of containment of chlorine or titanium tetrachloride.

Chlorine is a yellow-greenish, non-flammable gas that is 2.5 times heavier than air and hence hugs the ground in the form of a dense vapour cloud if released. At atmospheric pressure, chlorine boils at $-34^{o}C$ and needs to be cooled at $-35^{o}C$ if storage at atmospheric pressure is desired.

The toxic effects of chlorine are summarised in Table 4.

Table 4 Toxic effects of chlorine

EFFECT	CONCENTRATION IN AIR (parts per million)	DURATION
Odour detectable by most people	1.0	Any
Threshold limit value*	1.0	8 hours
Negligible effects, mild irritation	3.0	Any
Strong irritation, serious distress	5-20	Any
Lethal	35-50	60-90 minutes
	40-60	30-69 minutes
	75	15 minutes
	1,000	A few breaths

* Threshold limit value is the average concentration to which nearly all workers might be repeatedly exposed for a normal eight-hour work day, every day, without adverse effect.

Source: ERMP

On the other hand, titanium tetrachloride is a liquid at atmospheric temperature and pressure. Once spilled, in moist air, titanium tetrachloride would hydrolise rapidly forming a dense, yellow-white cloud containing amongst others, hydrochloric acid. Hydrochloric acid is toxic and irritant to the eyes and skin.

7.3.3 Risk Estimation

Risk estimation seeks to measure the likelihood of an event (of some stated magnitude) occurring and the likelihood and nature of the consequences that follow. In essence, risk estimation consists of multiplying the failure frequency by the severity, ie: calculation of consequences, of an event or incident. An event (or an unwanted event) is defined as an action or accident leading to fatalities.

7.3.3.1 Identification of Unwanted Events and their Likelihood of Failure

The Cremer & Warner Report (ERMP Volume 2) identified a number of possible unwanted events through information and experience previously obtained from other studies, and from design data provided by SCM Chemicals Ltd for their plants at both Stallingborough, UK, and Baltimore, USA. These release events, their rates, and the frequency of their failure had been previously provided to the Authority and were utilised in the DEP modelling of the risk results.

The Cremer & Warner Report notes that probability factors are involved in the assessment of the final outcome of a release or event. These factors include:

- wind direction and stability;
- the duration of a release;
- whether persons are indoor or outdoor; or
- whether they can escape from a chlorine or titanium tetrachloride cloud.

7.3.3.2 Calculation of Severity of Consequences

The Cremer & Warner Report (ERMP Volume 2) discusses the methodology by which accident consequences analysis are undertaken. By using passive dispersion and dense vapour cloud models, downwind concentrations of the loss of containment of chlorine and titanium tetrachloride are calculated for various meteorological conditions.

The toxic gas concentrations are then converted into a toxic dose (based on the time an individual may be exposed) and this in turn is used to calculate the likelihood of an individual being killed at any point downwind.

A similar approach is undertaken for the titanium tetrachloride case.

7.3.4 Risk Estimation Results

The risk levels that would be generated by the proposal for the Kemerton site are presented in the NOI. These risk levels for 100% outdoor are shown in Figure 12. The Appendix to the NOI states that "Cremer & Warner conclude that this loction (Kemerton site) is suitable for the proposed plant (storing 50 tonnes of chlorine) as no residential property would be subject to an individual risk greater than $1 \times 10^{-6} y^{-1}$" (Cremer & Warner 1987).

7.3.5 Evaluation of Risk and Hazards

Given that the EPA had a number of new industrial plants to evaluate, the Authority sought expert advice and recently released a set of guidelines on the "Evaluation of Risks and Hazards of Industrial Development on Residential Areas in Western Australia" (EPA 278 May 1987). For new industrial installations, the relevant guidelines for assessment are as below:

"The following are proposed by the Authority, as a guide for the assessment of the fatality risk acceptability of new industrial installations:

- The Authority has taken note of how decisions on risks are taken in other parts of the world. In the light of that knowledge the Authority will classify decisions into three categories. These are as follows:

  - A small level of risk which is acceptable to the Environmental Protection Authority;

  - A high level of risk which is unacceptable to the Authority and which warrants rejection; and

  - A middle level of risk, which subject to further evaluation and appropriate actions may be considered to be acceptable to the Authority.

- An individual risk level in residential zones of less than one in a million a year is so small as to be acceptable to the Environmental Protection Authority.

- An individual risk level in residential zones exceeding ten in a million a year is so high as to be unacceptable to the Environmental Protection Authority.

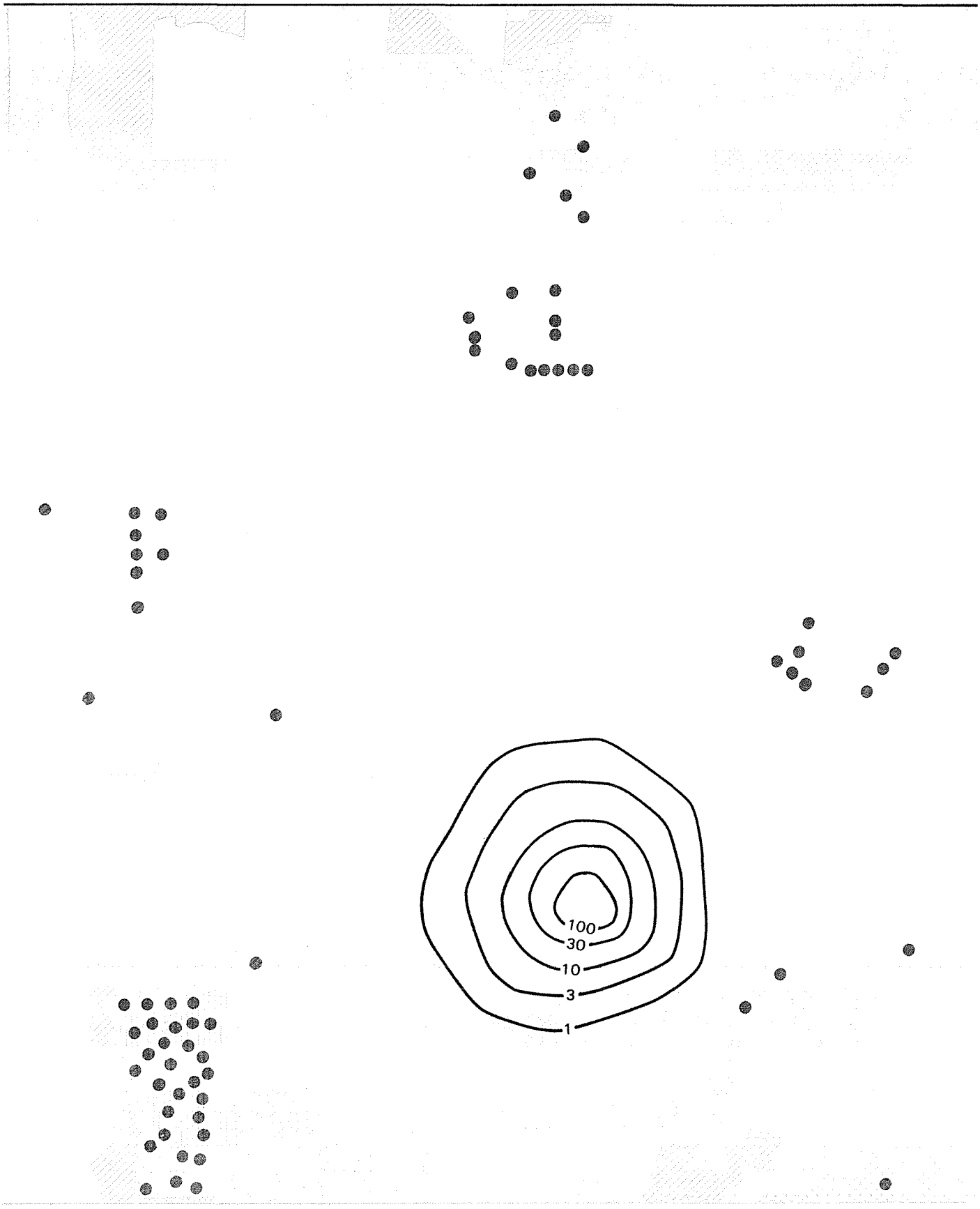

Figure 12. Existing Land Use, Distribution of Dwellings and Risk Contours

- Where the preliminary risk level in residential zones has been calculated to be in the range one in a million to ten in a million a year, the Authority will call for further evaluation of the risks associated with the project. The Authority may then be prepared to recommend that the project be acceptable subject to certain planning and technical requirements.

- A major technical requirement will be the commissioning of a Hazard and Operability Study (HAZOP) at a appropriate stage or stages of the project. Such a study is an effective technique for discovering potential hazards and operating difficulties at the design stage. Significant reductions of hazards, and in the number of problems encountered in operations, as a result of such studies are possible. The Hazard and Operability Study should be undertaken by the proponent with a qualified person, approved by the Authority, who will be required to certify to the Authority that the study was carried out in a proper manner. This study should explore all feasible ways of reducing hazards. The proponent may be required to update the risk analysis, and make the results public." (EPA May 1987)

7.3.6 Risk Assessment

Due to its assessment of the Australind proposal the Authority has a large quantity of technical information which was used by the NSW Department of Environment and Planning to model the likely risk levels to be generated for this proposal. DEP has advised the Authority that likely risk levels to be experienced from the proposed plant at Kemerton would be as presented in the NOI. This analysis agrees with the risk results for the 50 tonne storage of chlorine (as 2 x 25 tonne storage vessels) as shown in Figure 12.

7.3.6.1 Assessment of Risk Levels in Complying with EPA Guidelines

The Authority believes that subject to compliance by the proponent of the EPA recommendations regarding risk and hazards (as outlined in this report), the outdoor risk levels for this plant would be so low as to be acceptable to the EPA.

However, the Authority is aware that even with adequate and appropriate safeguards, residual risk from the plant remains and needs to be properly managed by the Company. This is due to the fact that there are limitations in technology, and accidental failures of material and components will occur, however infrequently. In addition, human error is possible.

7.3.6.2 Further Risk-Related Issues Arising from this Proposal

The Authority has previously undertaken an Assessment for a chlor-alkali plant at Kwinana (EPA September 1985) similar to the one proposed at Kemerton. The Authority notes that the buffer zone surrounding the two plants is of similar magnitude. Given this fact, the Authority believes that the two plants need to have similar safeguards for the SCM proposal to be acceptable.

While the Authority believes that with similar safeguards to those at Kwinana, the likely risk from the proposed SCM plant can be made acceptable, the proposal still raises a number of risk-related issues identified in previous or current submissions to the Authority. These are:

(a) Risk management strategy

An appropriate risk management strategy needs to be developed to manage the following:

- design construction and commissioning of the plant;
- the company has withdrawn the commitment to implement a number of safeguards previously proposed at Australind. Given this situation, will the plant be 'less safe' at Kemerton? Which of these safeguards can be removed and which are needed to make the plant safe enough?
- appropriate training of plant operators and a strategy by which human error due to inadequate training, irresponsibility due to intoxication etc., is prevented or managed; and
- methods for ensuring that the plant is appropriately maintained and that risks do not increase due to the ageing of the plant.

The Authority's assessment of the above matters is discussed in Section 7.3.6.5.

(b) Chlorine storage

The main concern at the plant is the 100 tonne refrigerated storage of chlorine, given that the risk analysis presented in the NOI is only for 50 tonne storage of chlorine.

The Authority's assessment of the above matters is discussed in Section 7.3.6.6.

(c) Management of plant operations

This issue concerns the chlor-alkali plant operator chosen by the Company. This operator needs to be experienced in the management of such plants.

The Authority's assessment on the above matters is discussed in Section 7.3.6.7.

(d) Emergency planning

It has been commented in some submissions that:

- the Company needs to prepare a plan in case of fire;
- the Company needs to develop an emergency plan for all contingencies especially those involving a loss of containment of toxic gases; and
- the Company's plan should be integrated with a Bunbury Regional Counter Disaster Plan.

The Authority's assessment of the above matters is discussed in Section 7.3.6.8.

7.3.6.3 Risk Assessment Issues Discussed in the EPA Assessment Report on the Australind Proposal

The EPA previously discussed the following issues in its Assessment Report on the Australind Proposal (EPA May 1987):

- the need for a site visit by a risk analyst while undertaking the risk study;
- the appropriateness of meteorology used in the gas dispersion calculations. (It should be noted that the Authority provided detailed meteorological information of the Kemerton area to the NSW Department of Environment and Planning and that this data was used by them in their modelling);
- the sensitivity of the Cremer & Warner model to toxic gas doses. (It should be noted that the NSW Department of Environment and Planning used the Technica SAFETI toxic gas dose for its modelling of the Kemerton proposal);
- the apparent difference in "buffer zone" between CSBP's 10 000 tpa chlor-alkali plant at Kwinana and the proposed 12 000 tpa chlor-alkali plant at Australind (Note that the extent of the current Cremer & Warner risk levels generated for Kemerton are comparable with the Kwinana chlor-alkali plant);
- the question of 2 km buffer zone suggested for one tonne storage of chlorine listed in the Draft Bunbury Regional Plan;
- the need for a clear line of responsibility for the ongoing management of risk and hazards within the Company's management structure. The Authority has already stated that "the ultimate responsibility to ensure plant safety rests with the management of the SCM Chemicals Ltd" (EPA May 1987, p57); and
- the need for the Company's ongoing management of the operations to be supervised by the EPA. (Note that the Authority will be supervising the Company's operation at Kemerton as per its comments in the EPA Assessment Report on the Australind proposal (EPA May 1987, p60)).

7.3.6.4 Assessment of the Proposed Risk Management Strategy

A risk management strategy contains details on how the risks and hazards from an industrial installation are to be managed. The proponent's risk management strategy consists of the following:

- making a commitment to undertake a Hazard and Operability (HAZOP) study for the plant;
- a commitment to train all personnel in safe work practices and emergency procedures; and
- a commitment to undertake another risk assessment at the completion of the final design to confirm or improve upon the results presented by the Cremer & Warner preliminary risk analysis presented in the NOI.

The Authority believes that the risks and hazards from the proposed plant can be made acceptable if appropriate action is taken. The proponent has already made commitments to undertake some of the risk management steps required. The Authority believes the following are also necessary:

- an assurance from the proponent that the most appropriate and reliable equipment will be used in the construction of the plant. (This matter needs to be addressed in the HAZOP for the plant);
- adequate supervision during the construction stage. (The Authority would refer this matter to the appropriate regulatory agencies if the proposal proceeds);
- a hazard analysis update including a fire safety study, a study detailing the management of the commissioning stage and a study of emergency procedures to be completed before plant commissioning (the proponent has made commitments to undertake some of these studies); and
- regular auditing of risks and hazards after commissioning.

Accordingly, the Environmental Protection Authority recommends as follows:

(3) The Environmental Protection Authority recommends that a condition of approval should be the preparation in stages of a comprehensive and integrated hazard and risk management strategy, to the Authority's satisfaction.

This should consist of the following with the results being forwarded to the Environmental Protection Authority:

- the HAZOP study to be completed and submitted before construction commences and to be conducted in a manner approved by the EPA. This HAZOP study should especially discuss the risk effects of the safeguards removed due to the plant being located at Kemerton;

- a final risk analysis report incorporating the plant design after HAZOP and (taking into consideration any additional safeguards/modifications arising out of the HAZOP analysis), to be submitted soon after construction;

- a hazard analysis update (including a fire safety study, and a study detailing the management of the commissioning stage and a study of emergency procedures) to be submitted before plant commissioning; and

- an audit of risk and hazards to be submitted to the EPA upon request.

The NOI states that:

"Owing to the spatial separation of the proposed chloride plant and residential properties, it is no longer appropriate for the proponent to make the following commitments with regard to safety features. These were proposed for the Australind site, purely in recognition of its close proximity to residential areas.

- Housing of the majority of the process containing titanium tetrachloride.

- Provision of a controlled water system to the building.

- Maintenance and cleaning of heat exchangers in a confined area. This will now be done in a well ventilated open area on concrete pad whose run off is directed to the waste water treatment plant.

- Venting of bursting discs to a scrubbing system.

- Provision of a scrubbing system for the building (which is no longer intended) and the back ups to be deleted. Stacks will be appropriately designed.

- Caustic scrubbing will be eliminated."

In addition, the Cremer & Warner letter (dated 26 May 1987) included as appendix to the NOI, states that:

"A number of changes have been made to the design and operation of the proposed plant and these have been included in the analysis.

The changes are as follows:-

1. The Chlorination Unit will not be enclosed in a building.

2. Bunded areas will not be protected from rainfall but will be pumped down to remove standing water.

3. The emergency scrubber (for scrubbing of the chlorinator relief system, etc.) will be deleted and replaced with a stack.

4. There will not be a chlorinator start-up scrubber.

5. Caustic scrubbers on emissions from the titanium dioxide process plant will be deleted.

6. The oxidation unit reactor will not be in a containment building.

7. All building scrubbers will be deleted."

The EPA concurs with the proponent that due to the adequate buffer zone, approximately 2 km radius at the Kemerton site, it may not be necessary to have all of the safeguards that were initially proposed for the Australind site with its approximate 600 m buffer area. However, as discussed earlier, in principle, the Authority believes that given the similarity of buffer zone distances at the Kwinana industrial area and the Kemerton site, an equivalent degree of safeguards should be required for the Kemerton proposal. This matter can best be clarified and resolved at the HAZOP analysis stage where each of the previously proposed safeguards needs to be investigated for its contribution to the plant hazards and the generated risk levels.

7.3.6.5 Assessment of Chlorine Storage and Proposed Safety Features

The proposal calls for the refrigerated storage of 100 tonne of chlorine in 3 x 50 tonne tanks (one tank would be on standby and would normally be kept empty). The Authority notes that the proponent has undertaken a risk analysis for the storage of only 50 tonnes at Kemerton (2 x 25 tonne tanks). Calculations carried out show that risk generated by the storage of 100 tonnes of chlorine would be unacceptable. Given this fact, the Authority believes that the proposed plant should be operated with a maximum of 50 tonne of chlorine being stored on site in 25 tonne storage tanks (3 x 25 tonne tanks with one stand by).

(4) **The Environmental Protection Authority recommends that no more than 50 tonnes of chlorine should be stored at the Kemerton plant location in containers not exceeding 25 tonnes capacity.**

The EPA is aware that the Company would require a small quantity of chlorine during the start-up and commissioning period. The Authority believes that the transport of this small quantity of chlorine over a very short-term period is acceptable.

(5) **The Environmental Protection Authority recommends that there be no sale of chlorine from the Kemerton site without a further specific assessment by the EPA and that the management of the transport of chlorine for commissioning should be discussed with the relevant Government agencies prior to commissioning.**

The EPA notes that the proponent has made a commitment to include a number of safeguards for the storage of chlorine. The EPA believes that these safeguards should be similar to those implemented at Kwinana.

(6) **The Environmental Protection Authority recommends that its requirements in terms of safeguards for the Kemerton proposal should be the same as those required for the chlor-alkali plant at Kwinana (EPA Bulletin 216). In addition the Authority endorses the commitment, made by the proponent, to install the following at Kemerton:**

- **full height concrete bunding;**
- **insulation tiles in the bunds;**
- **a foam suppression system; and**
- **isolating valves on the main storage tanks and process items. Storage tank isolation valves require two actuation points.**

7.3.6.6 Assessment of the Management of Plant Operations

The proposal calls for the construction of a 12 000 tpa chlor-alkali plant. It is critical that this plant be operated and managed in an acceptable manner.

SCM Chemicals Ltd has not yet chosen the company which would be operating this plant. SCM is currently investigating the proposal to sub-contract the chlor-alkali plant to an experienced operator. The Authority concurs with the proponent's view which it believes is appropriate. However, the proponent should retain the responsibility for the environmental management performance of the plant.

(7) The Environmental Protection Authority notes that the proponent is investigating sub-contracting the chlor-alkali plant. While the Authority approves of this procedure, it recommends that the proponent be held responsible for the environmental performance of the chlor-alkali plant, regardless of the operating company.

7.3.6.7 Assessment of Emergency Planning

The Authority believes that the proponent needs to prepare:

- an emergency plan to prevent and manage any fire on site and in the surrounding (bush) area; and
- an emergency plan for all other contingencies especially those involving a loss of containment of toxic gas.

The Authority is aware that the State Emergency Services is preparing a regional counter disaster plan for the Bunbury Region for a number of emergencies including fire, bush fires, floods, toxic gas release etc. The Authority believes that the Company's emergency plan should be integrated with the regional counter disaster plan for the Bunbury area.

(8) The Environmental Protection Authority recommends that the proponent's emergency plan and procedures be integrated with the proposed State Emergency Services' Bunbury Regional Counter Disaster Plan.

It is understood that the Regional Counter Disaster Plan will cover contingencies for chemical release emergencies as well as natural emergencies such as floods and fire.

In addition, the EPA recommends that the proponent participate in the development of a fire management strategy for the Kemerton region and contributes towards its implementation.

7.3.6.8 Conclusion on the Assessment of Risk and Hazards

The EPA concludes that if the following are implemented

- the proponent's proposed safeguards;
- the Authority's recommendations on the risk and hazard assessment; and
- the plant is operated in a responsible manner.

Then the likely risk generated from the plant would be low enough to be acceptable to the Environmental Protection Authority.

7.4 ENVIRONMENTAL IMPACTS FROM THE EMISSIONS OF WASTES AT THE KEMERTON SITE

The NOI identified a number of waste products being generated from the plant which would require treatment and/or disposal. These include:

- liquid wastes;
- atmospheric emissions;
- solid wastes; and
- radioactive wastes.

7.4.1 Liquid Waste Impacts

7.4.1.1 Liquid Waste Treatment and Disposal Discussed in the NOI.

The proposed liquid waste treatment and disposal for this project, outlined in the NOI, has been presented in Chapter 4 of this Assessment Report. In summary this proposal consists of:

- collection of process water, acidic and alkaline liquors, and a quantity of bleed-off sulphuric acid;
- treatment of the above wastewater by sedimentation through a clarifier followed by neutralisation through lime dosing; and
- disposal of 2 700 kilolitres per day (2.7 ML/day) of heated ($40^{o}C$) clarified overflow through a gravity pipeline to a drain from which it would flow into the Wellesley River.

7.4.1.2 Environmental Impacts of Wastewater Discharge Outlined in the NOI

The proponent has argued in the NOI (pp27-28) that environmental impacts associated with the liquid wastewater treatment and disposal into the Wellesley River would be minimal and should be considered acceptable because:

- the treated wastewater being discharged into the Wellesley River is very similar to diluted seawater, having salt levels of about 14 500 ppm;
- the discharged wastewater would only contain small amounts of non-settleable or marginally settleable suspended solids (however the NOI does not provide quantification of the final discharge concentrations of particular materials);

- the proponent's wastewater disposal strategy for the Wellesley River consists of achieving adequate dilution of the discharge with river water;

- the NOI states that while flow records for the river are not available the likely low flow conditions in the Wellesley River would average about 0.36 m^3/s and would occasionally (for periods of 1 to 3 weeks) be as low as about 0.12 m^3/s;

- while the NOI also admits that detailed salinity records for the Wellesley River are not available, the document states that it would be reasonable to assume that winter flows would be of good quality (less than 500 ppm TDS);

- during summer low flow conditions, the river salinity is likely to increase. The proponent's one sample (taken late May 1987) shows that river pH was 7.3, with a salt concentration of 1 650 ppm;

- the proponent notes that the generally accepted quality of irrigation water is 1 500 ppm of salt concentration;

- based upon the measured water quality in the Wellesley River, the proposal to discharge 2 700 kL/d (0.031 m^3s^{-1}) of wastewater with a TDS of about 14 500 ppm will have the following (acceptable) impact upon water quality during periods of low flow:

  - during average low flow conditions, the streamflow will increase by about 10% and the TDS will increase by about 60% to about 2 700 ppm; and

  - during minimum low flow conditions, the streamflow will increase by about 25% and the TDS will increase by about 155% to about 4 300 ppm.

- during winter flow conditions, the combination of increased flows and lower salinity should ensure that the combined TDS will be less than about 500 ppm;

- the Wellesley River is approximately 3.8 km from the Marriott Road crossing to its confluence with the Brunswick River. The first 1.5 km of this length is bordered to the west by natural vegetation and to the east by irrigated grazing land. Further downstream the Wellesley River is bordered by dryland pasture. Along the first 2 km of this length there are stands of Eucalyptus rudis and Melaleuca rhaphiophylla, both of which are known to be salt tolerant.

Additional information provided to the EPA by the proponent consists of a brief "Environmental Appraisal of the Plant Site and Wellesley River" prepared by Kinhill Engineering Pty Ltd. This report, included as Appendix 3 of this Assessment Report, states that:

"Little information is available on the tolerance of these species (Eucalyptus rudis and Melaleuca rhaphiophylla) to salinities of up to 3 000ppm over long period of time. It is thought however, due to general knowledge of other rivers, that neither species would be adversely affected by the proposed increase in salinity. Trees of Melaleuca rhaphiophylla on the Canning River near Mt Henry Bridge survive where the water becomes seasonally brackish and in the estuarine environment of the lower reaches of the Swan River (E.M. Mattiske, pers. comm). E. rudis has also been seen to tolerate low levels of salinity but no long term monitoring or controlled experiments on the ability of plants to withstand such conditions has been carried out. Species known to grow well down from the proposed wastewater outlet, below the junction of the Brunswick and Collie Rivers tolerate far higher levels of salinity than will be produced. These species, Casuarina obesa and Melaleuca hamulosa would obviously not be affected by wastewater discharge". (p3-4)

7.4.1.3 Wastewater Issues Raised in Submissions

The Authority has received a number of submissions expressing concerns regarding the wastewater treatment and disposal outlined in the NOI. The issues raised were as follows:

- total opposition to discharge into the Wellesley River;
- concern about the adequacy and appropriateness of wastewater treatment proposed for the liquid discharge;
- safeguards to be undertaken to prevent accidental spillage or discharge of untreated wastewater;
- level of upgrading required on the drain into which wastewater is proposed to be discharged into the Wellesley River. A number of submissions stated that to prevent groundwater contamination, this discharge should be through a pipe, or a lined drain;
- concern was raised on the adequacy of dilution which is likely to be achieved during summer low flow conditions. It was pointed out that the wastewater entering the river would likely travel as a plug flow and would stratify into two distinct lenses due to the differing density of fresh and salt water;
- a number of submissions from government departments including the Water Authority of Western Australia, the Department of Agriculture and the Waterways Commission, have pointed out that the likely salinity in terms of TDS of the wastewater being discharged would be higher than 14 500 ppm and would most likely be 20 000 ppm or higher;

- the Water Authority of Western Australia has pointed out that while detailed flow data is not available for the Wellesley River, it is likely that low flow levels being experienced during summer periods may be lower than those used for the proponent's calculations;

- the Agriculture Department's submission has pointed out that even when using the proponent's flow figures, the likely salinity of the river in the low flow situation may be between 4 000 - 6 000 ppm;

- concern has been raised on the effect of increased river salinity on the flora in the proximity of the river ecosystem. This is due to:

  - a lower salt tolerance for a native vegetation species under discussion than that put forward by the proponent's consultant;

  - possibility of salt build up in soil in areas surrounding the river due to flash floods in summer and river overflow; and

  - cumulative effect of heavy metals discharge in the river sediment.

- a number of submissions discussed the impact of the higher river salinity on river fauna including fish, birds, kangaroos, etc;

- concern about radio-nuclides being discharged into the river and accumulating over time;

- concern is expressed on the loss of riparian rights to river water extraction including water for irrigation. Some local residents have stated that legal action may be taken to prevent the discharge by the Company on the matter of the loss of riperian rights;

- concern has been expressed about the long-term build up of salt levels and other constituents within and in the surrounds of the river; and

- finally, a number of submissions have pointed out that the likely aluminium smelter would also need to discharge wastewater. They point out the logic of having an ocean discharge pipeline.

7.4.1.4 EPA Assessment of Wastewater Treatment and Disposal Outlined in the NOI

The NOI states that the wastewater treatment would consist of "neutralisation, thickening filtration and lined holding ponds" (NOI p8). The Authority notes that for the Australind proposal, the proponent had modified the original wastewater treatment discussed

in the ERMP, such that discharge of underflow from the clarifier into the infiltration pond would not be occurring. While such a commitment for the Kemerton site has not been explicitly discussed in the NOI, the EPA is aware that the proponent wishes to filter the underflow and treat the supernatant in the clarifier. This needs to be done to prevent any groundwater contamination.

(9) **The Environmental Protection Authority recommends that the underflow from the thickener at the Kemerton site be treated in such a manner so as to prevent the likelihood of groundwater contamination at the Kemerton site.**

The NOI mentions that the "alternative of deep well injection, piping to the ocean or complete evaporation all have significant economic impediments in terms of either capital cost, operating cost or both" (NOI p6). Hence the document prefers the option of disposing of the treated saline wastewater to the Wellesley River.

The Authority has investigated the environmental consequences and impacts associated with these options.

Given that a proposal to discharge treated wastewater is presented to the EPA, the Authority has undertaken investigations of this proposal in order to determine the merit (or otherwise) of this proposal.

7.4.1.5 Information Collected by the EPA on the Impact of Treated Wastewater Discharge into the Wellesley River

The Kemerton site and its surrounds are a catchment for the Wellesley River which is a tributary of the Brunswick River which is in turn a tributory of the Collie River.

The Wellesley River and its environment have been discussed in Chapter 5 of this Assessment Report.

The Authority has identified a number of beneficial uses of the Wellesley River including the following:

- the conservation values of the river ecosystem including fauna and flora;
- the aesthetic and recreational values of the river; and
- the riparian rights of the local users including use of river water for irrigation.

The Authority believes that these beneficial uses must be protected.

In order to assess the impact of the proposal to discharge 2 700 kL/day of treated saline wastewater on the identified beneficial uses of the river, the following information has either been provided to the EPA or has been collected from studies, meetings or investigations initiated by the Authority.

(a) Flow in the river

While all concerned agree that there is little data available on the low flow conditions experienced by the river, differing figures are presented and are used to calculate likely dilution of the wastewater salinity. The proponent has used a low flow average condition of 0.36 m^3/s with an occasional (1-3 weeks) lower flow rate of 0.12 m^3sec.

The Water Authority of Western Australia notes in a submission that:

> "Previous low flow measurements on the Wellesley River during the summer of 1984 indicated significant additional seepage from the wetlands around Wellesley River. Minimum flow rates of the Wellesley River at Marriot Road of 0.265 m^3/sec during the 1984 survey are higher than the estimated figure of between 0.10 to 0.15 m^3/sec during 1987. The preceding wet year of 1983 presumably contributed to the higher groundwater discharges in 1984" (WAWA submission dated 18 June 1987)

A subsequent Water Authority of Western Australia submission dated 8 July 1987 goes on to say that:

> "In addition to the information provided (in the 18 June submission), it should be recognised that the summer flows originate in part from runoff of irrigation water, and it is expected that future progress by irrigators in water efficiency, and possible conversion of the irrigation distribution system to pipes are likely to result in summer flows being reduced to zero or near zero. The duration of the low flow period (rather than 1-3 weeks mentioned in the NOI) is also likely to be significantly extended." (WAWA submission)

(b) Salinity characteristics of discharged wastewater

The NOI presents the characteristics of the discharged wastewater as shown in Table 2. The document claims that the Total Dissolved Solids (TDS) of the wastewater would be about 14 500 ppm.

This claim is disputed by a number of government agencies including the Department of Agriculture, the Water Authority of Western Australia and the Leschanault Inlet Management Authority. Using the information provided by the NOI and shown in Table 2, the following comments have been provided to the EPA:

- "the quality of the effluent as described in the NOI is under question. The proponent indicates a salinity of 14 500 mg/L (ppm) but examination of ionic components indicates the salinity will be well in excess of 20 000 mg/L; possibly as high as 30 000 mg/L." (WAWA submission, 8 July 1987);

- the NOI proposes a minimum discharge of 2 700 kL/day of saline (waste) water. The upper limit has not been presented. The document quotes a figure of 14 500 ppm TDS for the wastewater, yet the summation of table 2.3 (of NOI) gives a TDS of 19 293 ppm." (LIMA submission).

(c) Background salinity levels of the river

The NOI states that detailed salinity records for the Wellesley River are not available. The document then goes on to state that

> "However, as most of the catchment comprises irrigated pasture, it would be reasonable to assume that winter flows would be of good quality (less than 500 ppm TDS). One sample (taken late May 1987) was tested at pH 7.3 and a salt (sodium chloride) concentration of 1 690 ppm, together with the following:
>
> | | |
> |---|---|
> | . Manganese | 380 parts per billion |
> | . Chromium | 4 parts per billion |
> | . Zinc | 20 parts per billion |
> | . Nickel | 1 parts per billion |
> | . Aluminium | 350 parts per billion |
>
> Therefore, it is evident that the water quality deteriorates during low flows, particularly in relation to salt". (NOI p29)

The Water Authority of Western Australia has provided the following comment on this issue:

> "The comments by the proponent on streamflow quality are based on assumptions and a single water sample from the river with a quoted quality of 1 690 mg/L (sodium chloride). The representation of water quality in a complex surface water system such as the Wellesley with only one sample is inappropriate.
>
> Unfortunately, there are limited data available on water quality in the Wellesley River, but the four samples taken by the Water Authority during the period February to April 1984 at Marriott Road showed salinities of 780 mg/L decreasing to 570 mg/L TDS as flows increased from 0.25 m^3/s to 1.0 m^3/s. This information is contrary to the assumption by the proponent that water quality deteriorates during low flows to the extent that the river would only be marginally suitable as a water source during low flow periods.
>
> It is likely that activities and conditions on the catchment would result in higher salinities occurring from time to time, such as has been observed by the proponent in their quoted sample". (WAWA submission dated 13 July 1987).

(d) Likely increase in river salinity due to discharge of wastewater

The proponent states that Company's calculations show that:

> "Based upon the measured water quality in the Wellesley River, the proposal to discharge 2 700 kL/d (0.031 m^3/s) of wastewater with a TDS of about 14 500 ppm will have the following impact upon water quality during periods of low flow:
>
> - during average low flow conditions, the streamflow will increase by about 10% and the TDS will increase by about 60% to about 2 700 ppm;
>
> - during minimum low flow conditions, the streamflow will increase by about 25% and the TDS will increase by about 155% to about 4 300 ppm.
>
> During winter flow conditions, the combination of increased flows and lower salinity should ensure that the combined TDS will be less than about 500 ppm." (NOI p29)

The Department of Agriculture has provided the following comments in its submission to the EPA:

> "The calculation of salinity increases in the Wellesley River presented on p28 (of the NOI) are disputed. An effluent salinity figure of 14 500 mg/L is used whereas Table 2.3 (of the NOI) indicates that this should be about 20 000 mg/L. Moreover the 'average' low flow figure, which must be regarded as dubious at best, should be adjusted by deleting a high flow figure on 8 April 1987 which was undoubtedly generated by 45 mm of rainfall the previous day. This results in a 'new average' low flow of 0.25 m^3/s. Under the assumptions below Wellesley River salinities could fluctuate between 4 000 mg/L and 6 000 mg/L as a result of effluent discharge.
>
> Given the heavy nature of the soils being irrigated from the Wellesley River, water of this quality is unsuitable for irrigation. Furthermore it will be unsuitable for pigs, poultry, lactating cows and general domestic use." (Department of Agriculture submission)

The Water Authority of Western Australia has provided the following advice to the EPA:

> "Salinities in excess of 3 000 mg/L could be regularly expected (due to wastewater discharged into) the Wellesley River. These could increase at times of minimum flow to approach 10 000 mg/L if the plant effluent discharge salinity is 20 000 mg/L. These salinity levels pose obvious problems for local water users and the local environment." (Water Authority submission 18 June 1987)

(e) Salt tolerance of river vegetation

The proponent's consultant has argued that the Eucalyptus rudis and Melaleuca rhaphiophylla species of flora prevalent along the river are tolerant to salinity of 3 000 ppm. The advice from the Department of Agriculture is that:

> "Contrary to the statement on pl6 of the NOI (para 7) E. Rudis is sensitive to soil salinity. Recent field studies at Lake Toolibin and Brookton have provided evidence for this. At Lake Toolibin soil chloride levels of 450 ppm were associated with severe loss of vigour in E. rudis. The effect of raised salinity in the Wellesley River on fringing communities of E. rudis is uncertain but dependent on whether the root-zone water supply is from the river water or from extraneous, fresh seepage flow towards the river.
>
> Therefore there is a significant salinity threat to E. rudis which cannot be dismissed on the basis that it is salt tolerant." (Department of Agriculture submission)

Given the critical nature of this issue, the EPA requested Mr Geoff Dimmock, an expert in this field, to investigate the environmental consequences of the rise in the background salinity of the Wellesley River on the surrounding native vegetation. The Mr Dimmock's report to the EPA is included as Appendix 4 of this Assessment Report.

In summary, the Mr Dimmock has informed the Authority that

> "There appears to be a significant risk that both Eucalyptus rudis and Melaleuca rhaphiophylla, the major tree species of the fringing woodland along the lower reaches of the river, may be stressed or even killed if the stream salinity is increased by effluent discharge from the proposed titanium dioxide plant at Kemerton." (Dimmock report)

(f) Riparian and irrigation uses of the river

The Authority is aware of the existing usage of the river for stock drinking and for existing and potential irrigation of pastures. Currently, approximately 24 hectares of pasture on the Ridley and Salom family farms is irrigated, with potential for larger hectarages in the future on adjoining properties to the river. In addition, there are at least seven farms with riparian rights on the river.

The Water Authority of Western Australia in its submission has stated that:

> "The proposal to discharge 2 700 kL/d of highly saline water into the Wellesley River is not acceptable to the Water Authority. At times of low or zero flow the resulting salinity level in the river (due to SCM's discharge) will be too high to be tolerated by the riparian users in the Wellesley and Brunswick Rivers downstream of the discharge point." (WAWA submission).

The Department of Agriculture has expressed a similar view in its submission to the EPA.

> "My Department is concerned about possible effects of the above proposal on the salinity of the Wellesley River because a number of farmers currently use the Wellesley and Brunswick Rivers for irrigation, stock and domestic purposes". (Department of Agriculture submission)

7.4.1.6 EPA Assessment on the Proponent's Preferred Wastewater Disposal Option

The Authority has carefully assessed the Company's proposal to discharge treated wastewater into the Wellesley River. The EPA's assessment of the proposal is that:

- given the low flow situation in the summer periods, the river salinity would increase significantly due to the saline wastewater discharge;
- even if the salinity rise is as predicted by the NOI document, there would be a significant risk that some or all of the major tree species of the fringing woodland along the lower reaches of the river may be stressed or killed; and
- there are a number of riparian users of the river who may be unreasonably disadvantaged if wastewater is discharged into the river.

Given the above, the Authority finds the proposal to discharge wastewater into the Wellesley River environmentally unacceptable.

7.4.1.7 Alternative Wastewater Disposal Options

The EPA initiated a number of studies, including one from the consultants Binnie & Partners, to determine what alternative viable options of wastewater disposal were feasible which could be carried out in a manner which would cause a minimum or acceptable impact on the environment. The basic conclusion of these studies is that ocean disposal through a pipe along Buffalo Road could be made to be environmentally acceptable. However, the Authority would need to make an environmental assessment of any wastewater disposal option proposed by the Company. It is the Authority's opinion that any such discharge would need to comply with strict environmental performance standards.

(10) **The Environmental Protection Authority concludes that the proposal to discharge wastewater into the Wellesley River would be environmentally unacceptable.**

The Authority recommends that the proponent investigates alternative approaches to the management of wastewater discharge (eg: ocean discharge or deepwell injection). In this regard the Authority considers that a properly designed and managed ocean outfall could be environmentally acceptable. The proposal for wastewater discharge would need to be submitted to the EPA for its assessment.

There are a number of additional issues requiring discussion:

Firstly, the Authority is concerned about the quantity of wastewater which would be generated from the proposed plant and believes that the proponent needs to investigate means by which this quantity can be reduced or minimised. This matter is further discussed in Section 7.5 of this Assessment Report.

Secondly, the EPA is concerned about the likelihood of an accident to any part of the effluent management or chemical containment and handling system of the wastewater treatment. This matter is further discussed in Section 8.4 of this Assessment Report.

Finally, if treated wastewater is discharged into the ocean, periodic monitoring would be required to ensure that disposal is carried out in an environmentally acceptable manner. Any proposal submitted on ocean disposal needs to discuss the monitoring required to manage ocean discharge.

7.4.2 Atmospheric Emissions and Their Impacts

7.4.2.1 Atmospheric Emissions Discussed in the NOI

The proposed discharges of air emissions through a 40 m stack from the plant at Kemerton are likely to be:

- between 35 000 - 40 000 tpa of carbon monoxide and carbon dioxide from the purification section;
- one to five (1-5) parts per million (ppm) of chlorine from the discharge of the chlor-alkali single scrubber system; and
- atmospheric gas emission from the air separation plant.

7.4.2.2 EPA Assessment on Normal Atmospheric Emissions

The Authority is aware that the normal atmospheric emissions from the proposed plant at Kemerton would be relatively low.

The proponent previously stated in the ERMP (p35) that the tail gases from the chlor-alkali plant scrubber would be between 1-5 ppm. The Authority believes that further pollution control equipment is required to reduce these emissions to less than one part per million and to increase the reliability and hence the safety of the pollution control systems.

(11) **The Environmental Protection Authority recommends that the proponent should install a chlorine scrubbing system on the chlor-alkali plant with sufficient back-up capacity to be able to absorb all of the chlorine produced at the full production rate for one hour.**

The Authority notes that appropriate air emission standards will be set under the works approval and licensing processes of the Environmental Protection Act 1986.

7.4.2.3 EPA Assessment on the Generation of Odours and Fugitive Emissions

The Authority believes that there should be no odours or fugitive emissions from the plant during normal operations. The proponent needs to have an objective to minimise the likelihood of fugitive emissions, from atypical conditions, to a frequency low enough to be acceptable to the Authority. In order to achieve this objective, the proponent needs to consider the matter of preventing fugitive emissions from the plant during the design stage of the HAZOP analysis.

7.4.2.4 Monitoring of Atmospheric Emissions

Monitoring of atmospheric emissions would be specified in the licence conditions under the provisions of the Environmental Protection Act 1986.

7.4.3 Solid Waste Disposal

As discussed in Chapter 4, the proposal at Kemerton in addition to the finishing plant operation at Australind would produce the following solid wastes:

- 266 tonne per day of material to be removed with 30% solids;
- a quantity of mildly radioactive waste; and
- domestic solid waste from the plant.

The NOI does not provide the details of how and exactly where the solid waste from the plant would be disposed. However, the document does state that this would be done off-site and most likely either at Capel or at a site east of the Wellesley River.

7.4.3.1 EPA Assessment of Non-Radioactive Solid Waste Disposal

Insufficient information has been provided by the proponent on the likely consequences of disposal of solid wastes. The proponent needs to resolve the matter of solid waste disposal to the satisfaction of the EPA.

(12) **The Environmental Protection Authority recommends that the Company's proposal for solid waste management and disposal from both sites be submitted to the EPA for assessment prior to completion of construction of the Kemerton plant.**

7.4.3.2 EPA Assessment of Mildly Radioactive Solid Waste Disposal

The Authority believes that the disposal site(s) for mildly radioactive solid waste should be approved by the Radiological Council.

(13) **The Environmental Protection Authority recommends that the disposal site(s) for solid waste, including that generated during concurrent operation of both plants, should be approved by appropriate Government agencies including the Radiological Council.**

7.4.4 Radioactive Waste Impacts

The ERMP (pp33-35) stated that due to the inefficiency of the mineral sand sorting operation, small quantities of radioactive mineral monazite associated with the feedstock typically display low levels of radioactivity. The document cited the following radioactive levels for ilmenite being processed by the sulphate-process:

- Thorium -228 0.40 becquerels per gram
- Radium -228 0.39 becquerels per gram
- Radium -226 0.07 becquerels per gram

The ERMP further stated that:

"Experience indicates that the only areas where the (radioactive) activity is concentrated above the level of the feedstock are in the chlorinator brickwork and bed, and isolated sections in the process equipment; the resultant typical activity levels are an order of magnitude greater than the feedstock." (ERMP p33)

The document then went on to say that:

"The potential for environmental impact from the activity entering the waste products can be assessed by considering two unlikely and hypothetical scenarios, where all the activity entering the plant reported to a particular waste product. These are discussed as follows:

- **Scenario 1 - all radiation to solid wastes:** Neutralization of the wastewater produced by the plant would result in 60 tonnes per day of a neutral solid waste, which would be recovered, following drying in infiltration ponds, for disposal by burial. If all the radiation in the feedstock entered this waste, the activity of the waste would only be two and a half times the activity of the feedstock. Even at these hypothetical levels, this material would not present any significant disposal problems, and a suitable disposal system based upon burial could easily be developed in association with the relevant authorities.

- **Scenario 2 - all radiation to wastewater:** All the wastewater produced by the plant and the water from the contaminant recovery programme would be combined into one stream prior to neutralization and disposal. The total quantity of wastewater would be 4 800 kilolitres per day.

If all the radiation in the feedstock entered the wastewater stream, the resultant radioactivity concentrations would be:

- Thorium -232 12 500 becquerels per kilolitre
- Radium -228 12 188 becquerels per kilolitre
- Radium -226 2 188 becquerels per kilolitre

To ascertain the significance of these levels in this hypothetical case, reference can be made to the concentrations of each radio-nuclide and published standards for drinking water quality, even though this is not normally a criterion used to assess wastewaters." (ERMP p34)

The document then concluded that:

> "At the concentrations predicted for the hypothetical scenario, this water would be comparable to water considered safe on the basis of exposure of slightly less than forty hours per week for the radium isotopes and of continuous exposure for the other radio-nuclides." (ERMP p35)

The Authority has previously sought the advice of the Radiological Council of Western Australia on this matter. The Council at that stage had informed the Authority that the paucity of information provided in the ERMP makes the assessment of the document's conclusions very difficult. However, the Council was satisfied that the radiological discharges from the plant could be managed if the Company prepares a radiation management programme to the satisfaction of the Radiological Council.

(14) **The Environmental Protection Authority recommends that a radiation management programme should be developed by the proponent for the commissioning and operation of the proposed plant to the satisfaction of the Radiological Council.**

The Authority's comments and recommendation regarding the mildly radioactive management of solid waste are discussed in Section 7.4.3.2 of this Assessment Report.

7.5 Environmental Impacts Due to Water Resource Extraction and Utilisation

The NOI states that the (fresh) process water requirement for the Australind site would be 6 250 kL/day including recovered contaminated groundwater, the expected freshwater requirement for the proposed plant at Kemerton would be approximately 4 500 kL/day.

The NOI lists a number of alternative water sources for obtaining the freshwater resource at Kemerton, including the following:

- reticulated water supplied by the State;
- surface water;
- shallow groundwater (to 30 m depth) and
- artesian groundwater (maximum depth 200 m).

While a preferred water supply option has not been selected, the NOI discusses the advantages and disadvantages of extracting groundwater. The major advantage being the cost effectiveness of this option. The proponent lists the following disadvantages associated with this option:

- shallow and deep groundwater sources beneath the company's 55 hectare site may not be sufficient to provide total water supply unless the borefield is extended east of the site;

- the likely extracted groundwater would have higher salinity than required by the company for process water. Hence the extracted groundwater would need to be treated prior to use in the process; and

- use of shallow groundwater may cause reduction of wetlands in the area.

The Authority believes that there are three matters which require assessment on this issue. These are:

- Is there adequate process water available for the proposed plant at Kemerton?

- Can that water be obtained in a manner such that adverse environmental impacts would not be experienced?

- Can that water be obtained such that the local existing and potential users of this resource are not unreasonably disadvantaged?

The EPA requested the Water Authority of Western Australia to investigate this matter and provide advice. The Water Authority's response to the EPA is as follows:

- "Fresh groundwater in quantities sufficient for industrial demands in the Kemerton area occurs mainly in the aquifers of the Leederville Formation which underlies the coastal plain between the Darling Range and the ocean.

  Groundwater in the Leederville Formation in this locality flows in a generally westerly direction and discharges into the ocean through a saltwater/freshwater interface.

  The groundwater throughflow in the Leederville Formation in the Kemerton locality has been determined to be 1 200 m^3/d. However, it is expected that abstraction from bores located in the Kemerton area will induce additional recharge from the overlying formations sufficient to support a draw up to 3 500 m^3/d as proposed for the smelter. If this expectation proves to be optimistic, it is considered feasible to locate additional bores north of the site and draw from possible excess availability in the zone of the Leederville Formation currently committed to provision of public water supplies for coastal development in the Binningup and Myalup area. The excess availability in this zone has been estimated to be 1 700 m^3d^{-1}." (Water Authority letter 22 May 1987)

- "It can be concluded that some local fresh groundwater can be made available to the project (about 3 000 m^3/d) at Kemerton but this will need to be in recognition that this will compromise groundwater availability to the smelter if it proceeds.

At the request of the Department of Resources Development, the Water Authority is currently investigating the feasibility and costs of alternative water supply sources for SCM at Kemerton involving combinations of surface and fresh and brackish groundwater sources.

The locality is proclaimed as a Groundwater Area under the Rights in Water and Irrigation Act, and any groundwater abstraction will be subject to licensing by the Water Authority." (Water Authority letter July 1987)

- "Water from some yet to be determined combination of fresh, brackish, surface and groundwater sources will be available to service the projects' water requirements. This water can be obtained in a manner which will be environmentally acceptable.

  As indicated earlier, the feasibility and costs of development of alternative sources is currently under investigation. Following a decision on a preferred source of water, the Water Authority will liaise with the Environmental Protection Authority regarding any need for EPA to seek further commitments from the proponent to ensure environmental acceptability." (Water Authority submission 10 July 1987)

Given the above, the EPA concludes that:

- adequate process water can be made available for the Kemerton proposal;
- this resource can be obtained in a manner which would have negligible impact on other existing and potential users of the water resource in the district; and
- while the EPA currently does not have adequate information to make an assessment, it believes that this resource could be obtained so as not to cause any adverse environmental impacts. However, the Authority would require that any proposal to obtain water for the plant undergoes an environmental assessment by the EPA.

(15) **The Environmental Protection Authority has been informed by the Water Authority of Western Australia (WAWA) that there is adequate fresh water available for the proposed plant at Kemerton.**

However, the EPA concludes that insufficient detail has been provided to enable the Authority to provide advice and make recommendations on water supply.

Accordingly the EPA recommends that the detailed water supply proposal be referred to EPA for assessment.

The Authority notes that the proposal for the Australind site required approximately 6 ML/day of fresh process water. However, the combined proposal at Kemerton and Australind will now require approximately a doubling of the previous freshwater requirement.

Similarly, the previous Australind proposal required disposal of 1 800 kL/day of wastewater. The Authority notes that the combined operation at Kemerton/Australind would now be discharging approximately 60% additional volume of wastewater.

The Authority believes that the proponent needs to manage the freshwater resource to achieve optimum utalisation as well as producing minimum wastewater requiring disposal.

7.6 OCCUPATIONAL HEALTH AND SOCIAL IMPACTS

7.6.1 Introduction

The following matters are identified for discussion in this section:

- matters which could affect the health or safety of personnel in the proposed SCM plant; and
- traffic impacts.
- noise?

7.6.2 Occupational Health and Safety

The EPA acknowledges that the responsibility for assessing the acceptability of risk levels within the proposed plant rests with the Commissioner for Occupational Health, Safety and Welfare (DOHSW). Accordingly, the Authority notes that the proponent needs to liaise with DOHSW.

7.6.3 Traffic Impacts

There would be traffic movement to and from the Kemerton site such as between the Kemerton and the Australind sites for the delivery of raw material and the titanium dioxide slurry, and for the transport of reagents, ie: sulphuric acid, caustic soda and titanium tetrachloride. The proponent has calculated the likely increase in traffic to the Australind site as an additional 15 600 movements per year.

The Main Roads Department's advice to the EPA on this matter is that:

> "Traffic movement increases are identified on Table 3.3 (of the NOI) as 15 600 movements per year. This has been compared with traffic south of Mandurah Bypass in Section 4.7 (of the NOI) since it was stated that no figures for traffic density were readily available for Old Coast Road through Australind, and a figure of 9 067 has been utilised as the existing annual average daily traffic (AADT).
>
> In the review of the ERMP for the Western Australian Aluminium Plant proposed for the Kemerton site in 1985 a traffic volume of 4 900 vehicles per day was estimated for Old Coast Road immediately south of Mariott Road, excluding any development at Kemerton, with an estimated heavy vehicle volume of 540 vehicles per day or 11% of the total.
>
> An increase of 15 600 vehicle movements per year equals 43 vehicles per day, adding 8% to the existing volume of heavy vehicles and increasing the overall proportion of heavy vehicles to 12% of the total traffic.
>
> Most of the additional 43 vehicles per day will utilise Australind Bypass according to Table 3.3, (of the NOI) however there will be an increase of 13.5 vehicles per day passing through Australind. In 1984 the traffic volume in Australind just north of Paris Road was 4 434 vehicles per day with 11% being heavy vehicles. Although there will be a reduction in traffic volumes through Australind when the bypass is completed, an additional 13.5 vehicles from the Kemerton Plant will still be only a small proportion of the total traffic.
>
> The effect on Old Coast Road of the increased heavy traffic from Kemerton will be minimal. No figures are given for increases in light vehicles however when compared to the total traffic volumes these increases will also be small, with no effect on Old Coad Road generally.
>
> There will be a requirement for some improvement to Mariott Road intersection, the level of improvement required will depend on the total volume of traffic turning into Mariott Road however an additional lane is likely to be required on the west side of the Highway as a minimum.
>
> Mariott Road will be the access road to the site from Old Coast Road. This road is under the control of Harvey Shire Council. However, the same comments are applicable to this project as were made regarding the Western Australian Aluminium Plant ERMP. Mariott Road is not suitable as an access road to the site because of poor sight distance at the Coast Road intersection and adjacent steep grades.
>
> This road should be relocated southwards between the Coast Road and the proposed plant site, and constructed to a standard suitable for the traffic volumes anticipated." (Main Roads Department submission)

The EPA accepts the Main Roads Department's conclusion that the effect on Old Coast Road of the increased heavy traffic from Kemerton would be minimal. The EPA notes the Department's comment that Mariott Road may not be suitable as an access road to the site and believes that this matter needs to be resolved if and when the Government gives approval for this proposal to proceed.

The other issue which needs discussion is the risk associated with transport of some reagents especially titanium tetrachloride.

The NOI makes the following comment on this matter:

> "The frequency of transport of titanium tetrachloride from Kemerton to Australind is low (average once per week) compared to the overall traffic density. The risk associated with such transport is also extremely low because of this low transport frequency." (NOI p30)

The Authority concurs with the proponent's assessment of the low risk associated with the transport of reagents. However, the Authority believes that transport of reagents, especially titanium tetrachloride, needs to be managed in an environmentally acceptable manner.

(16) The Environmental Protection Authority concludes that the transport of reagents, especially titanium tetrachloride, should be undertaken in a safe manner and recommends that the proponent undertakes appropriate transport safeguards and prepares a contingency plan to the satisfaction of the relevant Government agencies.

8. ASSESSMENT OF ENVIRONMENTAL IMPACTS AT THE AUSTRALIND SITE

8.1 INTRODUCTION

The EPA previously undertook a detailed assessment of the proposal at the Australind site (EPA Bulletin 275 May 1987). After the relocation of the chloride-process titanium dioxide plant at Kemerton, the following operations are proposed at the Australind site which require environmental assessment:

- construction of a larger (double the existing size) finishing plant at the Australind site;
- storage of reagents such as titanium tetrachloride would still be at the Australind site and require management in terms of risk and hazards;
- discharge of the same quantity, as previously proposed, of treated wastewater (4 800 kL/day) into the Collie River. However, the characteristics of discharged wastewater have changed (see Table 5). The proponent has provided additional modelling information discussing temperature impact of this wastewater on the Collie River;
- the continued use of the sulphuric acid plant at the Australind site; and
- the use of the redundant sulphate-process plant for alternative processes (in the future).

8.2 CONSTRUCTION STAGE IMPACTS

The Authority believes that the proponent needs to liaise closely with the relevant control agencies, including the Harvey Shire Council and the Leschenault Inlet Management Authority (LIMA) during the construction phase of the finishing plant at the Australind site to ensure that no issues arise, which could adversely affect the environment, especially of the Collie River, or inconvenience the local population.

8.3 RISK AND HAZARD IMPACTS

In Section 7.6.3 above, the need for the risk management of transporting titanium tetrachloride was discussed (see Recommendation 16). A small quantity of this material would be stored at the Australind site. While the risk associated with this storage would be very low, it still needs safeguards and management in terms of enclosed buildings for storage, etc.

(17) **The Environmental Protection Authority recommends that the safeguards required for the storage of titanium tetrachloride at the Australind site should be discussed with the relevant Government agencies and be taken into consideration into the HAZOP analysis.**

8.4 WASTEWATER DISCHARGE INTO THE COLLIE RIVER

The discharge of wastewater to the Collie River was previously modelled by Dr J.R. Hunter of Curtin University. The Authority reviewed this modelling study which predicted dilution factors for wastewater discharge into the river and showed likely temperature increase above ambient for summer and winter conditions.

In its assessment, the EPA noted that "Collie River flow can be lower than 1 m^3/sec and that the proponent needs to take this fact into consideration while designing the wastewater treatment and disposal system" (EPA Bulletin 275 p69).

The composition of the discharged wastewater compared with originally proposed wastewater in the ERMP has been provided in the NOI and is presented as Table 5.

Table 5. Composition of Discharged Wastewater Compared with Originally Proposed Wastewater and Seawater of Salinity 11.1 parts per thousand:

	Proposed Australind Wastewater (mgms per litre)	Stage II ERMP Wastewater (mgms per litre)	Seawater of Salinity 11.1 parts per 1000 (mgms per litre)
Chloride (Cl^-)	950	5791	6175
Sodium (Na^+)	3550	2405	3439
Calcium (Ca^{++})	470	1570	132
Sulphate (SO_4^-)	7900	1760	866
Magnesium (Mg^{++})	54	190	413
Manganese (Mn^{++})	1	84	1
Temperature	30^o - 32^o	35^o	-

Table 5 shows that chloride, calcium and magnesium and manganese ions would be reduced in the discharged wastewater as would the temperature. However, sulphate and sodium ions would increase. Except for the sulphate level, the final wastewater being discharged to the Collie River is comparable to diluted seawater.

The proponent has now submitted additional information in the form of a report on "Further Appraisal of a Proposed Discharge to the Collie River" by Dr Hunter. Where the previous 1986 Hunter report described the overall capacity of the Collie River to receive discharged dissolved matter, the new 1987 Hunter report addresses the problem of the dispersal of heat from the effluent and its effect on the river. The report concludes that:

> "under 'extremely low' (0.1 m^3/s) and 'low flow' (1.0 m^3/s) conditions, the region that is in excess of 2 deg. C above the ambient temperature, would never occupy more than 50% of the width of the estuary. Hunter (1986) showed that this warmer water would reside predominantly in the upper surface layer (of thickness approximately 1 metre). there appears to be little difference between the predicted temperature distributions for the three effluent mixes and hence little benefit in discharging the raw effluent diluted with groundwater. The predictions are somewhat different under conditions of average tidal currents and no tidal currents, but the areas of estuary warmed above 1 deg. C are roughly the same. In the former case the heated water is at various times distributed over a considerable length (2 500 metres) of the estuary, while in the latter case the warmed area is only about 500 metres long." (Hunter 1987 p9)

The Authority notes that previously the consultant discussed a reduction to ambient river temperature, following discharge into the Collie River, at a 10 metre radius distance from the outfall (Hunter, 1986). However, the Hunter (1987) modelling shows that this event would not be occurring until a distance further downstream and may require up to 50% of the width of the river until ambient river temperatures are reached during extremely 'low' and 'low flow' conditions.

The Authority previously stated that it believes that the wastewater discharge to the Collie River from the Australind site should conform with schedule 7(2) of the Department of Conservation and Environment Bulletin 103, 1981, Marine and Estuarine Water Quality Criteria for the Maintenance and Preservation of Aquatic Ecosystems. The details of beneficial use No. 7 and the quality criteria for schedule 7(2) were included as Appendix 8 of the previous Assessment Report of the Australind proposal. (EPA Bulletin 275 1986)

(18) **The Environmental Protection Authority recommends that the wastewater discharge to the Collie River from the Australind site conforms with the marine and estuarine water quality criteria in 7(2) of the DCE Bulletin 103 (1981) for the maintenance and preservation of aquatic ecosystems.**

Schedule 7(2) limits the receiving water temperature increase to 2^{o} above the normal ambient temperature of the surface water. However, this schedule does not quantify discharge concentration for levels of radioactivity, chromium, manganese, vanadium or suspended solids.

The above matters, including the need to monitor fish migration patterns for pre-discharge and post-discharge conditions, have been highlighted by the Leschenault Inlet Management Authority (LIMA) in its submission to the EPA. The Authority concurs with the LIMA comments but believes that these matters can be appropriately addressed as Licence Conditions under the Environmental Protection Act 1986.

The EPA makes the following recommendation regarding the monitoring required at the Collie River:

(19) The Environmental Protection Authority recommends that the proponent undertakes periodic wastewater monitoring including:

- temperature of the wastewater discharge and of the surface waters of the Collie River an appropriate distance upstream and downstream from the point of discharge;
- pH, total dissolved solids, level of radioactivity, levels of chromium and manganese, and total suspended solids of the effluent;
- baseline (that is pre-discharge) and post-discharge characterisation of the benthos of the Collie River in the vicinity of the outfall; and
- volume and velocity of flow of the Collie River under low flow conditions.

The proponent should develop a monitoring programme in consultation with the Leschenault Inlet Management Authority and for the approval of the EPA.

The EPA was previously concerned about the failure of the wastewater treatment system and the consequences of untreated wastewater being discharged into the Collie River. The Authority has the same concern about the wastewater treatment at the Kemerton site. Accordingly the EPA makes the following recommendation.

(20) The Environmental Protection Authority recommends that the proponent prepare a contingency plan at both the Australind and the Kemerton sites in consultation with the Leschenault Inlet Management Authority and to the satisfaction of the EPA, which addresses the management actions to be taken in the event of failure of any part of the effluent management or chemical containment and handling systems of the proposed plant as they may impact upon the Collie River or the Leschenault Inlet, or the ocean.

The Authority has undertaken an extensive review of the proponent's proposal to discharge into the Collie River. The Authority concludes that this discharge strategy appears to be appropriate and if managed properly should not cause any adverse impact on the Collie River.

The Authority, after undertaking its assessment, believes that the discharge into the Collie River should be environmentally acceptable. The Authority has also recommended a monitoring programme. However, if these monitoring results over the first year of operation show that adverse environmental impacts are being experienced in the Collie River, then the Authority will review an alternative wastewater disposal option, ie: through the existing pipeline, into the ocean.

(21) **The Environmental Protection Authority recommends that the pipeline across Leschenault Peninsula be maintained until monitoring results of wastewater effluent discharge to the Collie River demonstrate to the Authority's satisfaction that unacceptable environmental impacts have not occurred.**

8.5 ATMOSPHERIC EMISSIONS AND THEIR IMPACTS

In its previous Assessment of the Australind proposal (Bulletin 275, 1987), the EPA expressed concern about the emissions of sulphur dioxide (SO_2) from the sulphuric acid plant. After undertaking its assessment, the Authority concluded that SO_2 emissions from the acid plant were environmentally unacceptable and recommended that the sulphuric acid plant cease operation at the Australind site.

However, the proponent has proposed in the NOI that the acid plant should be allowed to continue at the Australind site because of the following reasons:

- continued use of the plant was an integral part of the negotiations for the Pigment Factory (Australind) Agreement and that the Agreement was predicated on the continued use of the acid plant;

- the acid plant is required as a source of stream for the finishing plant; and

- after the changeover, the plant will comply with relevant standards for gaseous emissions.

The Authority has taken into consideration the last point, ie: the acid plant would be complying with appropriate performance standards. The Authority believes that given the meteorology of the Australind site and the proximity of residential development, emission standards appropriate to the Australind plant need to be developed and complied with the proponent. The EPA has developed such a standard and believes that this standard should be conformed to between now and the end of the concurrent period in June 1990.

In the development of its standard, the Authority notes that the current emissions of SO_2 from the plant are far in excess of NHMRC/AEC standards which are written in terms of emissions per tonne of product. As such they do not properly address the environmental impact of the emissions.

Over the years SCM has been a source of complaints, especially for odours, particularly from residents of Australind. Monitoring, north of the plant, undertaken in 1974/75 indicated 24 hour average levels of SO_2 similar to generally accepted standards (eg: WHO 100-150 ug/m^3).

Modelling of the plume dispersion indicates that one hour average levels due to the acid plant in isolation would reach 500-600 ug/m^3 (Victoria 500 $m/^3$). Standards for SO_2 are set to reflect a steady and uniform distribution of the gas throughout the air, a situation which pertains several kilometres from a source. However, due to the proximity of the plant to residential areas (about 500 m), the one hour average level is likely to be a result of numerous short bursts of higher concentrations, with instantaneous levels over 1500 ug/m^3. It is these brief, high concentrations which cause discomfort to close-by residents.

The Authority recognises that the acid plant is able to comply with the emission standard for SO_2 set in 1984 by the then Air Pollution Control Council. This standard was set in recognition of the performance of the existing single pass plant and was expected to provide an appropriate ambient air quality. However, over the years SCM emissions from their plant has caused considerable discomfort to close-by residents.

The Authority believes that the current, major redevelopment proposals should provide an opportunity to improve the quality of the air environment for the local community. However, if the Australind plant can be operated during the period of concurrent use, so as to meet a more stringent air quality standard, the Government may wish to review the ongoing operation of the acid plant.

(22) **The Environmental Protection Authority recommends that the existing sulphuric acid plant and the existing sulphate-process plant (as described redundant in the ERMP) at Australind should not operate beyond 30 June 1990 (or at an extension of time determined under the Pigment Factory (Australind) Agreement 1986). Up until this time the EPA recommends the following guidelines apply to these plants:**

- **Until 30 December 1987, the sulphur dioxide emissions from the Australind plant should not exceed 1 000 micrograms per cubic metres averaged hourly; and**

- **from the 1 January 1988, and until the cessation of the concurrent operating period, the sulphur dioxide emissions from the combined Australind plant should not exceed 1 000 micrograms per cubic metres at any time in any residential area.**

OTHER ISUES

The Authority previously commented on the liquid effluent disposal on the Peninsula and recommended as follows:

(23) **The Environmental Protection Authority recommends that the management strategy for liquid effluent disposal on the Peninsula until 30 June 1990 (or an extension of time determined under the Pigment Factory (Australind) Agreement Act 1986) should maximise the use of existing lagoons and the reactivation of old lagoons so as to avoid further degradation of the northern end of the Peninsula.**

The suitability of the Company's Australind site has been compromised by adjacent residential and recreatiinal developments. In the Authority's view the Australind site is therefore an inappropriate site for the location of heavy industry, particularly if there are significant gaseous emissions from such industry.

(24) **The Environmental Protection Authority concludes that the existing Australind plant site is an inappropriate location for heavy industry.**

In May 1987 the Government announced that it would proceed with the development of the Kemerton Community Park concept and that a land use and development plan would be developed for this area. The Department of Conservation and Land Management will play a key role in the development of this management plan and it is therefore appropriate for the proponent to liaise with this agency.

(25) **The Environmental Protection Authority recommends that the proponent liaises with the Department of Conservation and Land Management to ensure that the Company's operation and Management Programme for the Kemerton plant site is compatible with the Management objectives developed for the Kemerton Community Park concept.**

9. ENVIRONMENTAL IMPACTS OF CONCURRENT OPERATIONS

Under the new Agreement Act, the existing sulphate-process plant would continue to be maintained and operated concurrently with the proposed chloride-process plant at Kemerton. During this period approximately 110 000 tonne of titanium dioxide would be produced at both the Kemerton and Australind sites until June 1990 (unless varied under the Agreement). This would entail for that year:

- the discharge of 5 000 kilolitres per day of treated wastewater from the chloride-process plant into the Collie River, 6 700 kilolitres per day of sulphate-process acidic wastewater on the Leschenault Peninsula and 2 700 kL of treated wastewater into the ocean (or through alternative disposal);

- a minimum air emission from the chloride-process plant and the existing air emissions of SO_2, NOX etc. from the sulphate-process plant at the Australind site;

- additional solid waste (mildly radioactive) needing disposal; and

- more than tripling of the existing heavy truck movements at Australind that year.

The Authority believes that some of these impacts, particularly noise and traffic, need close management during the concurrent operation year. These would be controlled through the pollution control licence conditions under the Environmental Protection Act 1986.

10. ENVIRONMENTAL MANAGEMENT AND MONITORING

The environmental assessment process in Western Australia places a great deal of emphasis on the management of environmental impacts and the monitoring of both the management programme and the impacts to ensure that appropriate steps are taken to ameliorate and minimise adverse affects.

10.1 ENVIRONMENTAL MANAGEMENT OUTLINED IN THE ERMP

The environmental management commitments made in the ERMP and the NOI are listed in Appendix 2 of this Assessment Report. The Company's key commitments to environmentally manage the proposal are:

- dust and noise during construction would be controlled, in consultation with the local authorities;
- the plant would be aesthetically designed and the site landscaped;
- all waste products would be safely disposed of;
- all appropriate safety features would be incorporated into the plant design;
- a Hazards and Operability (HAZOP) Study would be undertaken for the plant, and all personnel would be trained in safe work practices and emergency procedures;
- the proponent would undertake another risk assessment at the completion of the final design in order to confirm or improve upon the results presented by Cremer & Warner; and
- the effectiveness of these measures to protect the environment would be regularly monitored and, should unforeseen problems eventuate, these would be rectified in consultation with the responsible authorities.

10.2 ENVIRONMENTAL MANAGEMENT AND MONITORING PROGRAMME

At the time that the NOI was released, no decision had been made by the Company as to final plant design or details of treatment and disposal of wastes. Details of a monitoring programme were not provided although the proponent has made commitments to undertake management and monitoring of the project (see Appendix 2). Other matters needing consideration have been identified in this Assessment Report with recommendations that, as appropriate, the proponent submits regular reports to the Authority on environmental performance.

The EPA has recommended in this Assessment Report that it closely monitors the construction and operation of this proposal. Such close monitoring carries a cost. The EPA considers it reasonable that the Licence fees payable by the proponent should help to meet these costs.

(26) The Environmental Protection Authority recommends that the proponent be required to meet the reasonable costs associated with monitoring the environmental performance of the construction and operational phases of the Australind and Kemerton plants.

11. CONCLUSION

This Assessment Report is submitted to provide an environmental input to decision making on the proposed chloride-process titanium dioxide plant at Kemerton. In preparing this report, the Authority has considered a range of documentation and technical information and has been assisted by contributions from the public and other government agencies.

The Authority believed that from an environmental viewpoint, it was inappropriate to locate the previously proposed plant at Australind. From its investigations on the Kemerton proposal, the Authority has concluded that if a chloride-process plant is designed, commissioned and managed properly, and given the 2-3 km buffer zone at the Kemerton site, then it could meet the EPA's expectations of environmental performance.

The Authority identified the following three key issues regarding the proposal which required detailed assessment:

(i) Risks and hazards: The proponent proposes a chlorine storage of 100 tonnes in 3 x 50 tonnes storage vessels (1 empty on stand by). However, a preliminary risk analysis undertaken by Cremer & Warner Ltd and submitted by the Company was for 50 tonnes chlorine storage (as 2 x 25 tonnes vessels). The Authority commissioned the NSW Department of Environment and Planning (DEP) to calculate the likely risk levels associated with the Company's proposal and to verify the Cremer & Warner modelling for the proposed plant with 50 and 100 tonnes of storage. DEP has informed the Authority that risk levels presented in the NOI are of the right order of magnitude for 50 tonnes storage of chlorine. Given that these levels comply with EPA guidelines the EPA finds the risk levels for the proposed plant with 50 tonne storage (as 2 x 25 tonne vessels) of chlorine to be so low as to be acceptable to the Authority. However, the EPA finds the 100 tonne storage of chlorine at Kemperton to be unacceptable.

(ii) Wastewater disposal into the Wellesley River: The Authority's investigations and advice from a number of organisations and experts show that this proposed method of wastewater disposal would be environmentally unacceptable. However, the EPA has investigated a number of alternative disposal options including ocean disposal. The Authority's conclusions are that some of these disposal options, particularly ocean disposal, should be able to be made environmentally acceptable.

(iii) Availability of process water for plant utilisation: The Authority has been informed by the Water Authority of Western Australia that water is available and can be provided to the Company without adverse environmental impacts and in a manner such that local users will not be disadvantaged. However, this matter would require further environmental assessment by the EPA.

After undertaking its assessment, the Authority makes the following conclusions:

- The Kemerton site for a 70 000 tpa chloride-process plant can be made environmentally acceptable.

- The risk levels for 100 tonne storage of chlorine is unacceptable to the Authority. However, the risk levels for 50 tonne storage is acceptable if stored in 25 tonne storage vessels.

- The EPA has been informed by the Water Authority of Western Australia (WAWA) that it can make available sufficient water for the Company without detrimentally affecting the existing users. The EPA does not have sufficient detail to give advice on the environmental acceptability of supplying the proponent's water requirements at Kemerton.

- The EPA's requirements in terms of safeguards for the Kemerton proposal should be the same as those required for chlorine production at Kwinana.

- The Authority's investigations have shown that the Company's saline wastewater discharge into the Wellesley River would be environmentally unacceptable.

- On the basis of preliminary investigation of alternative wastewater disposal options, the Authority concludes that piping of the treated saline wastewater to the ocean could be made environmentally acceptable.

Given the above, the Authority believes that the proposed plant at Kemerton can be made environmentally acceptable.

The Authority has reiterated its earlier recommendation that the existing sulphuric acid and sulphate-process plants should not operate beyond 30 June 1990 (or at an extension of time under the Pigment Factory (Australind) Agreement Act 1986).

During the period of concurrent operations of the sulphate-process plant (Australind) and the chloride-process plant (Kemerton), the EPA has recommended environmental performance guidelines for air emissions at Australind. This will enable the Government, should it so wish, to consider the merits of operation of the sulphuric acid and the redundant sulphate process plants at Australind beyond 30 June 1990 in the context of the Company's overall environmental performance.

There are a number of other issues which have been assessed and discussed in this Assessment Report. The general conclusion is that these can be managed such that the proposal is environmentally acceptable.

The Authority would require regular reporting from the proponent on the Company's management and monitoring programme and would review and assess these reports in consultation with relevant interested bodies.

The Authority concludes that the proposed chloride-process plant at Kemerton is acceptable on environmental grounds subject to compliance by the proponent with commitments given (as listed in Appendix 2 of this Assessment Report) and subject to the adoption and implementation of the Authority's recommendations.

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13. ACKNOWLEDGEMENTS

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Bunbury Region

- Harvey Shire Council
  (both Councillors and staff especially Mr Charles Lockwood)
- South West Development Authority
- Leschenault Inlet Management Authority
- Leschanault Action group

Government Agencies

- Waterways Commission
  (Mr Rob Atkins)
- Water Authority of Western Australia
  (Messrs Chris Fitzharding and Harry Ventriss)
- Department of Agriculture
  (Mr Ross George)
- Department of Resources Development
  (Mr John Prior)

Interstate

- NSW Department of Environment and Planning
  (Mr Len Gawaski)

Others

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Mr Bill Pradhan, Senior Environmental officer - Evaluation Division, was the EPA officer who co-ordinated and managed this Assessment

APPENDIX 1

This appendix contains the List of Government Departments and others (including individuals and groups) who have made submissions, to the EPA, on this proposal.

A total of 38 submissions were received, 14 from Government departments and 24 public submissions.

In addition, approximately 150 persons attended the public meetingheld on 2 July 1987, the taped transcripts of which have been used as submissions.

LIST OF SUBMISSIONS

Government Agency Submissions

Director of Agriculture
Western Australian Department of Agriculture

General Manager
South West Development Authority

Acting Director
Government Chemical Laboratories

Acting Chairman
Leschenault Inlet Management Authority

Department of Occupation
Health and Welfare

Director
Waterways Commission

Department of Conservation and Land Management

Main Roads Department

Water Authority of Western Australia (four submissions)

Shire Clerk
Harvey Shire Council

State Planning Commission

Public Submissions

J Rose Burekup	M Johansen Eaton	J Evans Australind
M & M Smith Australind	P Eckersley Leschenault	J Reading Brunswick
J Tunstill Australind	R & A Whitehead Leschenault	T Salom Brunswick Junction
G Tothill Binningup	R Ridley Australind	J Salom Brunswick Junction
M Salom Brunswick Junction	B Ridley Brunswick Junction	J Salom Brunswick Junction
C Salom Brunswick Junction	R Mifflin Brunswick Junction	S Mifflin Brunswick Junction
T & T Salom "The Gunyah"	G & S De Chaneet Leschenault	P Rutherford Australind
B. James Leschenault	E. James Leschenault	Leschenault Action Group Leschenault

APPENDIX 2

Management Commitments made by the Proponent in the ERMP, in the proponent's response to issues raised in submissions and to issues raised by the EPA, and in the Notice of Intent (June 1987).

ENVIRONMENTAL COMMITMENTS

NB. * indicates modifications or additions proposed in Notice of Intent (June 1987).

* Owing to the changed scope of the plant and split location, all the management commitments made in the Stage II ERMP are not necessarily relevant. There also need to be further commitments made for the management of the environment in the Kemerton area.

1. CONSTRUCTION (S 10.2, ERMP)

- During the construction phase of the project, the proponent would liaise with local authorities to ensure that noise, dust and traffic impacts were minimised.
- All construction materials and practices would be in accordance with the relevant Australian or international codes.

2. OPERATION (S 10.3, ERMP)

The proponent has made the following commitments to environmental management during plant operation:

2.1 Wastewater:

- The vegetation on the banks of the Collie River adjacent to the plant would be regularly monitored.
- Surface runoff from the plant would be controlled.
- Regular monitoring of the discharge to the Collie River would be implemented to ensure that the system operated as predicted.

* . Waste waters can be appropriately discharged, after suitable treatment, to the (Wellesley and) Collie River(s).

- No wastewater will be infiltrated at the site. The proponent will be filtering the thickener underflow to reduce its water content and disposing of the filtrate with the balance of the wastewater.
- The proponent gave a commitment to alter the wastewater treatment process to reduce manganese levels to concentration of the order of parts per million.

- The alkalinity of the wastewater will be raised to about pH 9.0 in order to precipitate manganese and heavy metals, although the latter are not expected to be present in significant quantities. The pH of the wastewater would then be adjusted to neutral level prior to disposal.

- The lime treatment used to neutralize the wastwater is known to cause effective precipitation of the radionuclides under consideration. The modified wastewater treatment process to remove manganese will further remove radionuclides to levels much less than those discussed in the ERMP.

- The proponent will regularly monitor the wastewater discharge and bed sediments in the Collie River for radionuclides; to assure the relevant authorities that the proposed disposal practice does not cause an unacceptable accumulation of radionuclides.

- Special consideration will be given to controlling the impact of temperature upon marine (aquatic) organisms.

- Commitments have been given to further modify the wastewater treatment should problems be detected. This monitoring will include analysis for heavy metals, even though these are not expected to be present in significant quantities.

* - The vegetation on the banks of the Wellesley River, adjacent to the confluence of the wastewater drain, would be regularly monitored.

* - Regular monitoring of the wastewater discharge from the Kemerton site would be implemented to ensure that the system operated as predicted.

2.2 Aesthetics/Noise/Odour:

- On-going control of dust would be implemented.

- Noise levels within the plant would be in accordance with statutory requirements.

- The plant site would be attractively landscaped, and buildings would be aesthetically designed.

- There should be negligible odour impact to surrounding residential areas arising from the proposed development.

- Odours would not originate from the proposed plant during normal operation.

2.3 General:

- The plant would undergo regular preventative maintenance.

- All waste products would be disposed of in an environmentally safe manner and in accordance with statutory requirements.

- A detailed final risk analysis would be undertaken in conjunction with the plant designers to confirm or improve upon the recommendations made in the risk assessment (Cremer & Warner, 1986) (See also Sections 4 and 5).

- A full hazards and operability study would be commissioned, and plant personnel would be trained in safe operating practices and emergency procedures. Training would be based upon the extensive experience available to the proponent from the existing Australind operations and chloride-process plants operating in the United States of America and the United Kingdom (see also Sections 5 and 6).

- All wastes would be regularly monitored for radio-nuclides.

- A centralised control policy would be implemented, whereby no changes to plant detail could be made until approved by the proponent's worldwide Central Safety Department.

* - Groundwater extraction from any surficial aquifiers would be conducted in such manner to avoid significant environmental impact on wetlands and their associated vegetation.

- The proponent will advise the EPA of their decision on a chlor-alkali plant operator as soon as this is decided.

3. SAFETY FEATURES (S 10.4, ERMP)

* The newly proposed plant will still contain tried and proven control technology and will still remain a very modern safe plant, equivalent to the latest installations effected elsewhere in the world by SCM.

The safety features that would be incorporated into the plant are summarised as follows:

3.1 Chloride-process plant:

- Design and operation of titanium tetrachloride vaporiser and oxygen preheater in accordance with the British Standard BS 5885 (British Standards Institution, 1980).

- Duplication and frequent replacement of temperature and pressure-sensing instrumentation in the chlorination section.

- Careful process control, accurate temperature and pressure monitoring, even water-cooling of chlorinator and prevention of solids build-up in the overhead mains.

* - Maintenance and cleaning of heat exchangers will be done in a well ventilated open area on a concrete pad whose run-off is directed to the wastewater treatment plant.

- Duplication and frequent routine replacement of sensors in the oxidation section.

- Reliable logic system to control reactor trip system.

- Provision of double remote acting block valves to isolate all chlorine pumps.

- Provision of an on-line scrubbing system for the 'hygiene snake' system (proprietary equipment), and scrubbing system stacks to be 46 metres high.

3.2 Chlor-alkali plant:

- Automatic tripping of direct current power to the membrane cells.

- Duplication of pumps, provision of back-up emergency power supply and appropriate instrument monitoring of the chlorine absorption plant.

- Plant design to the standards of the Chlorine Institute (United States) and the Bureau International Technique du Chlor (Europe).

- Gravity feeding of brine from storage tanks to membrane cells.

- Monitoring of brine feed to individual cells.

- Fitting of brine head tanks to cells to maintain differential pressure across the membrane in the event of sudden loss of brine flow.

- Installation of emergency buttons in the cell room; controlled shut-down of chlorine manufacturing and liquefaction facilities.

- Provision of a back-up absorption column.

- Minimum instrumentation of absorption unit to consist of monitoring alarms for caustic concentrations and flows, chlorine concentration in the vent streams, low caustic levels in recirculation tanks and high temperature in the column(s) liquor.

- Height of absorption unit column to be 46 metres.

- Absorption unit that allows for electrical voltage fluctuations and power failures; provision of a diesels generator as a back-up to drive the caustic recirculation pumps and extraction fans.

- Provision of double remote acting block valves to isolate all chlorine pumps.

3.3 Storage:

* - Total storage capacity of approximately 100 tonnes of liquid chlorine as intermediate storage between the two process plants with average storage of 50 tonnes.

- Design of storage vessels and supports to withstand the worst foreseeable earthquake loading.

- Fully refrigerated liquid chlorine storage at -34°C.

- Insulation of storage vessels, and operation at ambient temperature.

- Except for a blanked drain connection, no bottom connections on the chlorine storage vessels.

- Elimination of the possibility of hydrogen/chlorine explosions in chlorine storage tanks by appropriate design of the membrane cell plant.

- Liquid chlorine will be pumped to the storage tank at -34°C and maintained at that temperature by withdrawing vapour to the hypo scrubber, thereby making storage temperature maintenance independent of refrigeration plant failure.

- Installation of remotely-operated valves on the liquid chlorine line from the liquefiers to the storage area, and the main chlorine connection on each tank, these being able to be operated either locally, from a safe location or from the control room.

- Design of storage vessel instrumentation and relief facilities in accordance with recognised codes of practice (eg Bureau International Technique du Chlor).

* . Chlorine storage tanks will be individually bunded to full height with concrete bunds.

* . The bunds will be lined with insulating tiles to prevent rapid heat transfer from the bund to the liquid chlorine.

* . Foam suppression - foam generators will be installed in the titanium tetrachloride and chlorine storage areas to provide a stable insulating barrier on top of the chlorine to suppress gas evolution.

* . Isolating valves will be installed on the main storage tanks, as well as excess flow check valves.

. Provision of double remote acting block valves to isolate all chlorine pumps.

3.4 Layout:

. Location of air separation plant away from titanium tetrachloride storage areas.

. Location of hydrogen away from chlorine compression and liquefaction areas.

. Location of liquid chlorine and titanium tetrachloride pipelines away from the bottom rung on pipe tracks, particularly across roads;
. Protection of storage vessel areas by traffic barriers (kerbing).

. Design of layout such that cranes may remove items for maintenance without having to lift over storage vessels.

. Design of plant such that close coupling of each section to minimise chlorine inventory is ensured.

3.5 Maintenance:

. Preventative maintenance scheme to replace vulnerable equipment before a failure becomes likely.

. Clearing and testing of the chlorine sensor in the tail gas line once per eight-hour shift, with provision to inject caustic into the scrubber, should chlorine be detected.

. Regular and frequent maintenance and testing of all sensors as required by service duty.

3.6 General:

- Use of a non-explosive grade of coke.
- Use of corrosion monitoring techniques such as ultra-sonic thickness surveys.
- Design of fuel management system in accordance with BS 5885 (British Standards Insitution, 1980) on prevention of explosions.
- Ability to operate plant from the control room for sufficient time to enable safe shut-down from there.
- Installation of chlorine detectors at appropriate points of the plant site.

4. EMERGENCY PLAN

* . The proponent's emergency plan and procedures will be integrated with the proposed State Emergecy Services' Bunbury Regional Counter Disaster Plan.

- The proponent will afford all practical co-operation in the formulation of public emergency and contingency plans.

5. MONITORING AND AUDITING (S 10.5, ERMP)

- Regular safety audits would be conducted to monitor the effectiveness of the proponent's commitments to safeguard people and property, and to ensure that they were being completely executed.
- Hazard and risk management programmes are in place at all sites and are monitored and audited currently by the Manager - Loss Prevention in Baltimore. A similar comprehensive programme is being developed for Bunbury, modelled substantially on the well-proven Stallingborough system.
- Significant interchange of appropriate personnel will be required during development of the programmes. Performance thereafter will be audited by Baltimore on a regular basis for hazard, safety and industrial hygiene management standards, as for existing sites.

- A further external audit on operations will take place via a system of "Permission for Change" which operates already on our existing plant, whereby all significant process changes are notified formally to Stallingborough, prior to implementation, for technical and hazard review. No changes are implemented without formal approval from the Hazard and Risk Manager at Stallingborough.

6. TRAINING

- Overseas training will take place at all levels down to, and including Supervisor/Foreman.

- Senior operator and Shift Supervisor training has commenced locally, utilising 27 and 18 week courses specifically designed in conjunction with Bunbury TAFE.

- Standard operating, process control, maintenance and safety procedures are being developed in conjunction with our Stallingborough and Baltimore site personnel. Full procedure manuals are available from all existing sites and a set of Bunbury specific manuals will be developed well prior to start up, to facilitate training.

7. DECOMMISSIONING (S 10.6, ERMP)

Unlike a mineral development project whose life-span is limited to the period over which a particular resource can be exploited, the proposed plant does not have a planned operational life, although the proponent estimates this to be at least fifty years.

Decommissioning might simply involve the plant being used for other purposes, in which case, another environmental impact study would be required; or could involve dismantling and removal of the facilities from the site.

APPENDIX 3

"Brief Environmental Appraisal of the plant site (at Kemerton) and Wellesley River".

Prepared by Kinhill Engineering Pty Ltd and presented to the EPA as further information by SCM Chemicals Ltd as an addition to the Company's Notice of Intent.

SCM CHEMICALS LTD

PROPOSED CHLORIDE PROCESS TITANIUM DIOXIDE PLANT AT KEMERTON

BRIEF ENVIRONMENTAL APPRAISAL OF THE PLANT SITE AND WELLESLEY RIVER

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1 STREAMFLOWS AND SALINITIES

The Wellesley River drains the Kemerton site and a large portion of the Harvey irrigation area (together with the Harvey River and the Harvey diversion drain). It forms a tributary of the Brunswick River which is a further tributary of the Collie River.

Streamflow records for the Wellesley River are not readily available. However, experience with other rivers' draining irrigation areas has shown that flows are highly seasonal, varying from reliably high winter (April-October) flows to low summer flows resulting from the release of irrigation water.

Typically, the lowest flows occur at the start of the irrigation season (October-November) or at the finish of the irrigation season (late April).

As part of the assessment for the proposal to establish the chloride process on SCM Chemicals Ltd land at Australind, the Water Authority has measured streamflows in tributaries of the Collie River during late March, April and May 1987 including the Brunswick River, immediately downstream of the confluence with the Wellesley River. Results of those measurements are given in Table 1.

Table 1 Measured streamflows in Brunswick River (Q612 1108)

Date	Streamflow (m^3/s)
23 March 1987	0.546
1 April 1987	0.773
8 April 1987	2.366
15 April 1987	0.384
23 April 1987	0.550
29 April 1987	0.614
6 May 1987	0.389
13 May 1987	0.534
20 May 1987	0.232

The average streamflow in the Brunswick River during the period 23 March 1987 to 20 May 1987 was 0.71 m^3/s while the lowest recorded flow was 0.232 m^3/s, which represents about 32% of the measured average streamflow.

Visual observations have indicated that at the streamflow measuring point (Q612 1108), the contribution from the Wellesley River is about 50% and this is supported by a comparison of the approximate areas under irrigation in the

catchments of the Wellesley and Brunswick Rivers. Therefore, at this stage, it is reasonable to assume that low flows in the Wellesley River would average about 0.36 m^3/s and would occassionally (for periods of 1 to 3 weeks) be as low as about 0.12 m^3/s.

Detail salinity records for the Wellesley River are also not available. However, as most of the catchment comprises irrigated pasture, it would be reasonable to assume that winter flows would be of good quality (less than 500 ppm TDS). One sample (taken late May 1987) was tested at pH 7.3 and a salt (sodium chloride) concentration of 1,690 p.p.m., together with the following:

. Manganese	380	p.p.b.
. Chromium	4	p.p.b.
. Zinc	<20	p.p.b.
. Nickel	<1	p.p.b.
. Aluminium	350	p.p.b.

Therefore, it is evident that the water quality deteriorates during low flows, particularly in relation to salt. The upper limit of salt concentration that is generally accepted for irrigation water is 1,500 p.p.m. and therefore the Wellesley River would only be marginally suitable as a source of water during low flow periods.

Based upon the measured water quality in the Wellesley River, the proposal to discharge 2,700 kL/d (0.031 m^3/s) of wastewater with a TDS of about 14,500 p.p.m. will have the following impact upon water quality:

- during average low flow conditions, the streamflow will increase by about 10% and the TDS will increase by about 60% to about 2,700 p.p.m.;

- during minimum low flow conditions, the streamflow will increase by about 25% and the TDS will increase by about 155% to about 4,300 p.p.m.

During winter flow conditions, the combination of increased flows and lower salinity should ensure that the combined TDS will be less than about 500 p.p.m.

2 POSSIBLE IMPACT ON FLORA AND VEGETATION

2.1 PLANT SITE

Natural vegetation at the proposed site for the plant has been previously cleared and is now regenerating. It was most likely originally a mixture of woodlands including Jarrah (E. marginata), Banksia spp. and Blackboy (Xanthorrhoea preissii). Allocasuarina fraserina was possibly also present at the western end of the site. Some of the many shrub species regenerating since the removal of stock include Kunzea vestita, Jacksonia furcellata, Hibbertia vaginata, Pericalymma ellipticum and Hibbertia hypericoides. Regrowth of Jarrah, Blackboy and some Marri (Eucalyptus calophylla) has also occurred. Since the vegetation of the site has already been considerably disturbed, the siting of the plant in this area has a very reduced impact on the vegetation. However, as the natural vegetation is regenerating rapidly, it is apparent that many root stocks still remain in the soil.

No gazetted rare or geographically restricted plants were observed on the site, but a well documented population of Pultenaea skinneri occurs on the southern side of the corner of Marriott Road adjoining, and just north of the large swampland.

2.2 THE IMPACT OF WASTE WATER DISPOSAL

The disposal of waste water from the plant may have long term implications for vegetation communities fringing the Wellesley River.

Drains carrying undiluted wastewater at concentrations of up to 12,800 p.p.m. TDS need to be carefully constructed so as to ensure that water of this quality is not allowed to infiltrate the existing water table, nor to come into continuous contact with plant species intolerant to high salinities.

The dilution of waste water with the waters of the Wellesley River is estimated to produce a river flow containing an average maximum salt concentration of 3,000 p.p.m. during low flows with a two week period of levels up to 4,000 p.p.m. once or twice during the year. Time and access constraints prevented a survey of plant species fringing the Wellesley River except for an area which could be examined from the Marriott Road bridge. At this site, and probably for a large part of the lower reaches of the river, the main species were Eucalyptus rudis and Melaleuca rhaphiophylla. A study of aerial photographs of the downstream portion of the Wellesley indicates stands of similar species for a distance of 2.5 km.

Little information is available on the tolerance of these species to salinities of up to 3,000 p.p.m. over long periods of time. It is thought however, due to general knowledge of other rivers, that neither species would be adversely affected by the proposed increase in salinity. Trees of Melaleuca rhaphiophylla on the Canning River near Mt Henry Bridge survive where the water becomes

seasonally brackish and in the estuarine environment of the lower reaches of the Swan River (E.M. Mattiske, pers. comm). E. rudis has also been seen to tolerate low levels of salinity but no long term monitoring or controlled experiments on the ability of plants to withstand such conditions has been carried out. Species known to grow well down from the proposed wastewater outlet, below the junction of the Brunswick and Collie Rivers tolerate far higher levels of salinity than will be produced. These species, Casuarina obesa and Melaleuca hamulosa, would obviously not be affected by wastewater discharge.

3 POSSIBLE IMPACT ON FAUNA

3.1 SITE INSPECTION

The site was inspected on 6 June 1987.

The plant site has been cleared and planted to pasture for appoximately ten years. Considerable regrowth has occured. Most of the site is well drained. To the west and south of Lot 22, exist large areas of native vegetation. Cleared farmland exists to the north and west of Lot 22 (over Marriott Road). The Department of Conservation and Land Management is presently planting pines on Lot 21 in accordance with the 'Conceptual Land Management Plan' (Forests Department 1985).

The drain in Lot 21 flows south, under Marriott Road, through Lot 40 and 41, then into the Wellesly River. A small drain runs north from the swamp on Lot 40 into this drain.

3.2 PREVIOUS BIOLOGICAL SURVEYS OF THE KEMERTON AREA

A number of fauna studies have been conducted in the Kemerton area.

The first set of fauna surveys were conducted for Alcoa when they were considering the site for the location of a aluminium smelter. Nichols (1980) conducted a brief survey of the site. This was followed by more detailed surveys of the invertebrate (Bunn 1982) and vertebrate fauna (Bamford and Watkins 1983) of the Kemerton wetlands. These surveys emphasized the conservation value of the wetlands. The fourth survey examined the amphibian and reptile of the Kemerton site (Watkins 1983).

Most of this information has been reviewed in the ERMP for the Western Australian Aluminium Plant (1984). in their review of the document, the EPA recognized the wetlands to be 'regionally valuable habitats for fauna' (DEC 1985).

Other studies conducted at the time of the ERMP, for the transmission line interconnections (Dames and Moore 1985) and a land management plan (Forests Department 1985). As part of this proposal, an additional fauna survey was conducted (Ninox 1985).

Fauna surveys of the Kemerton area have recorded a total of:

- 8 species of amphibian
- 17 species of reptiles
- 79 species of birds
- 12 species of mammals.

(This is a provisional list as a copy of the Ninox (1985) report was not sited).

None of these species are gazetted as 'rare and endangered'.

The occurance of one species, the Honey Possum (Tarsipies rostratus), is note worthy because Kemerton is the only location of this species on the Swan Coastal Plain between Bussleton and Byford (Watkins 1983). The records of this species were overlooked by the Aluminium Plant ERMP.

The high species diversity of the Kemerton area is due to the number of wetlands and low level of disturbance of the bushland. The areas of pasture make only a small contribution to the conservation value of the area.

3.3 ASSESSMENT OF POTENTIAL IMPACTS

The proposed development would have two impacts on the native fauna; habitat loss on the construction site, and habitat alteration due to liquid waste disposal.

Habitat loss on the construction site would not be of major concern because of the degraded nature of the vegetation caused by farming and secondly, the proposed planting of the area to pines. Providing the large areas of natural vegetation in the area are maintained and appropriately managed, the areas' fauna will be retained.

It is presently proposed to pipe wastewater into the drain on Lot 21 which flows into the Wellesley River. From this point, the wastewater would flow downstream for approximately 12 km where it would enter Leschenault Inlet.

The impacts of the wastewater on the waterway can be divided into three zones:

a) high impact area - drain through famland - caused by volume, salinity and temperature;

b) medium impact area - Wellesley River - caused by volume and salinity in summer months;

c) low impact area - Brunswick River, Collie River and Leschenault Inlet.

The EPA has found that the liquid waste disposal into the Collie River proposed at the Australind site to be environmentally acceptable (EPA 1987). Their approval is based on a wastewater modelling study and water quality criteria. The EPA approval implies that their would be minimal environmental effect on the Collie River and Leschenault Inlet.

Wastewater would impact on the native fauna in the vicinity of the Wellesley River through changes in water quality and due to pressure changes in vegetation along the waterways. Establishment of details on the effects on native fauna and the signficance of these changed would, however require further study.

Attention would need to be given to the drain which runs into the swamp on Lot 40 to prevent the inflow of saline into this wetland.

3.4 CONCLUSIONS

From a brief fauna survey, it can be concluded that:

- Construction of the plant on Lot 22 would have minimal impact on the native fauna;
- A buffer zone should be incorporated in the development plan between the plant and the native vegetation to the west and south of the site;
- Liquid waste disposal is the environmental impact of most concern of the development. As it is presently proposed, it is likely to have some impacts on the fauna utilizing the drain on farmland and may have an effect on a length of the Wellesley River.
- Attention would need to be given to preventing contamination of the swamp on Lot 40 by wastewater.

4 REFERENCES

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APPENDIX 4

Mr G DIMMOCK'S REPORT to the EPA on the environmental consequences of the rise in the background salinity of the Wellesley River on the surrounding native vegetation.

CSIRO

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9 July 1987

Mr R A Field
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Dear Sir

PROPOSED SCM CHLORIDE PROCESS TITANIUM DIOXIDE PLANT AT KEMERTON

Please find enclosed a report prepared in conjunction with Mr R P Atkins of the Waterways Commission, on the possible effects of saline effluent on the vegetation along the Wellesley River.

There appears to be a significant risk that both Eucalyptus rudis and Melaleuca rhaphiophylla, the major tree species of the fringing woodland along the lower reaches of the river, may be stressed or even killed if the stream salinity is increased by effluent discharge from the proposed titanium dioxide plant at Kemerton.

The report may be quoted whole or in part if required.

Yours faithfully

G M Dimmock

G M DIMMOCK
Senior Experimental Scientist

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Effects of Saline Effluent on the Fringing Vegetation of the Wellesley River at Kemerton

In its proposal to locate a chloride process titanium dioxide plant at Kemerton, SCM Chemicals Ltd has a preferred option to dispose of highly saline plant effluent waters by discharging them into the Wellesley River. This report is concerned with the possible effects of the saline effluent on the fringing vegetation of the river downstream from the discharge point near the Marriott Road bridge.

The site was visited on 26 June 1987 and an inspection made on foot of the river and its fringing vegetation for about 500 m downstream from the bridge. The river occupies a narrow meandering course entrenched in a floodplain which in the lower reaches is up to 250 m wide. In the area visited, the floodplain carries a woodland vegetation consisting of two main species, Eucalyptus rudis and Melaleuca rhaphiophylla, with minor occurrences on the inland edge of Melaleuca preissiana and Astartea fascicularis. Small areas of the rush, Bolboschoenus cardwellii, were present near the stream bank. Based on a study of the aerial photographs, apparently similar vegetation continues to within about 1 km of the junction with the Brunswick River. This was confirmed with a visit by R P Atkins to Salom's farm on 6 July 1987. At this site, B. cardwellii was quite extensive in open patches within the woodland.

The discharge of saline effluent into the river may affect the vegetation in two ways:

(1) Trees growing immediately along the banks are likely to be most directly affected by increases in the salinity of the stream water.

(2) Trees growing further inland on the floodplain may receive periodic inundations from high flows either in winter or during flash storms in summer. In the latter case, water of maximum salinity, resulting from a combination of the normally higher summer salt concentrations and minimum dilution of the effluent, will be flushed across the floodplain and deposited on the soil surface and in shallow pools and billabongs. Subsequent evaporation will add to the store of salt in the soil and successive inundations over a number of years may cause this to build up to levels toxic to the vegetation. No information is available on how long it would take for this to happen. However it is understood that similar considerations have arisen in the disposal of environmental contaminants from uranium mining at Jabiru in the Northern Territory. Some modelling has been done on the mechanisms for disposal of toxic materials from the floodplain of Magela Creek and although the soil and climatic conditions at Kemerton are totally different, some general principles may apply. However, there was insufficient time to obtain this information.

Although the two principal tree species, Eucalyptus rudis and Melaleuca rhaphiophylla, are reported to be salt tolerant, recent work by Pepper and Craig (1986) indicates that E. rudis is in fact salt sensitive and has a low survival rate in saline soils. In a field experiment conducted over 8 years on a site 20 km east of Brookton, the species showed poor health and vigour at soil salinities greater than 1000 mSm^{-1} (equivalent to approximately 5970 mg L^{-1} NaCl in a saturation extract of the soil (Richards 1954, p.12)). This information is difficult to apply directly to the situation along the floodplain of the Wellesley River, but if the salinity of the streamwater under minimum low flow conditions is increased to 4300 mg/L as estimated by the propenent (SCM Chemicals Ltd, NOI, June

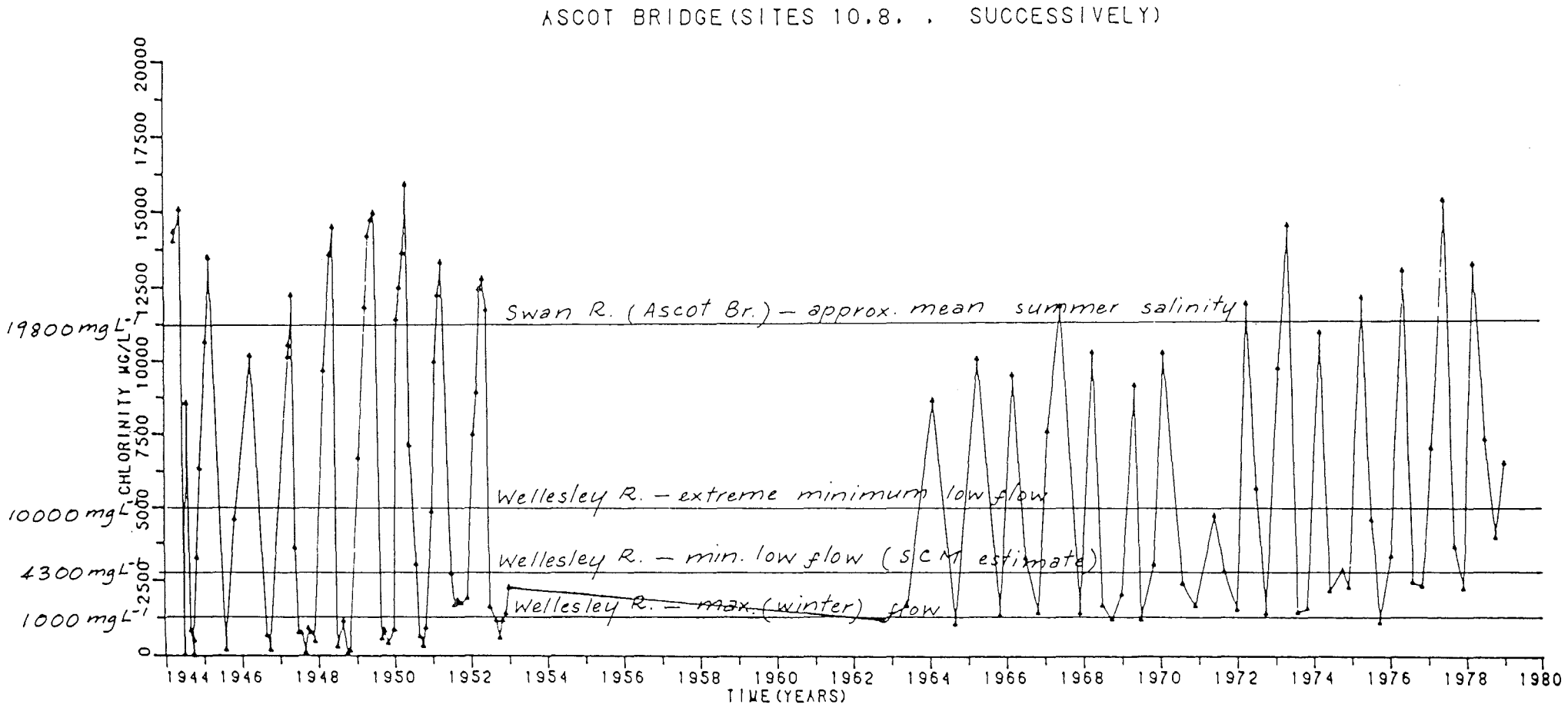
1987), there is a significant risk that E. rudis will experience stress. If the concentrations reach 10000 mg/L as has been suggested by Mr I Loh of the Water Authority in a letter to the EPA dated 18 June, 1987, the risk would be considerably greater. Furthermore, in seasons when the natural river flow ceases altogether and the only flow consists of undiluted effluent discharge of salt concentration of 14500 mg/L or more, the trees may well die.

No direct information is available on the salt tolerance of Melaleuca rhaphiophylla. Nevertheless, by examining its distribution along streams of known salinity, it is possible to make an estimate of the upper limits of the salt tolerance of the species. The most accessible location for which the necessary information is available is the Swan Estuary. The peripheral vegetation has been mapped (Pen 1983) and the Waterways Commission has reliable, long-term salinity data (Henderson et al 1983) for a number of stations along the river where salt concentrations spanned the range likely to be encountered in the Wellesley. Accordingly, several of these sites were visited in company with Mr R P Atkins of the Waterways Commission on 2 July 1987. At Ascot Bridge, M. rhaphiophylla occurs at the water's edge where average summer salinity is of the order of 11000 mg/L chlorinity (19800 mg/L TDS) (Figure 1). Further downstream, at Maylands Jetty, average summer salinity is of the order of 14000 mg/L chlorinity (25300 mg/L TDS) (Figure 2) and M. rhaphiophulla is found inland of a narrow zone of Juncus kraussii. Here it is possible that the extreme salinity is ameliorated to some extent by freshwater seepages from the adjacent steep banks, allowing M. rhaphiophylla to persist in an otherwise apparently inhospitable environment.

Along the Wellesley River, the groundwater is more saline and different mechanisms may apply. One sample of groundwater taken in May 1985 from a depth of 5 m, 2 km west of the river, had a salinity of about 700 mg/L. In this area, M. rhaphiophylla has adapted to a relatively low salt regime and there is a possibility that it may experience salt shock if the salinity is suddenly increased.

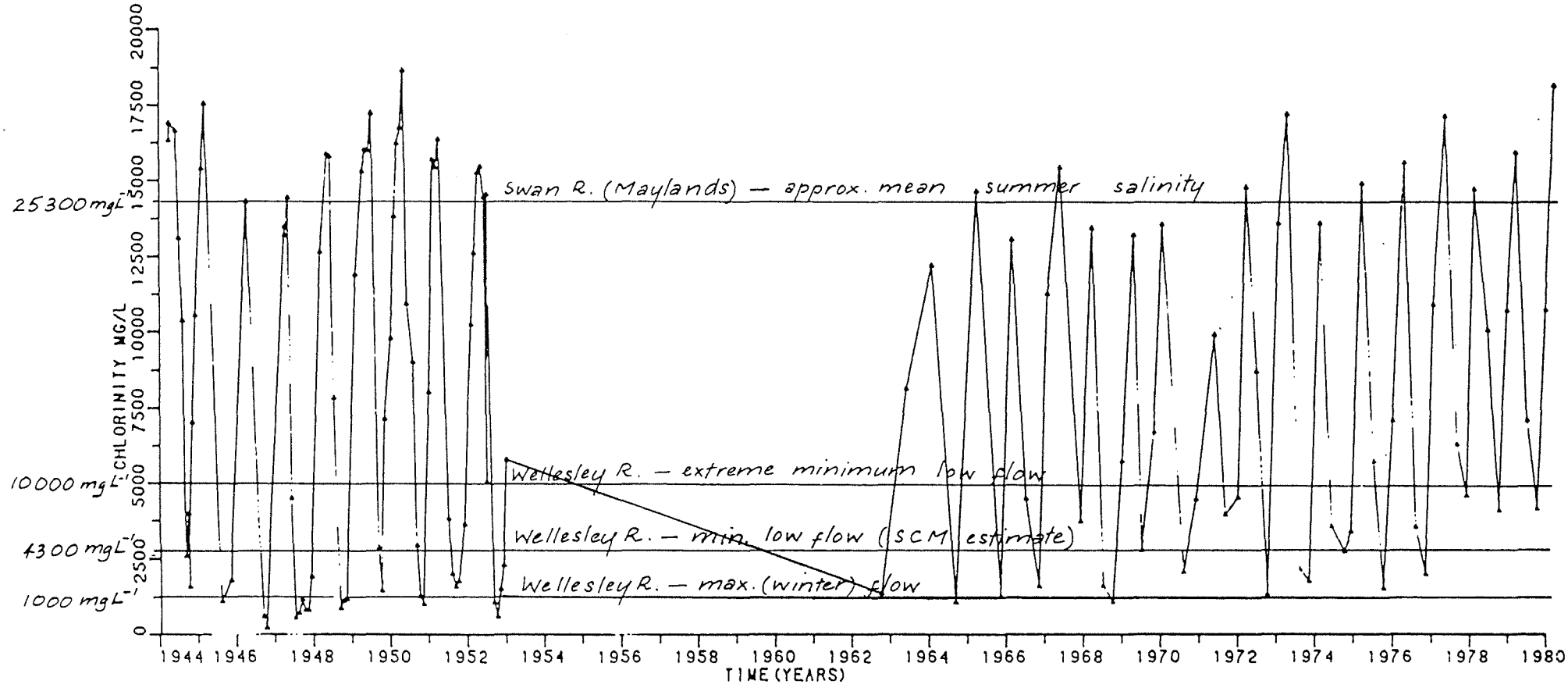
In summary, there appears to be a significant risk that both Eucalyptus rudis and Melaleuca rhaphiophylla, the major tree species of the fringing woodland along the lower reaches of the Wellesley River, may be stressed or even killed if the stream salinity is increased by effluent discharge from the proposed titanium dioxide plant at Kemerton.

FIG. 1. Salinity ($mg\,L^{-1}$ TDS) of Swan R. at Ascot Bridge compared with Wellesley R. under various flow conditions



[Source: Henderson et al. (1983)]

FIG. 2. Salinity (mgL^{-1} TDS) of Swan R. at Maylands Jetty compared with Wellesley R. under various flow conditions



[Source: Henderson et al. (1983)]