

RARE EARTH TREATMENT PLANT
RHONE POULENC CHIMIE AUSTRALIA PTY LTD

Report and Recommendations
of the
Environmental Protection Authority

Environmental Protection Authority
Perth, Western Australia

Bulletin 352 September 1988

ISSN 1030 - 0120
ISSB 0 7309 1861 0

CONTENTS

		Page
i	SUMMARY AND RECOMMENDATIONS	iii
1.	INTRODUCTION	1
2.	PROJECT DESCRIPTION	1
2.1	<u>PROCESS</u>	1
2.1.1	STAGE ONE	2
2.1.2	STAGE TWO	2
2.2	<u>INFRASTRUCTURE</u>	2
2.3	<u>CONSTRUCTION AND OPERATION PHASES</u>	2
3.	EXISTING ENVIRONMENT	2
3.1	<u>CLIMATE</u>	2
3.2	<u>REGIONAL LAND USE AND TENURE</u>	3
3.3	<u>GEOLOGY</u>	3
3.4	<u>SOILS</u>	3
3.5	<u>HYDROGEOLOGY</u>	3
3.6	<u>HYDROLOGY</u>	3
3.7	<u>BIOLOGICAL ENVIRONMENT</u>	3
3.8	<u>FAUNA</u>	3
3.9	<u>HISTORICAL SITES</u>	4
3.10	<u>ETHNOGRAPHY AND ARCHAEOLOGY</u>	4
4.	PUBLIC AND GOVERNMENT SUBMISSIONS	4
5.	ENVIRONMENTAL IMPACTS OF STAGE ONE	5
5.1	<u>VEGETATION AND FLORA</u>	5
5.2	<u>FAUNA</u>	5
5.3	<u>NOISE</u>	5
5.4	<u>TRANSPORT</u>	5
5.5	<u>RADIOLOGICAL IMPACTS</u>	6
5.6	<u>EVAPORATION PONDS</u>	6
6.	ENVIRONMENTAL IMPACTS OF STAGE TWO	8
6.1	<u>VEGETATION, FLORA AND FAUNA, AND NOISE</u>	8
6.2	<u>TRANSPORT</u>	8
6.3	<u>EVAPORATION PONDS</u>	8
6.4	<u>RADIUM REMOVAL</u>	9
6.5	<u>RADIOLOGICAL IMPACTS</u>	10
7.	CONCLUSION	10
7.1	<u>STAGE ONE</u>	10
7.2	<u>STAGE TWO</u>	11

APPENDICIES

	Page
A. Environmental Commitments	
B. Summary and Review of Public Submissions	
C. Proponents reply to Submissions	

FIGURE

1 Locality Map	2
--------------------------	---

Rhone Poulenc Chimie Australia Pty Ltd, has submitted a proposal to establish a Rare Earth Treatment Plant at Pinjarra in Western Australia.

The proposal has two stages. The first stage would treat the monazite with caustic to produce a solid containing rare earth hydroxides and a calcium phosphate waste. The second stage would treat the solid containing the rare earth hydroxide to produce rare earth salts, thorium waste and the ammonium nitrate waste. Upon consideration of the proposal the Environmental Protection Authority has concluded that Stage One is environmentally acceptable and that Stage Two is not environmentally acceptable.

The project at full production would process 15,000 tonnes of monazite per annum to produce rare earth salts and a product containing rare earth hydroxide. The proponent would initially only produce the rare earth hydroxide product, and then at a later date half of that product would be treated at Pinjarra to produce rare earth salts.

Stage One of the process would produce calcium phosphate as a waste product which would be disposed of in evaporation ponds in Pinjarra. Stage Two would produce a low level radioactive thorium hydroxide waste, which would be disposed of off site, and liquid wastes containing ammonium nitrate and radium which would be disposed of in the evaporation ponds.

The project would have a construction workforce of approximately 200 people and a permanent workforce of 100 people.

The Environmental Protection Authority determined that an Environmental Review and Management Programme would be required to assess the proposal. The Commonwealth Department of the Arts, Sport, Environment Tourism and Territories also wished to assess the proposal, therefore the Environmental Review and Management Programme had to fulfill the requirement of a Draft Environmental Impact Statement. The ERMP had a public review period of ten weeks.

The Environmental Protection Authority has previously assessed a proposal by Allied Eneabba to establish a Rare Earth Treatment Plant and this was found to be environmentally acceptable. That proposal was located at a different site and was using a different process. That site does not have the same constraints as the Pinjarra Site in part because the groundwater is not potable and the site is not in the catchment of an inlet system with nutrient enrichment problems.

The Environmental Protection Authority has reached conclusions on the two stages of the proposal separately, taking into account the public submissions received, and the proponents response there to.

The Authority has concluded that Stage One of the proposal which would produce the rare earth hydroxide product, is environmentally acceptable.

RECOMMENDATION 1

The Environmental Protection Authority concludes that Stage One of the proposal to produce rare earth hydroxide product is environmentally acceptable and recommends that it could proceed subject to the EPA's recommendations and the proponent abiding by the environmental commitment in the Environmental Review and Management Programme (Listed in Appendix A

A) including:

- . management of principal sources of radiation exposure;
- . commitment to the ALARA (as low as reasonably achievable), principle of minimizing radiation doses; and
- . management of the closure and rehabilitation of Pinjarra evaporation ponds.

RECOMMENDATION 2

The Environmental Protection Authority recommends that before commissioning the plant the proponent prepare and implement a groundwater monitoring programme to the satisfaction of the EPA and the Water Authority of Western Australia.

RECOMMENDATION 3

The Environmental Protection Authority recommends that should the monitoring of the underdrains or groundwater identify seepage containing excess quantities of salts, then the problem should be rectified and the design of future evaporation ponds should be modified by the proponent to prevent seepage from the ponds.

RECOMMENDATION 4

The Environmental Protection Authority recommends that the transport of Rare Earth Hydroxide Product be restricted to carriage by road to Pinjarra and by rail from Pinjarra to Fremantle.

RECOMMENDATION 5

The Environmental Protection Authority recommends that prior to decommissioning a rehabilitation plan for the evaporation ponds be prepared and implemented by the proponent to the satisfaction of the EPA and Department of Mines.

The Authority has also reviewed the potential impacts of Stage Two of the proposal. For the proposal to be acceptable it must be demonstrably possible to manage the environmental impacts during the operational phase and the long term environmental impacts and occupational health issues must be acceptable. There must be a "walk away" solution such that the state does not incur future environmental problems after completion of the project. The major environmental issues associated with Stage Two of the proposal are:

- . production, transport and disposal of the thorium hydroxide radioactive waste;
- . radium disposal in the evaporation ponds; and
- . ammonium nitrate disposal in the ponds.

1. Transport of Thorium Hydroxide Waste

The transport of the thorium hydroxide has been addressed in the Public Environmental Report on the Department of Health's Integrated Waste Disposal Facility. The proposal to transport the waste in iso-container by rail and road to the Integrated Waste Disposal Facility would meet the Commonwealth Code of Practice for the Safe Transport of Radioactive Substances. The Environmental Protection Authority considers that the transport of the waste may be manageable but requires further investigation and community involvement.

2. Disposal of the Thorium Waste

The Authority believes that disposal of the thorium waste could occur in an environmentally acceptable manner. This has been addressed in greater detail in the Environmental Protection Authority's Report and Recommendations on the Integrated Waste Disposal Facility, Bulletin No 353.

3. Radium Disposal in the Evaporation Ponds

The Authority has concluded that the disposal of small quantities of radium 226 and 228 in the evaporation ponds at Pinjarra does not represent an environmental (nor health) threat.

4. Ammonium Nitrate Disposal in the Evaporation Ponds

16,000 tonnes per annum of ammonium nitrate would be disposed of in the evaporation ponds. The Environmental Protection Authority believes that this should be environmentally manageable during the operational phase of the proposal. However, the Authority does not consider the storage of large quantities of ammonium nitrate, above potable groundwater and in the catchment of the Peel-Harvey Inlet, which has nutrient enrichment problems, to be environmentally acceptable in the long term.

The ammonium nitrate waste would consist of three streams:

- . 10,000 tonnes per annum of clear ammonium nitrate;
- . 2,000 tonnes per annum of ammonium nitrate contaminated with organic material; and
- . 4,000 tonnes per annum of ammonium nitrate contaminated with 7 gram per annum radium.

It may be possible to sell as fertilizer and/or explosive, the clean ammonium nitrate and the organic contaminated ammonium nitrate. It would not be possible to sell the remaining radium contaminated ammonium nitrate.

There is no apparent environmentally acceptable method available for removal, transportation and disposal of the radium contaminated ammonium nitrate.

The option involving the removal of the radium from the ammonium nitrate by a radium removal circuit in the plant, hence allowing the ammonium nitrate to be sold and removed from the ponds is unacceptable from an occupational health aspect.

Given that many of the environmental issues raised by stage two have yet to be satisfactorily resolved the Environmental Protection Authority has concluded that Stage Two is environmentally unacceptable.

RECOMMENDATION 6

The Environmental Protection Authority concludes that Stage Two is environmentally unacceptable and recommends that it does not proceed for the following reasons:

- a) The long term storage of large quantities of ammonium nitrate in the Peel-Harvey Catchment is unacceptable in the long term because of the potential to add significant quantities of nitrogen to the Peel Harvey Inlet an area already subject to nutrient enrichment problem;
- b) The long term storage of large quantities of ammonium nitrate above potable and near potable ground water sources is unacceptable in the long term because of the potential to pollute those sources with nitrate, and
- c) There is no apparent environmentally acceptable method for the removal, transportation and disposal of radium contaminated ammonium nitrate.

1. INTRODUCTION

Rhone Poulenc Chimie Australia Pty Ltd, proposes to establish a Rare Earth Processing Plant at Pinjarra in Western Australia. (See Figure 1.)

The project would process monazite, a rare earth phosphate mineral, to produce rare earth products which would be exported either as solid containing rare earth hydroxide or as the more refined rare earth salts.

The Environmental Protection Authority decided that an Environmental Review and Management Programme should be prepared to allow the assessment of the proposal. The Commonwealth Department of the Arts, Sports, Environment, Tourism and Territories also required that the project be assessed and so the Environmental Review and Management Programme was required to fulfill the specifications of a Draft Environment Impact Statement.

The Environmental Protection Authority has previously assessed another proposal to establish a Rare Earth Treatment Plant by Allied Eneabba Limited in 1985. That proposal, which was considered environmentally acceptable subject to a number of recommendations, was situated at another site and proposed a different processing method.

Rhone Poulenc Chimie Australia Pty Ltd has indicated that the proposal would be developed in two stages. Stage One will produce rare earth hydroxides and Stage Two will further refine some of the rare earth hydroxides to produce rare earth salts. Stage Two also produces a low level radioactive thorium waste.

The disposal and transport of the low level radioactive thorium waste has been assessed as part of the Department of Health's proposed Integrated Waste Disposal Facility, and the Authority's assessment is presented in Bulletin No 353.

The two stages of the proposal will be assessed separately.

2. PROJECT DESCRIPTION

2.1 PROCESS

2.1.1 STAGE ONE

Rhone Poulenc Chimie Australia proposes to treat up to 15,000 tonnes per annum of monazite to produce an intermediate product containing rare earth hydroxide. The monazite would be supplied by Western Australian producers until supplies were depleted and then imported monazite would be treated.

Monazite would be transported to the Pinjarra site by rail and road. Monazite would be debagged, then pneumatically transferred to a storage bin from where it would be sent to a wet grinding mill. The ground ore would then be mixed with hot concentrated caustic soda, forming a slurried mixture of trisodium phosphate and solids containing the rare earth hydroxides. The solids would be separated from the dissolved trisodium phosphate which would then be treated with lime. An 8000 tonne per annum calcium phosphate cake would be produced. The calcium phosphate would be disposed of in the evaporation ponds at the Pinjarra Site. The solid known as the intermediate product, containing the rare earths hydroxide and other material including the radioactive elements, would be shipped overseas.

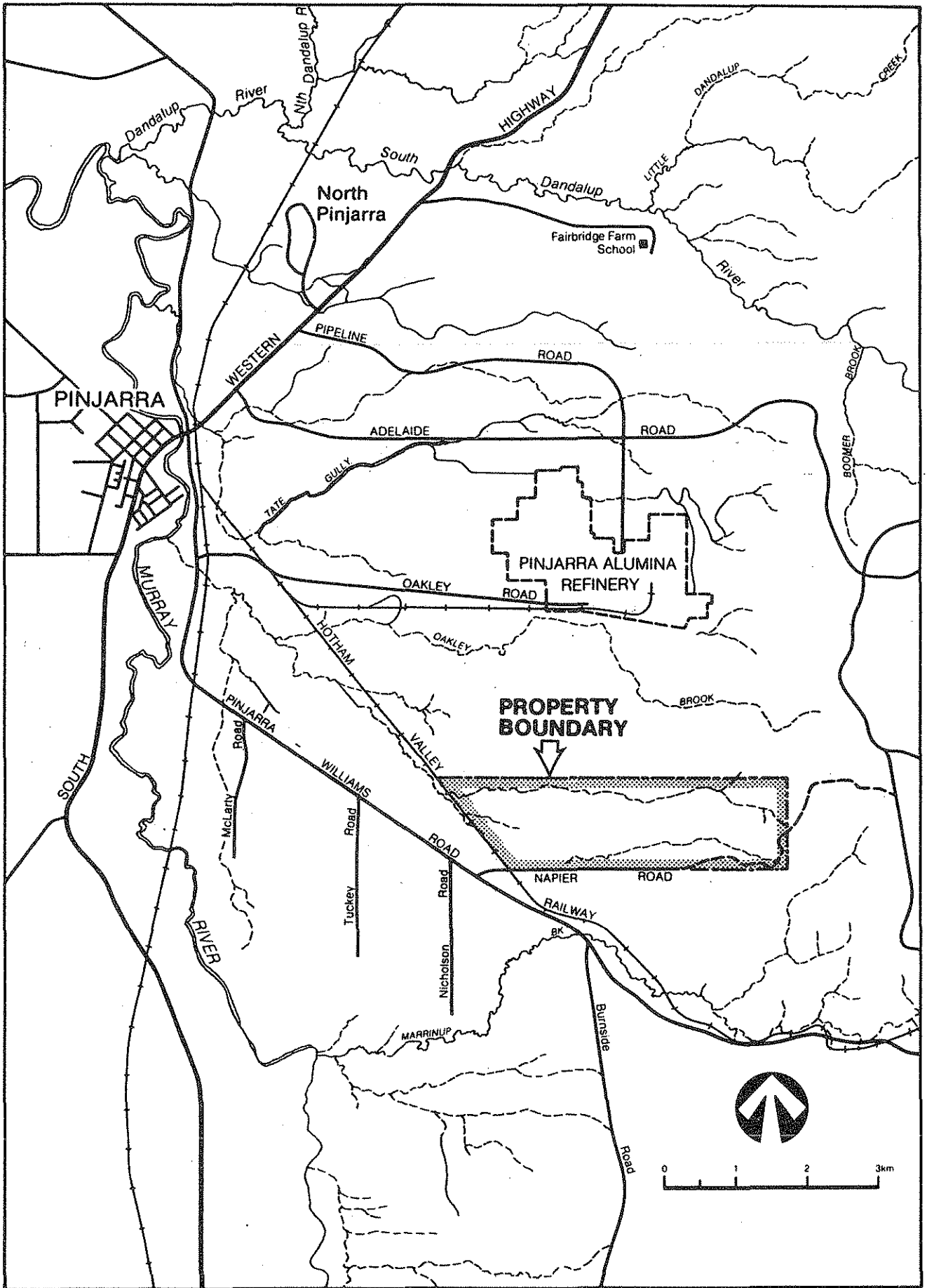


Figure 1. Locality Map .

Liquid and solid wastes would be disposed of in the evaporation ponds. The solid wastes include sodium hydroxide, calcium phosphate, small quantities of sodium phosphate, calcium hydroxide and rare earth hydroxide.

2.1.2 STAGE TWO

In Stage Two, half the intermediate product would be further treated at Pinjarra.

The rare earth hydroxide solids would be dissolved in nitric acid and ammonia and then passed through a rotary filter. The filter cake which consists of thorium hydroxide, impurities and water would be transported to a remote site for disposal. The rare earth nitrates would pass to the next stage of purification, solvent extraction. After removal of the impurities, the rare earth nitrates would be separated using a series of solvent extraction systems. The rare earth nitrates would then be converted to the salts required. Ammonium nitrate is formed as a by-product of these processes. The ammonium nitrate and other wastes such as ammonium chloride, rare earth nitrates and radium 226 and 228 would be disposed of in the evaporation ponds.

2.2 INFRASTRUCTURE

The proposal would receive power from a 22kV 600 VA connection with the SECWA system.

It would require up to 900,000 cubic meters of water per annum. Rhone Poulenc is investigating the potential of an underground aquifer to provide this water. The aquifer is currently licensed for 300,000 cubic meters per annum, for the Gallium Plant. If the investigation does not indicate that the aquifer can supply the additional water alternative sources will be used.

Natural gas would be supplied from the Pinjarra-Waroona main of the SECWA system. Gas requirement would be 493,000 Giga-Joules per annum.

Napier Road, which would be sealed and upgraded, would provide access to the plant. The Napier Road and Pinjarra-Williams Road intersection will also be upgraded.

Septic tanks and leach drains will be installed for the plant and offices.

2.3 CONSTRUCTION AND OPERATION PHASES

The construction of the proposed plant should take approximately 24 months. Most construction material would be provided by local suppliers. Up to 200 jobs would be created during the construction phase of the project. The expected life of the proposed project is a minimum of 20 years. The operation is expected to provide a total of 100 permanent jobs. The plant would run 24 hours a day, 7 days a week.

3. EXISTING ENVIRONMENT

3.1 CLIMATE

The climate of south-west Western Australia is temperate mediterranean. The average rainfall at Pinjarra is 958 mm. The evaporation rate in the Pinjarra

area is approximately 1600 mm per annum. The winds are predominantly from the south, south-west, north-east in summer, and west, north west, north eastern, in winter.

3.2 REGIONAL LAND USE AND TENURE

The five hundred (500) hectare plant site is located on land previously within the boundary of Alcoa of Australia Limited Pinjarra Alumina Refinery. The primary land use of the region is farming, forestry and mining, with urban development near Mandurah and Pinjarra.

3.3 GEOLOGY

The plant site is located on the Perth Basin. The Perth Basin is a deep trough filled with phanerozoic sedimentary rocks and with a surface mantle of Quaternary deposits. The geological units outcropping at the surface of the proposed site are Colluvium, Bassendean sands and Yoganup formation.

3.4 SOILS

The soils at the Pinjarra site are mainly grey-brown sands at the surface becoming yellow with depth. Areas of grey-brown gravely sands or sandy loams over a mottled sandy clay are also found.

3.5 HYDROGEOLOGY

The proposed plant is near the Darling Scarp on the western boundary on the Perth Basin. The Leederville and Cockleshell Gully Formations subcrop within 50 m of the ground surface.

This area is mantled by clayey Quaternary sediments which contain discontinuous, unconfined to confined sand aquifers with minor amounts of potable and near potable water. The Leederville Formation contains moderate amounts of reasonable quality groundwater. The Cockleshell Gully contains important confined sandstone aquifers.

Regional groundwater flow is to the west in both the Mesozoic and Quaternary sediments. The main area for recharge for these formations is the area near the Darling Scarp.

3.6 HYDROLOGY

The site is located within the Murray River drainage basin. Surface drainage is via two westward flowing streams. The Murray River has a catchment of 8300 km² and a highly seasonal flow, 90% of the annual flow occurs between June to September. The Murray derives water from low rainfall agricultural areas east of the escarpment, where soil salt storage levels are high. Because of this, salinity in the river can be high.

3.7 BIOLOGICAL ENVIRONMENT

There is virtually no native vegetation left on the proposed sites of the evaporation pond, processing plant, storm pond or plant access road. The ground layer of vegetation is a mixture of pasture grasses, lupins and other legumes and a variety of weeds. Jarrah and Marri trees are scattered through the site. No rare, geographically restricted or poorly known species of plants are likely to occur on any of the project sites.

3.8 FAUNA

The only mammals recorded on the project sites are feral rabbits and domestic cattle and sheep. It is very unlikely that any of the native mammals or other native vertebrate and invertebrate animals living on the project sites is rare, restricted or endangered.

3.9 HISTORICAL SITES

Discussions with the WA Heritage Committee revealed that there are no areas in or near the process plant site listed on the National Estate.

3.10 ETHNOGRAPHY AND ARCHAEOLOGY

There are no previously recorded ethnographic sites within the survey area. The nearest known site is a Wurdaratji cave in the Darling Range, approximately 3 kilometres north-west of the plant site. A survey revealed an Aboriginal camp site on the back of a small creek which runs through the proposed plant site. No archeological material was recorded as a result of a systematic survey of the proposed plant site.

4. PUBLIC AND GOVERNMENT SUBMISSIONS

The ERMP was released to the public and Government Departments for a ten week review period which ended on 2 May 1988.

A total of 1170 submissions were received; of these 19 were from Government Departments, 5 from Local Authorities and the balance from members of the public, conservation groups, companies and tertiary institutions. The majority of the submissions (98%) received were opposed to the proposal.

A number of environmental issues were raised in the submission and required addressing by the proponent.

1. The Evaporation Ponds:

- . the security of long term and short term disposal of phosphates and ammonium nitrates in the evaporation ponds;
- . the disposal of radium in the evaporation ponds;
- . design details of the ponds to minimise seepage;
- . monitoring of the ponds; and
- . radiation emissions from the ponds.

2. Transport:

- . safety of transporting dangerous chemicals;
- . safety of transporting radioactive material, ie monazite, rare earth hydroxide, thorium waste;
- . emergency and contingency plan should be developed; and
- . radiation exposure to truck drivers and public associated with transport of radioactive substances.

3. Radiation:

- . radiation emission from the plant and evaporation plant areas;
- . radiation doses to the workers, general public and environment; and
- . the effect of radiation on organisms other than people.

4. Lack of detail in ERMP.

5. Decommissioning of the plant.

6. Disposal of the thorium waste.

A summary and review of submissions is presented in Appendix B, and the proponent's responses are presented in Appendix C.

The information and comments provided in the submissions have been used to assist in the evaluation and assessment of this proposal.

5. ENVIRONMENTAL IMPACTS OF STAGE ONE

5.1 VEGETATION AND FLORA

There is virtually no native vegetation on the proposed plants, evaporation pond sites, plant access road or storm ponds. Consequently the impacts on native vegetation and flora will be minimal.

5.2 FAUNA

The only habitats for native fauna in the project area are in the disturbed woodland, that will be partially cleared for construction of the plant. These trees provide shelter, feeding and nesting habitats for birds. These habitats are well represented over a large area of coastal plain.

The evaporation ponds and the storm water ponds will be attractions for water fowl and wading birds, Alcoa experience at the Pinjarra plant indicates that the impact would be minor. The steepness of the shores of the rare earth processing plant lakes and lack of vegetation will help minimise the attractiveness of the lakes to water fowl and wading birds.

5.3 NOISE

The construction phase may impact on the environment in the form of noise. However, the noise from the construction phase would be relatively short-lived, and the nearest residence is 800 m from the plant site and roads. The process plant is of quiet operation and is expected to have little impact on the surrounding areas.

5.4 TRANSPORT

Transport issues of this project comprise two parts, construction traffic and operation traffic which includes transportation of the rare earth hydroxide product.

The construction traffic would travel mainly on major highways which have the capacity for heavy traffic. The Pinjarra Williams and Napier Roads would be the most affected roads. Napier Road and Pinjarra-Williams Road - Napier Road intersection have been upgraded by the company. The level of disturbance due to increased traffic would vary during the construction phase and would then cease after approximately eighteen months.

Transport of goods during the operation phase would involve rail and road transport.

Monazite would be transported by rail from Eneabba to Pinjarra, and then trucked to the plant site. Monazite from the Capel area would be trucked directly to the plant site. The transportation of Monazite is covered by a Commonwealth Code of Practice for the Safe Transportation of Radioactive Substances.

Reagents for the project would be transported by truck. It is anticipated that approximately thirty-seven truck movements a week would be required to supply reagents to the plant. The major chemicals to be used in Stage One are lime, sodium hydroxide, small quantities of nitric acid and ammonia. Transport of dangerous chemicals is covered by the Department of Mines Dangerous Goods (Road Transport) Regulations 1983, and these chemicals would be transported in purpose-built trucks.

The rare earth hydroxide product would be a low specific activity radioactive substance and as such the transportation of the rare earths hydroxide product would be governed by the Code of Practice for the Safe Transport of Radioactive Substances. The Intermediate Product would emit similar levels of gamma radiation to that of monazite which is presently transported through the south-west. As rail is the safest way for material to be transported, it will be required of the proponent to transport the hydroxide product to Pinjarra by road and then by rail to Fremantle.

The occupants living in the 35 residences which front the Pinjarra-Williams Road between Napier Road and the Pinjarra siding may be affected by the increase in truck traffic during the operation of the project. However, the truck movement due to the project would be less than four trucks per hour and any impact should be low.

5.5 RADIOLOGICAL IMPACTS

It is important to ensure that workers, the general public and the environment do not receive an unacceptable level of radiation exposure.

There are several sections of the processing in Stage One which could lead to radiation exposure:

- . transport of monazite feedstock;
- . transfer of feed to mill;
- . milling of monazite; and
- . transport of intermediate product.

The three main pathways of radiation exposure associated with Stage One of the processing are:

- . radioactive dust;

- . radon gas and daughter products; and
- . gamma radiation.

The only radiation exposure of significance during transport of monazite and intermediate product is gamma radiation flux which penetrates the walls of the container. Monazite has been transported in the State for many years and is governed by the Commonwealth Code of Practice for the Safe Transport of Radioactive Substances 1982. The rare earth hydroxide product would have similar gamma radiation levels and would be covered by the same code

Transfer of the monazite feedstock to the mill, could involve the release of monazite dust to the atmosphere. The proponent has made a commitment to install appropriate dust facilities, to ensure that radioactive dust is not released to the environment.

Milling involves grinding the monazite to a fine powder. This could lead to the production of dust. The proponent has made a commitment to wet grinding to minimise the dust. Because the milling of the monazite increases the surface area of the material, it also allows greater emanation rates of radon gas from the monazite. Increasing the levels of radon gas in the air would cause a corresponding increase in radon daughter concentrations, which would have to be reduced. The proponent would be required to provide adequate ventilation to the employees work areas to allow dilution of the radon and radon daughter concentrations to acceptable levels. Radon and radon daughters would be released to the environment by the milling of the monazite and the subsequent ventilation of the plant. The proponent would provide a sufficiently large buffer zone around the plant to allow dilution and dispersion of the radon and radon daughter, so as no increase in background levels could be detected at the boundary of the buffer zone. Under these conditions radon and radon daughter emission from the plant would not represent a radiation hazard to either members of the public or the environment.

5.6 EVAPORATION PONDS

The evaporation ponds could have an impact on the surrounding environment. They would contain the liquid and solid wastes from the processing. Discharge of these wastes, by seepage or overtopping of the ponds could contaminate the environment. The proponent has designed the ponds to minimise these problems. The evaporation ponds would include a one metre layer of compacted clay underneath, which would be followed by a series of underdrains and then another 300 mm of compacted clay. The first clay layer should minimise seepage and the underdrain should intercept any seepage through that clay layer. The second clay layer has been constructed to minimise the upward movement of groundwater and to slow any seepage that might bypass the underdrains. The ponds would be operated with a free board of 1.3 metre.

The major component of the waste for Stage One would be calcium phosphate. The evaporation ponds would be in the catchment area for the Murray River, which flows into the Peel-Harvey Inlet. The Peel-Harvey Inlet has a nutrient enrichment problem. The input of nutrient into the inlet has been the subject of a series of investigations, and a management programme to reduce the quantity of phosphorus flowing into the inlet is being developed and assessed by EPA.

Eight thousand tonnes of calcium phosphate would be disposed of in the evaporation ponds of the Rare Earth Plant per annum. It would be highly insoluble under alkaline and neutral conditions present in the ponds. The proponent was requested to investigate the effects of infiltrating rainfall, and rising water tables on the levels of phosphate discharged from the ponds. Taking a worst case situation; ie at the completion of the project, when all the evaporation ponds are full; only small quantities of phosphorus, 20 kg per annum due to infiltrating rainfall and 7 kg per annum due to rising water table would be released.

The proponent was also requested to investigate the effect of breaching a wall of one of the evaporation ponds. In a worst case situation, the breach has the potential to release 920 kg of phosphorus into the environment.

The Environmental Protection Authority considers the above environmental impacts are manageable.

6. ENVIRONMENTAL IMPACTS OF STAGE TWO

For the proposal to be acceptable it should:

- a) demonstrate that the environmental impacts during the operational phase are manageable.
- b) require a "walk away" option after completion of the project and so be environmentally acceptable in the long term.
- c) not create any occupational health problems.

6.1 VEGETATION, FLORA AND FAUNA, AND NOISE

Impacts on vegetation, flora and fauna would be minimal and similar to those discussed in Stage One (5.1 and 2.2).

Noise has also been discussed in Environmental Impacts of Stage One and would not be expected to be significantly different (5.3).

6.2 TRANSPORT

Transport of goods during the operation phase of Stage Two would involve rail and road transport.

Transport of Monazite would be as discussed for Stage One. Stage Two would require further chemicals such as large quantities of nitric acid and ammonia. These would be transported subject to the Department of Mines Dangerous Goods (Road Transport) Regulations 1983, and would be transported in purpose-built trucks. The Rare Earth nitrates and salts would be packaged, marked and handled in accordance with the appropriate statutory requirements.

The transport of the low level radioactive thorium hydroxide waste is addressed in the Public Environmental Report on the Integrated Waste Disposal Facility. The assessment of the transport can be found in the Environmental Protection Authorities Report and Recommendations on the Integrated Waste Disposal Facility, Bulletin No 353. The Authority considers that the transport of the thorium hydroxide waste in iso-container by rail and road to the Integrated Waste Disposal Facility is manageable but requires further investigations and liaison with local communities.

6.3 EVAPORATION PONDS

The same evaporation ponds used in Stage One would be used in Stage Two, to dispose of the solid and liquid wastes. Once again, the major environmental impacts associated with the evaporation ponds is seepage into the groundwater and the Murray catchment area. The major solid waste is ammonium nitrate, approximately 16,000 tonnes per annum would be disposed of in the ponds. During Stage Two radium would also be directed to the ponds.

Ammonium nitrate is very soluble (unlike the Ca phosphate), and it is also easily transported through soil and clays. Seepage from the evaporation ponds would carry excessive levels of nitrogen. During the operational phase, an underdrain system would be used to intercept any material seeping through the clay liner of the evaporation ponds. This seepage would be returned to the evaporation ponds. The proponent was requested to investigate the potential for release of nitrogen from the evaporation ponds, at the completion of the operations and after shut down of the underdrains. Seepage caused by infiltrating rainfall and the effect of a rising water table were both investigated. Both situations have the potential to introduce large quantities of nitrogen into the Murray River catchment and hence to the Peel-Harvey Inlet, which has nutrient enrichment problems. The EPA has concluded that it would be necessary to remove the ammonium nitrate from the ponds to make the evaporation ponds environmentally manageable in the long term.

The ammonium nitrate waste consists of three streams:

- . 10,000 tonnes per annum of clean ammonium nitrate;
- . 2,000 tonnes per annum of ammonium nitrate contaminated with organics; and
- . 4,000 tonnes per annum of ammonium nitrate contaminated with 7 grams per annum radium.

It may be possible to sell up to 12,000 tonnes per annum of the clean ammonium nitrate and organically contaminated ammonium nitrate as fertilizer and/or explosive material, and thus remove it from the ponds. This leaves approximately 4000 tonnes of radium contaminated ammonium nitrate for disposal. This ammonium nitrate could not be sold unless the radium was removed.

Disposal of the radium contaminated ammonium nitrate off site presents transport problems. The ammonium nitrate and radium are in solution and as yet no environmentally acceptable proposal for transport of the waste to the Integrated Waste Disposal Facility has been suggested.

Radium disposal in the evaporation ponds would not represent a health or environmental problem. The majority of the activity is due to radium 228 which has a half life of approximately seven years. After 60 years 90 % of the activity would have decayed away. The remaining activity would be due to radium 226 which has a much longer half life, approximately 1600 years.

6.4 RADIUM REMOVAL

In comparable plants in the United States of America and France all the ammonium nitrate waste is sold as fertilizer. Both plants operate a radium removal circuit to clean the radium contaminated ammonium nitrate. A radium removal circuit can cause high levels of gamma radiation in that section of

the plant. Also the operation of the circuit involves several manual activities such as precoating the filter required to filter the radium solids. In the United States of America, radiation doses are calculated in a different manner, which means a worker could be allowed to receive up to 3 times the radiation dose limits set in Western Australia. Both the United States and France also use staff rotation to reduce individual radiation doses.

It is accepted by the proponent and the radiological authorities in Western Australia that a radium removal circuit would not meet standards set in this State. It would also create a problem of radium disposal.

6.5 RADIOLOGICAL IMPACTS

Radiation emissions for Stage Two, without a radium removal circuit, are very similar to those in Stage One and can be managed to an acceptable standard. The thorium hydroxide waste is an additional radiation hazard. The major concern being inhalation of radioactive dust. The thorium hydroxide waste is collected as a damp filter cake and would be kept damp to minimise the dust. The proponent has made a commitment to the ALARA principle, to keep radiation doses as low as reasonably achievable.

The transport of thorium hydroxide waste has been addressed in the Public Environmental Report on the Department of Health's Integrated Waste Disposal Facility. The proposal to transport the thorium waste, by road and rail in iso-containers to the Integrated Waste Facility would meet the Commonwealth Code of Practice for the Safe Transport of Radioactive Substances. The Environmental Protection Authority considers that the transport of the waste is manageable but requires further investigations and liaison with the communities involved.

The disposal of thorium hydroxide waste was investigated for the Allied Eneabba proposed Rare Earth Treatment Plant. Shallow burial in a geological and hydrogeologically stable area with no potable water is considered environmentally acceptable. Further details of the disposal are given in the Environmental Protection Authority's Report and Recommendation on the Integrated Waste Disposal Facility Bulletin No 353. The Authority considers the disposal of low level radioactive thorium waste to be manageable.

7. CONCLUSION

The proposal has two stages. Upon consideration of the proposal the Environmental Protection Authority has concluded that Stage One was environmentally acceptable subject to recommendations and that Stage Two was not environmentally acceptable.

A similar proposal by Allied Eneabba, previously assessed by the Environmental Protection Authority, was found to be environmentally acceptable. It was situated at a different site, which did not have the same constraints as the Pinjarra Site. It also used a different process for treating the monazite.

7.1 STAGE ONE

The Authority has concluded that Stage One of the proposal and the potential environmental impacts from it are acceptable and manageable. The Authority has considered the impact of the evaporation ponds on the local groundwater and possible impact on the Peel-Harvey Inlet and considers that these impacts are acceptable provided the calcium phosphate is managed.

RECOMMENDATION 1

The Environmental Protection Authority concludes that Stage One is environmentally acceptable and recommends that it could proceed subject to the EPA's recommendations and the proponent abiding by the environmental commitment in the Environmental Review and Management Program (Listed in Appendix A) including:

- . management of principal sources of radiation exposure;
- . commitment to the ALARA (as low as reasonably achievable), principle of minimizing radiation doses, and
- . management of the closure and rehabilitation of Pinjarra evaporation ponds.

RECOMMENDATION 2

The Environmental Protection Authority recommends that before commissioning the plant the proponent design and implement a groundwater monitoring programme to the satisfaction of the EPA and the Water Authority of Western Australia.

RECOMMENDATION 3

The Environmental Protection Authority recommends that should the monitoring of the underdrains or groundwater identify seepage containing excess quantities of salts then the problem will be rectified and the design of future evaporation ponds will be modified by the proponent to prevent seepage from the ponds.

RECOMMENDATION 4

The Environmental Protection Authority recommends that the Intermediate Product be transported by road to Pinjarra and rail from Pinjarra.

RECOMMENDATION 5

The Environmental Protection Authority recommends that prior to decommissioning a rehabilitation plan for the evaporation ponds be prepared by the proponent to the satisfaction of the EPA and Department of Mines.

7.2 STAGE TWO

For Stage Two to be acceptable the proposal should:

- a) be environmentally acceptable during the operation phase;
- b) require no ongoing maintenance after the completion of the project and be environmentally acceptable in the long term; and
- c) not create any occupational health problem.

The Environmental Protection Authority has concluded that the environmental impacts of Stage Two were probably manageable during the operation phase. It also concluded that if no radium removal circuit was introduced that the occupation health aspects could be managed.

The Environmental Protection Authority has concluded that the long-term environmental impacts of the project have not yet been shown to be manageable.

The storage of quantities of ammonium nitrate in the Peel-Harvey catchment has the potential to cause the addition of large amounts of nitrogen to the Peel-Harvey Inlet. The Peel-Harvey Inlet already suffers from a nutrient enrichment problem. Storage of ammonium nitrate above potable or near potable groundwater could also lead to pollution of the groundwater with nitrate.

It appears to be impossible at this stage to remove all the ammonium nitrate from ponds and sell it as either fertilizer or explosive. There would be about 4000 tonnes of ammonium nitrate contaminated with radium which could not be sold. The radium could not be removed from the ammonium nitrate without occupational health problems.

The proponent has not suggested any environmentally acceptable method for the removal, transportation and disposal of the radium contaminated ammonium nitrate.

RECOMMENDATION 6

The Environmental Protection Authority concludes that Stage Two is environmentally unacceptable and recommends that it does not proceed for the following reasons:

- a) The long term storage of large quantities of ammonium nitrate in the Peel-Harvey Catchment is unacceptable in the long term because of the potential to add significant quantities of nitrogen to the Peel Harvey Inlet, an area already subject to nutrient enrichment problem; and
- b) The long term storage of large quantities of ammonium nitrate above potable and near potable ground water sources is unacceptable in the long term because of the potential to pollute those sources with nitrate.
- c) There is no apparent environmentally acceptable method available for the removal, transportation and disposal of the radium contaminated ammonium nitrate.



APPENDIX A

ENVIRONMENTAL COMMITMENTS

SUMMARY OF COMMITMENTS

1. The proponent will comply with the requirements of the draft Commonwealth Code of Practice on Radiation Protection in the Mining and Milling of Radioactive Ores (dated June 1987).
2. The proponent is committed to the ALARA principle (that radiation doses be kept as low as reasonably achievable, economic and social factors being taken into account).
3. The proponent will undertake a baseline radiation level survey at the gangue residue disposal facility when site selection is completed. The scale and scope of this survey will generally be in accordance with that already performed at the Pinjarra plant site, and will be subject to ratification by the regulating authority.
4. Management of the principal sources of radiation exposure will be as follows:
 - o Exposure to gamma radiation will be minimised by means such as; the use, where practicable, of automation; the designation of restricted/controlled areas; and the enclosure of the Milling area.
 - o Radiation exposure due to airborne particles will be minimised by the wet grinding of monazite, and the handling of the gangue residue in a moist form.
 - o The Pinjarra plant will be properly ventilated to ensure that radon and thoron gases do not accumulate.
 - o Adequate ventilation will also ensure that radon and thoron daughter levels are maintained within acceptable levels.
 - o The management of radionuclides will ensure that public reference levels in potentially potable water off the proponent's property will not be exceeded.
5. The proponent will implement a comprehensive radiation monitoring and health surveillance programme.

6. Reporting of radiation monitoring data and record keeping will be undertaken in accordance with the Mining and Milling Code.
7. Radiation protection assessments given in this document will be verified during plant commissioning.
8. Monitoring of radiation levels will continue over the life of the project, for the process plant, transportation aspects, and waste disposal facilities.
9. The proponent will develop a comprehensive contingency plan for transportation of gangue residue from the plant site to the disposal facility when details of materials handling and transportation have been finalised.
10. The proponent will dispose of all non-process wastes in an environmentally acceptable manner, and in accordance with EPA licencing requirements.
11. A comprehensive network of groundwater monitoring bores has been constructed at the Pinjarra plant site and will be monitored for both water level and groundwater salt content on a routine basis. The results of this monitoring will be made available to EPA in the form of an annual report, except that if results indicate that leakage from the ponds is occurring, the Authority will be notified forthwith.
12. The proponent has prepared contingency plans which will be implemented should the environmental effects of the Pinjarra evaporation ponds become unacceptable.
13. Management of the closure and rehabilitation of the Pinjarra evaporation ponds will entail the remaining free water being evaporated off, and cover materials being placed over the ponds. The nature, thickness and configuration of the cover will necessarily depend upon matters such as the radioactivity at the surface, and the stability of the materials in the pond, at the time of closure. It will, therefore be necessary to undertake an investigation of the ponds in order to develop an adequate design for the cover.

APPENDIX B

SUMMARY AND REVIEW OF PUBLIC SUBMISSIONS

SUMMARY AND REVIEW OF SUBMISSIONS

The Environmental Protection Authority has received approximately 1150 submissions on Rhone Poulenc Chemie Rare Earth Treatment Plant. The submissions were received by members of the public, interested bodies and a variety of government authorities.

A number of environmental issues were raised and required addressing by the proponent:

1. EVAPORATION PONDS

The evaporation ponds at the Pinjarra site were the centre of a large number of submissions and several aspects of the ponds require further clarification:

- (i) Large quantities of phosphate and nitrate will be stored in the evaporation ponds. The proponent should model the movement and concentration of these nutrients when the underdrains are no longer functional. Including total tonnage which would be released into the groundwater each year.
- (ii) The proponent should indicate the approximate concentration of Ra 226, Ra 228 and any other radionuclides in the evaporation ponds.
- (iii) The proponent should give an indication as to the design safety factors for the ponds ie. What is the min free board at which ponds will be operated. How does this compare to the 100 year flood.
- (iv) The proponent should indicate what would occur should one of the bund walls be broken by either earthquakes or flooding and what effect this would have on the Murray River System including quantities of nitrate and phosphate released.
- (v) The proponent should give predictive rates of emanation of radon and gamma radiation from the evaporation ponds.
- (vi) Water monitoring programs around the evaporation ponds should include ammonia, nitrate, phosphate sodium, calcium and radium.
- (vii) The proponent should advise why it considers the radium will be insoluble.
- (viii) The proponent should advise the effects of a fire on the evaporation pond after rehabilitation.
- (ix) There have been several submissions questioning the evaporation rates of the area and the pond size.
- (x) The proponent should indicate what levels of Ra 226 and Ra 228 and other radionuclides are in the groundwater and what levels of Ra 228 and radionuclides will seep into the groundwater.

- (xi) The interaction of the gallium plant liquors and rare earth liquors in the evaporation ponds should be discussed.

2. TRANSPORT

Several submissions were concerned with transport of a variety of materials to and from the process site:

- (i) The intermediate product produced at stage 1 of the project contains thorium and uranium and would be more radioactive than monazite. This would be transported through urbanised areas. What safeguards are in place?
- (ii) How many extra trucks of dangerous chemicals and what are the safeguards?
- (iii) Is Rhone Poulenc going to upgrade the Williams Pinjarra Road to allow for all the extra trucks?
- (iv) What are the emergency plans for spillage of radioactive waste, intermediate product, rare earth nitrates, and other hazardous chemicals?
- (v) Will there be specially designed trucks for transport of monazite and intermediate product to lower radiation exposure of drivers and public?

3. RADIATION

The majority of the submission expressed concern about the radiation associated with the project.

- (i) Several submissions expressed concern over emissions of radioactive gases and dust from the plant site and their potential to contaminate the surrounding area.
- (ii) Similar concerns were expressed over emission from the evaporation ponds.
- (iii) Several submissions expressed concern over gama radiation associated with the transport of wastes and monozite and intermediate products. What safety measures were being taken for the drivers etc.
- (iv) Several submissions were concerned about the proponents commitment to the ALARA principle.
- (v) Several submissions expressed concern about the number handling of both monozite, the radioactive waste. Further discussion on bulk handling of the monozite is required.
- (vi) A lot of submissions were concerned that the effect of radiation on organisms other than man was not addressed.

- (vii) Many submissions expressed concern over radioactive element entering the food chain, by dust on farmlands uptake by vegetation and then by cattle. The proponent should indicate any levels of contamination expected and transfer mechanism.
- (viii) There was concern expressed over other countries radioactive waste being disposed of here.

Processing Plant

Many submissions were concerned about the lack of detail in the processing plant:

- (1) What control will there be to contain emission from the plant.
- (2) What organic solvents would be used and what would be their environmental impacts.
- (3) Would it be possible to use hydrochloric acid or sulphuric acid in the process instead of nitric acid which has more environmental impact.
- (4) What other hazardous chemicals are being used and what safeguards will be in place.

General Points

- (1) The proponent should make a commitment to comply with all relevant State statutory requirements.
- (2) There is concern over the capacity of the groundwater aquifer to supply an extra 900 000 m³ per year. The proponent should address this problem.
- (3) One submission enquired about provision of housing in the Murray Shire for the plant.
- (4) Several submissions enquired about the decommissioning of the plant.
- (5) Any water released from the storm water, which may include, boilerwashdowns or cooling tower blowdowns should be analysed for chromates. Levels above 3 µg/l should be considered unsuitable for discharge.
- (6) Several submissions appear to be confused by the Gallium plant and the Rare Earth Plant. The proponent should clarify the two projects.

- (7) More baseline data is required especially for the radionuclides as much of the baseline data provided is below the detection limit of the equipment used.
- (8) Some more details required in particle size of monozite and products and waste to allow calculation of radiation doses from dust etc.
- (9) Recycling of any water should be considered to reduce the demand of the aquifer.
- (10) The possibility of dieback spread should be addressed.
- (11) Many submissions were concerned over the need for emergency procedures in the event of accidents and spillages.
- (12) Many submissions committed on the lack of detail in the ERMP.

Low Level Radioactive Waste

Many submissions were concerned with the disposal and transport of the low-level radioactive waste.

These issues will now be addressed as part of the Department of Health Proposed Integrated Waste Disposal Facility.

APPENDIX C

PROponents REPLY TO SUBMISSIONS



ENVIRONMENTAL REVIEW AND MANAGEMENT
PROGRAMME/ENVIRONMENTAL IMPACT STATEMENT

SUPPLEMENT

RARE EARTHS PROCESSING PLANT

for

Rhône-Poulenc Chimie Australia Pty Ltd

Dames & Moore



Dames & Moore Job No. 12088-012-071

July 1988



TABLE OF CONTENTS

	<u>Page No.</u>
1.0 INTRODUCTION	1
2.0 SCOPE OF WORK	1
2.1 WA GOVERNMENT'S PROPOSED INTEGRATED HAZARDOUS WASTE DISPOSAL FACILITY	1
2.2 GENERAL	2
3.0 RESPONSE TO SUBMISSIONS	3
3.1 THE PINJARRA PLANT EVAPORATION PONDS	3
3.1.1 Pond Design	3
3.1.2 Nutrients	4
3.1.2.1 Mobilisation of Nutrients by Infiltrating Rainfall	4
3.1.2.2 Mobilisation of Nutrients by Rising Water Table	6
3.1.2.3 Discussion	7
3.1.3 Radiation	8
3.1.3.1 Radium	8
3.1.3.2 Gamma Emission	9
3.1.3.3 Radon Production	10
3.1.4 Contingency Planning	11
3.1.4.1 Flooding - Overtopping	11
3.1.4.2 Flooding - Erosion	11
3.1.4.3 Seismic Risk	12
3.1.4.4 Breach of Pond Wall	12
3.1.4.5 Bushfire	15
3.1.5 Interaction between Rare Earths Plant and Gallium Plant Liquors	
3.2 TRANSPORT	15
3.2.1 Intermediate Product	17
3.2.2 Rare Earths Nitrate	18
3.2.3 Hazardous Chemicals	18
3.2.4 Emergency Plans in the Event of Spillage of Hazardous Chemicals	18
3.2.5 General	18

	<u>Page No.</u>
3.3 RADIATION PROTECTION	19
3.3.1 Dust Emissions	19
3.3.2 Gas Emissions	20
3.3.3 Monazite Handling	20
3.3.4 Contamination Ex-plant	21
3.3.5 Process Details	22
3.4 GENERAL	
3.4.1 Compliance with Statutory Requirements	22
3.4.2 Water Supply	23
3.4.3 Effect on Housing	23
3.4.4 Decommissioning	23
3.4.5 Release of Stormwaters	24
3.4.6 Water Monitoring Programme	24
3.4.7 The Gallium Project and the Rare Earths Project	25
3.4.8 Background Radiation Survey	26
3.4.9 Data on Particle Sizing of Monazite and Plant Products	27
3.4.10 Potential for Spread of Dieback	27
3.4.11 Adequacy of Detail in the ERMP/Draft EIS	27
4.0 CONCLUSION	28
5.0 REFERENCES	30
6.0 GLOSSARY	31

1.0 INTRODUCTION

Rhône-Poulenc Chimie Australia Pty Ltd has prepared an Environmental Review and Management Programme/Draft Environmental Impact Statement (ERMP/Draft EIS) for a proposal to develop a Rare Earths Processing Plant in Western Australia.

The ERMP/Draft EIS was released for public review for a 10 week period beginning 22 February 1988.

Comments and submissions received by both the Western Australian Environmental Protection Authority (EPA) and the Commonwealth Department of Arts, Sport, the Environment, Tourism and Territories have been summarised and reviewed by EPA. This summary and review is reproduced in Appendix A, and has been supplied to Rhône-Poulenc so that where appropriate, responses can be made.

This supplement to the Draft EIS contains these responses, and in conjunction with the ERMP/Draft EIS forms the Final EIS as required under the Environment Protection (Impact of Proposals) Act 1974-1987.

2.0 SCOPE OF THE DOCUMENT

2.1 THE W.A. GOVERNMENT PROPOSAL FOR AN INTEGRATED HAZARDOUS WASTE DISPOSAL FACILITY

Subsequent to the preparation of the ERMP/Draft EIS, the Western Australian government has initiated a proposal to develop an Integrated Hazardous Waste Disposal Facility. The proponent for this proposal is the Health Department of W.A., which released a Public Environmental Report (PER) for public review on 21 May 1988. The PER recognises that:

"The proposal specifically includes:....

- o an area for the burial of low level intractable wastes arising from the processing of mineral sands....."

and;

"The Health Department will raise charges on behalf of the Government for the transport and disposal of appropriate wastes. The charging procedure will include:

- (1) recovery of the costs of transport and handling procedures;

- (2) a proportional charge to cover Government costs incurred in surveillance and monitoring of the integrated waste disposal facility during the operational and post operational phases and for any remedial work which may be found to be necessary in the future;
- (3) an agreement by which each waste producer disposing of its intractable wastes through the integrated waste disposal facility will remain liable for costs incurred in rectifying any deficiencies arising at the facility with their wastes from inadequate specification of the type and nature of the wastes or their conditioning for a period of 10 years from the date of acceptance by the Health Department for consignment for disposal. At the expiration of this 10 year period all title to, and responsibility for continued management of the wastes will be the responsibility of the Health Department on behalf of the Government of Western Australia.
- (4) costs for any additional conditioning and packaging of wastes prescribed by the Health Department to render them acceptable for consignment and disposal."

(Maunsell & Partners, 1988)

It is therefore, evident that the transportation, disposal and management of the gangue residue will not be the responsibility of Rhône-Poulenc, and consequently EPA has not required any response to comments made on this aspect of the project. Rhône-Poulenc has been advised that all such comments will be incorporated in the assessment process for the proposed Integrated Hazardous Waste Disposal Facility.

2.2 GENERAL

In addressing EPA's Summary and Review of Submissions, Rhône-Poulenc has attempted to respond to all comments, although some are beyond the scope of Rhône-Poulenc as proponent for this project.

There is a considerable degree of overlap between some comments, and where a single response deals with a number of comments, the particular comments, as identified in EPA's summary and review of submissions are indicated in parentheses.

3.0 RESPONSE TO SUBMISSIONS

3.1 THE PINJARRA PLANT EVAPORATION PONDS

Two significant types of waste will be deposited in the evaporation ponds - nutrients, principally calcium phosphate ($\text{Ca}_3(\text{PO}_4)_2$) and ammonium nitrate (NH_4NO_3) and radionuclides, principally radium (Ra_{226} and Ra_{228}) and their daughter products. Concern has been expressed at the presence of nutrients within the catchment of the Peel-Harvey system, where nutrient enrichment of the estuary has created significant environmental impacts in recent years. Rhône-Poulenc is aware of the sensitive nature of the catchment and has proposed a management programme for the ponds to address concerns regarding both nutrients and radionuclides. This programme comprises:

- o The construction of an underdrainage system, to intercept any seepages that may occur during the operational life of the ponds.
- o Dewatering (by evaporation) and capping with impermeable materials on decommissioning of individual ponds, to ensure that the potential for leaching of nutrients and radionuclides from the stored wastes is essentially eliminated.

3.1.1 Pond Design

The pond system consists of storm lakes and evaporation ponds as shown on Figures 1 and 2. The system has been designed based on a mean annual evaporation rate of 2500mm and a mean annual rainfall of 880mm. Thus, the mean net natural evaporation rate is 135mm/month. This has been reduced to allow for the effect of the various concentrations of salts in the ponds. For the first pond (B1), it will be reduced to 104mm/month, the second (B2) and third ponds (B3) will have design evaporation rates of 87mm/month and 52mm/month, respectively. Pond B1 will have a constant water level and overflow into B2, most residue will accumulate in B1. Pond B2 will then discharge into B3 (Figure 2).

The initial inflow rate to the ponds will be $14.4\text{m}^3/\text{hour}$ (for the gallium project) and will increase to a maximum of $21\text{m}^3/\text{hour}$ with completion of the rare earths project.

Initially, two storm ponds and two evaporation ponds will be constructed with a total area of 8 hectares. All ponds will be operated with standing water but with a minimum level in the storm ponds. This is to maximise evaporation rates. The mean evaporation rate from these ponds will be $9.6\text{m}^3/\text{hr}$. Hence, the net filling rate of the ponds will be $510\text{mm}/\text{year}$ increasing to $1200\text{mm}/\text{year}$ when the rare earths project come into operation (scheduled for early 1991).

To achieve a balance between evaporation and input, additional ponds of approximately 16 hectares will be required. However, these will not need to be operational until some time in 1992 even allowing for a net evaporation rate of one half the design rate. The intervening period will allow evaluation of site specific evaporation rates and to monitor the performance of the clay seals and underdrain systems. A long term total pond area of 30 ha will be used for the worst case seepage calculations.

The decommissioning of the ponds is referred to in the ERMP and Section 3.4.4 of this Supplement. [1(iii)(ix)]

3.1.2 Nutrients

The evaporation ponds that will be used for the disposal of residues from the plant will eventually occupy an area of about 30ha and extend (at the deepest point) to an elevation of about +44.5m AHD. The ponds will be underlain by an extensive underdrain system consisting of 500mm sand over a minimum of 500mm compacted in situ clay to 98% SMDD with a permeability of $5 \times 10^{-9}\text{m}/\text{sec}$ and will be sealed with a 1000mm thick compacted clay liner (Figure 3).

Upon decommissioning, all liquids will be evaporated off and the ponds will be backfilled and covered with a contoured and compacted clay cap which will divert runoff away from the pond area.

In order to address the "worst case" scenario of nutrient loading to the environment caused by the ponds, it has been assumed that the underdrain system is not in operation after decommissioning, for the purpose of the discussions and calculations shown below.

Two scenarios of nutrient mobilisation from the decommissioned ponds have been considered:

- o Infiltrating Rainfall
- o Saturation of ponds caused by water table rise

3.1.2.1 Mobilisation of Nutrients by Infiltrating Rainfall

In order to calculate the potential leaching of nutrients from the pond area after decommissioning an estimate of the percentage of rainfall which reaches the water table (recharge) is required.

This recharge has been estimated for the sandier sections of the Swan Coastal Plain. In the Mirrabooka wellfield it is estimated to be 8.3% (Bestow, 1971). For the western half of the Gnangara Mound it has been estimated as 8.5% (Allen, 1976). For the entire Gnangara Mound, Allen (1981) has estimated recharge as 11.5% and for the Jandakot Mound, Davidson (1984) has calculated it to be 12.3%. The generally accepted range for the Swan Coastal Plain is 5-15%.

Closer to the Pinjarra area, Deeney (in press) has calculated that the recharge through sections of Guildford Clay near Waroona is approximately 1.8% of annual rainfall.

The percentage of rainfall entering a compacted clay cap contoured to promote surface runoff and covered with grass vegetation must be very small and can only be estimated. Based on the results from Waroona and considering the compacted nature of the clay cap estimated recharge through the ponds is probably less than 0.2%, and 0.1% is considered to be a realistic estimate when transpiration losses are taken into account. The table below outlines estimated flows through the pond area using differing recharge rates and assuming an annual rainfall of about 900mm.

% Rainfall	Infiltration (m)	Pond Area (10 ⁴ m ²)	Annual Recharge	
			(m ³ /year)	(m ³ /day)
0.05	0.0005	30	135	0.37
0.1	0.0009	30	270	0.74
0.2	0.0018	30	540	1.48

Although it is felt that 0.1% of rainfall infiltrating the clay cap is reasonable, in order to develop other scenarios values of 0.2% (2 times estimated actual) and 0.05% (one half of estimated actual) are also considered. This indicates that 135-540m³/year or 0.37-1.48m³/day may pass through the buried nutrient source.

To translate this amount of vertical water throughflow to nutrient loading the solubility of the nutrient sources in water will be used. This, once again, may be an overestimate of potential nutrient loading because the nutrient source will generally be in the unsaturated zone.

The form of phosphorus in the decommissioned ponds is tribasic calcium phosphate, (Ca₃(PO₄)₂) and dibasic phosphate (CaHPO₄·2H₂O). If the higher solubility of dibasic phosphate (0.02 grams per 100 grams of water) is used, the 135-540m³ of water could contain about 27-108kg/year (135-540m³ x 1000L/m³ x 0.2g/L) of salt. This is equivalent to a phosphorus load to the environment of about 5-20kg/yr. In terms of potential environmental impact, it is widely recognised (Kinhill, 1988) that phosphorus is the critical nutrient in the Peel-Harvey System. The Western Australian Government's management strategy aims at lowering the phosphorus input to the Peel Inlet and Harvey Estuary to 85 tonnes/year. The worst case quantity of phosphorus from the ponds, 20kg/yr, amounts to 0.024% of the goal input, so it is considered insignificant when dilution and attenuation effects are taken into account.

Nitrogen is also a key element in the eutrophication of the Peel-Harvey Estuarine System, although nitrogen does not appear to have an effect on the algal bloom in this system. The annual load of nitrogen input to the Peel-Harvey System was 1,200 tonnes for the years 1977-84 (DCE, 1985), mostly from the wheat-belt catchments flowing into the Murray River. The form of nitrogen in the evaporation pond residue is ammonium nitrate (NH₄NO₃). The solubility of this compound is about 208 grams per 100 grams of water. The estimate of 135-540m³ of water which is assumed to pass through the pond area each year could therefore contain about 280-1120 tonnes (135-540m³ x 1000L/m³ x 2080g/L) of NH₄NO₃, or approximately 100-390 tonnes of nitrogen.

While this amount of nitrogen appears large it corresponds to annual recharge rates which are based on estimated recharge rates. Such estimates could be significantly improved by monitoring pond performance during the early years of operation. No study has been done to quantify the attenuation of nitrates by the soils and plants or of the amount that would bypass the Murray River-Peel Inlet system.

3.1.2.2 Mobilisation of Nutrients by Rising Water Table

The lowest design elevation of the ponds is approximately 44.5m AHD (for the western edge of B2). One of the criteria of overall pond design will be to minimise the depth the ponds and underdrain system extend below the highest recorded groundwater level in the shallow piezometers. Within practical and engineering limitations, this indicates that the lowest design elevation of the ponds will generally be in the range 44-46m AHD. During the initial period of groundwater level monitoring, (July 1987 to August 1988) the following groundwater elevation ranges were measured:

PIEZOMETER NEST	PORTION OF PONDS	GROUNDWATER LEVEL (m AHD)
6	Northwest corner	39 - 42
7	West-central side	38 - 42
8	Southwest corner	38 - 41
9	North central side	41 - 45
10	South central side	42 - 45

The highest groundwater levels were recorded in August/September and generally occurred over a 1-2 month period.

From the groundwater level data it appears that eastern portions of pond B2 could be in the saturated zone for a one to two month period each year due to a seasonal rise of the water table. This time period has been minimised by pond design within the constraints of the existing topography of the site. Calculations have shown that with a 500mm compacted clay liner below the underdrain, groundwater takes about 100 days to move through the clay. The head differential which could cause this movement will be removed within 30-60 days by a declining water table. The resulting seepage into the buried nutrient source would be nil because in actual fact the groundwater has to move through 1.5m of compacted clay before entering the residue.

In considering the worst case scenario, however, it has been assumed that the water table rises 0.5m into the residue in pond B2 every 10 years. This worst case scenario may never be realised if the performance of pond B2 can be demonstrated to be satisfactory.

Assuming the following parameters;

- o Clay specific yield (1%)
- o Area of ponds B2 possibly affected (4ha)
- o Maximum rise of water table into residue (0.5m)

and if the total thickness of 1.5m of low permeability clay liner is disregarded, then a 0.5m water table rise into the residue represents $(0.5\text{m rise} \times 4 \times 10^4\text{m}^2 \times 0.01) = 200\text{m}^3$ of water which can mobilise nutrients. Utilising the data given in 3.1.2.1 above, it may be calculated that, in the worst case, this volume of water can contain about 7kg of P and 145 tonnes of N once every 10 years. These values are equivalent to an annual loading of 0.7kg P/year and 14.5 tonnes of N/year.

These values therefore represent possible maximum nutrient loads caused by a rising water table into pond B2 but are considered unrealistic as the low permeability of the compacted clay liners has been ignored and the underdrain system is assumed inoperative.

3.1.2.3 Discussion

The above worst-case analyses have shown that the decommissioned evaporation ponds represent a source of nutrients which can be mobilised by both infiltrating rainfall and a rising water table. Both of these potential methods are recognised and nutrient mobilisation will be minimised by:

- o The use of a compacted clay cap over the decommissioned ponds, and
- o An evaporation pond design which will minimise the depth of ponds below the water table.

In both cases the potential addition of phosphorus to the groundwater system is not considered significant within the context of the Peel-Harvey Estuary system.

The extremely high solubility of ammonium nitrate, however, results in potential nitrogen loadings from the decommissioned ponds. These potential loadings can only be properly assessed by monitoring evaporation pond performance in the early years of the project and extrapolating these results to assess future nutrient movement out of the decommissioned ponds.

Under present engineering design, ponds B1 and B2 are considered models for monitoring infiltration and underdrain performance in both the unsaturated zone and upper phreatic surface. The results of these performances, assessed by monitoring during the early years of plant life, will be used as a guide for future pond design.

Management strategies will be implemented to ensure that nutrient loadings to the environment are environmentally acceptable. These strategies are set out in Section 9.3.1 of the ERMP/Draft EIS. Of particular significance to the question of potential nitrogen loadings to the environment is the possibility of diverting some or all of the ammonium nitrate from the waste stream directed to the ponds, and producing a saleable commodity during the plant operating life or alternative disposal means afterwards. The proponent currently sells NH_4NO_3 from its plants in the USA and France, and has an economic (as well as environmental) incentive to do so at the proposed Pinjarra plant as rapidly as possible. [1(i)]

3.1.3 Radiation

3.1.3.1 Radium

The significant radionuclides that will be deposited into the evaporation ponds are the decay products of Uranium and Thorium, Radium 226 and 228. (The U and Th themselves being deposited and included in the gangue residue). In the short term the dominant radionuclide is Ra_{228} (with a half-life of 6.7 years) while in the longer term, the dominant radionuclide is Ra_{226} (half life = 1600 years).

For an effluent stream with 30% moisture content, the quantity of material deposited in the ponds will be 76,000 tonnes per annum. On the conservative assumption that 100% of the radium from the monazite will be deposited in the ponds (whereas in reality a fraction will be contained in the gangue residue), the activity of the pond residue due to the two radium isotopes will be as follows:

	Ra ₂₂₆ (Bq/kg)	Ra ₂₂₈ (Bq/kg)
Activity of pond residue during operations	4.1. x 10 ³	4.9 x 10 ⁴
Activity of pond residue post operations	4.1. x 10 ³	0

As the proponent is committed to rehabilitating the ponds so that radiation levels are no higher than background or permitted levels, the capping of the ponds to achieve this with the Ra₂₂₈ will be more than sufficient for the longer term Ra₂₂₆.

3.1.3.2 Gamma Emission

Predicted gamma exposure rates (UNSCEAR 1977) from exposed sludge are as follows:

$$\begin{aligned}
 \text{Dose rate uGy/hr} &= 0.43 A_{\text{Ra226}} + 0.66 A_{\text{Ra228}} \\
 &= 0.43 \times 4.1 + 0.66 \times 49 \\
 &= 34.1 \text{ uGy/hr}
 \end{aligned}$$

This is assuming no shielding of the sludge by water and a uniform distribution of radium in the sludge. After 50 years the rate will be reduced to 1.8 uGy/hr.

In normal operations the ponds will contain standing water, constituting a shield against radiation.

For a half value layer for water of 10cm, (and the minimum depth of water of approximately 0.5m), the gamma exposure would be reduced to $34.1 \times 0.031 = 1$ uGy/hr. This should ensure that during normal operations the ponds are not a designated area.

The ponds will be decommissioned and covered before all of the Ra_{228} decays away. Therefore while drying the ponds and covering them as a part of the decommissioning process, the pond will be considered a designated area.

The free water in the ponds will be slightly radioactive but should not contribute noticeably to the gamma exposure as it is expected to be in the range of 0.15Bq/g of Ra_{228} . This will be checked after commissioning of the Radium separation unit in the Pinjarra plant.

Conclusion: Gamma radiation during operation and rehabilitation of the project will be within the limits of environmental acceptability. [1(ii)]

3.1.3.3 Radon production

From the Guideline to the 1982 Waste Management Code, calculations can be made for the radon flux from bare tailings deposits and covered tailings. A full description of calculations is included in Appendix B.

In normal operation, the pond will contain free water over the tailings, the attenuation coefficient will be extremely high and the emission of radon from the ponds will be negligible.

During pond rehabilitation, it will be necessary for the free water to be evaporated off and it should be assumed that $45 \text{ mBq} \times \text{m}^{-2} \times \text{g}^{-1}$ of radon will be emitted from the pond during this limited period during commissioning and rehabilitation.

Assuming that a 5 ha pond (225m x 225m) is decommissioned at each operation and that a light breeze of 10km/hr spreads the radon within a 1m thick layer, the average concentration would then be:

$$\frac{45 \times 50,000 \times 3,600}{1,000 \times 10,000 \times 225 \times 1} = 3.6 \text{ Bq/m}^3$$

The Radiation Safety (General) Regulations 1983 provide a limit set at 110 Bq/m³. This indicates that there is no risk of exceeding the limits set in the regulations while covering the ponds and show that there is no need for more sophisticated modelling. [1(v)]

3.1.4 Contingency Planning

3.1.4.1 Flooding - Overtopping

The first pond (B1) in the evaporation pond system will run at a constant adjustable level overflowing into the second pond (B2), and hence overtopping of the first pond cannot occur. The second pond will be operated with a minimum freeboard of approximately 1.5 metres. The highest one day recorded rainfall (Perth Bureau) is 99mm. Even allowing for some increase in this figure for location differences, there is no likelihood of the pond overtopping from rainfall.

The storm ponds are designed to accommodate 100mm of rain from the plant site area. The operating philosophy of the storm ponds is to direct clean rainwater to the adjacent creeks and contaminated water to the evaporation ponds. Allowing for no diversion and up to 100mm of rainfall, this would increase the depth in the second evaporation pond by an additional 130mm. Combining the effects of heavy rainfall on the plant site and the pond system together with the maximum operating level intended in the ponds still leaves approximately 1.3 metres of freeboard.

[1(iii)(iv)(ix)]

3.1.4.2 Flooding - Erosion

The potential for flooding of the land around the evaporation ponds has been assessed based on a 1 in 100 years storm of 30 minutes duration having a rainfall intensity of 60mm/hr and analysis of this flood was carried out using the accepted hydraulic drainage design methods of Manning's formula and the Rational method as detailed in the Australian Rainfall and Runoff text of 1987, produced by the Institution of Engineers Australia.

Water flow resulting from the above storm would only fill the two creeks running past the plant and ponds to the north and south.

In the north creek, the water surface level would be 0.5m below the creek banks and the corresponding ground level at the evaporation ponds. A similar situation exists with the south creek.

In summary, under a 1 in 100 year storm, the surface level of the water in the vicinity of the plant and evaporation ponds will be below the level of the natural surface at these facilities, and thus there is no possibility that the facilities will be flooded. [1(iii)(iv)]

3.1.4.3 Seismic Risk

Bureau of Mineral Resources (BMR) records show only 8 earth tremors above 2 on the modified Mercalli Scale (MM2) has occurred at Pinjarra since 1941. The highest intensity was in 1968 (Meckering earthquake) which recorded an intensity of MM5. Intensities of MM9 or 10 are required to potentially cause serious damage to dam type structures.

Conclusion : Damage to ponds by earthquake is most improbable. [1(iv)]

3.1.4.4 Breach of Pond Wall

While data presented in Section 3.1.4.2 and 3.1.4.3 above indicate the very low probability of the evaporation pond walls being breached due to flood or earthquake events, there remains a finite possibility of a breach occurring.

In that event, the following is likely to occur:

- o The free water covering the wastes, and the semi-liquid wastes themselves will flow out of the breach, and into either one (or both) of the two ephemeral water courses that traverse the proponent's property in an east to west direction.

- o As a result of the low gradients of these water courses, particularly towards the western end of the property, and between the property and the Murray River, the solids will largely settle out, and most if not all of the fluid would be expected to infiltrate into the sandy soils. In the worst case, if a breach occurred when streams were flowing and the natural water table approximated the ground surface, water containing both radionuclides and nutrients would conceivably reach the Murray River. In these circumstances considerable dilution would be expected. The activity and mean concentration of the radionuclides in the pond water (in its undiluted state) are given in ERMP/Draft EIS Volume 2, Supporting Document 2, Table 5.2. The volume of water that would be expected to escape as a result of the breaching of a pond wall may be estimated from the area of typical pond and the average depth of water overlying the waste (225m x 225m x 0.5m \approx 25,000m³).

To calculate the quantity of nitrogen and phosphorus in the liquid waste, the solubility of the nutrient sources will be used - for the phosphate salt 0.02g per 100g of water, and for ammonium nitrate 208g per 100g of water. Assuming that the volume of liquid waste is 25,300m³ and that it is saturated with the nutrients, it would contain 5,060kg of phosphate salt, equivalent to 920 kg of phosphorus.

Due to the high solubility of ammonium nitrate, the liquid waste, if saturated, could contain 52,624 tonnes of dissolved NH₄NO₃, equivalent to 18,400 tonnes of nitrogen.

To determine the time taken for the full discharge of liquid waste from a breach of a pond wall to flow into the Murray River, the following assumptions have been made:

1. Breach in wall 20m wide x 3m deep (2.5m solids, 0.5m liquid)
Area of liquid/solid flow = 60m²
2. Liquid component of waste is all discharged out of the pond in 2 hours.
3. Breach occurs in west wall of the second evaporation pond such that all liquid flows quickly to the creek on the north side of the plant site.
4. Time is late winter (e.g. August), such that surface flood conditions prevail:
 - o land is saturated
 - o water table is at surface over lower lying land
 - o none of the liquid waste soaks into the ground
 - o water course has base flow due to winter rainfall runoff

5. Velocity of flow in water course = 0.75m/sec.
6. Length of creek from evaporation pond to Murray River = 9.3km.
7. Volume of liquid waste in a pond that will be discharged = $(225 \times 225 \times 0.5) = 25,300\text{m}^3$.

Assuming the above conditions, the flow velocity of the liquid will be 3.5m/sec and the volume flow $3.52\text{m}^3/\text{sec}$. The velocity of flow in the creek is taken as 0.75m/sec, this being an acceptable rate of flow for such a secondary water course with saturated ground conditions, traversing flat and low sloping country.

For a given flow rate, the time taken for all the liquid waste to be discharged from the creek is dependent on the cross sectional area of flow; for this analysis, an average creek slope has been determined, from which an average cross sectional area of the liquid has been derived. This is a trapezoidal shape, with top water surface width of 10m, bottom width of 0.8m and flow depth of 0.6m. The area is 3.24m^2 and the corresponding volumetric flow rate is $3.24 \times 0.75 = 2.43\text{m}^3/\text{sec}$. This flow is positioned on top of the existing winter runoff flow of top surface width 0.8m.

Based on the above, the time taken for the complete liquid waste volume to enter the Murray River is just under 3 hours.

While the probability of such a breach occurring is extremely low, the assumed worst case conditions that would maximise the potential for the waste to reach the Murray River are wet, winter conditions, and high natural flow rates would be anticipated for the river. Conversely, when flow rates in the Murray River are at a minimum (in dry, summer conditions) the potential for any spilled waste to reach the river will be minimised.

The solid or semi-solid waste that would be deposited downslope from the evaporation pond would be of an activity as described in Section 3.1.3.2 above, and would be cleaned-up and re-deposited into a secure storage on the proponent's property.

3.1.4.5 Bushfire

The effects of a bushfire on the rehabilitated surface of an evaporation pond are apparently of some concern in the event that, as is normal practice in fire - fighting, earth moving equipment is utilised to clear fire breaks. It is highly unlikely that the inert cover to the pond will be penetrated, as a minimum cover thickness of one metre is currently envisaged. [1(viii)]

3.1.5 Interaction between Rare Earths Plant and Gallium Plant liquors

As indicated in the ERMP/Draft EIS (Volume 1, Section 3.3.1) the effluents from the two plants are complimentary in terms of environmental management, as one is alkaline while the other is acidic. In addition, studies by Rhône-Poulenc utilising effluents from operating Gallium and Rare Earths plants have shown that, in the mixing process, in excess of 99% of the radium in the rare earths effluent is rendered insoluble. Detailed results from these studies constitute proprietary information and will not be made public, although Rhône-Poulenc will on request make the results available to the appropriate Government authorities. [1(vii)(xi)]

3.2 TRANSPORT

As noted in Section 2.1 above, the current proposal by the Western Australian Government to develop an Integrated Hazardous Waste Disposal Facility will relieve Rhône-Poulenc of responsibility for the transportation of waste products beyond the proponent's property boundary. This section on transportation therefore deals only with the transport of input raw materials and products of the plant.

In order to clarify the current situation with regard to the transportation of hazardous materials in Western Australia, the following is an extract from EPA's Bulletin 276 (February 1987), entitled "Legislative Control of Hazardous Substances in Western Australia":

"4.7.4 Transport

The road transport of hazardous substances, except for explosives and radioactive substances, is primarily controlled by the Dangerous Goods (Road Transport) Regulations 1983 of the Explosives and Dangerous Goods Act 1961. The Regulations essentially adopt the road transport requirements of the Australian Code for the Transport of Dangerous Goods by Road and Rail 1983 (Advisory Committee on the Transport of Dangerous Goods, 1980). They specify requirements for the labelling and identification of packages, placarding of vehicles, the design and construction of packages and bulk tanks, and the inspection and licensing of vehicles. They also give emergency procedure instructions which form the basis of the WA Transport Emergency Assistance Scheme (see below). Amendments to the Regulations, which will institute a programme for the training and licensing of drivers, have recently passed through Parliament. These requirements will ensure that drivers are aware of the necessary emergency procedures in the event of an accident.

The Dangerous Goods (Road Transport) Regulations apply only to substances listed in the Schedule to the Regulations. If a particular substance is not scheduled, it is exempt from road transport requirements for dangerous goods.

Rail transport of hazardous substances is controlled under the Government Railways Act 1904 and Regulations. All transport is required to be in accordance with the Railways of Australia Code of Practice and Conditions for the Carriage of Dangerous Goods 1984 and is subject to approval under the Explosives and Dangerous Goods Act. The code of practice incorporates the Australian Code for the Transport of Dangerous Goods by Roads and Rail 1983.

Air transport is a Commonwealth matter under the Air Navigation Act. This legislation incorporates the International Civil Aviation Organisation's Regulations for the airfreight of hazardous substances. The State has no legislative responsibility in this area, due to the comprehensive nature of Commonwealth legislation, and for constitutional reasons.

The transport of radioactive substances is controlled separately from other hazardous substances under the Radiation Safety Act 1975, and Radiation Safety (Transport of Radioactive Substances) Regulations 1982. The Act requires all consignors to hold a licence. The Regulations call for conformity with the Australian Code of Practice for the Safe Transport of Radioactive Substances 1982, and the International Atomic Energy Agency Regulations for the Safe Transport of Radioactive Materials 1973. The Code and Regulations apply to all modes of transport.

In some instances, the requirements of these Regulations do not meet those of the Dangerous Goods (Road Transport) Regulations (e.g. the special licensing of vehicles). In such cases, it has been necessary to employ a combination of both sets of regulations to ensure radioactive substances are transported safely. In all other respects, this legislation is considered to be adequate.

The transport of explosives is controlled by the Explosives Regulations 1963 to the Explosives and Dangerous Goods Act 1961. The Act requires licences to be held before any explosive exceeding a prescribed quantity is conveyed by vehicle or vessel. The Explosives Regulations specify stringent requirements for the transport of explosives by road, including the suitability of vehicles and the segregation of goods, and give the Chief Inspector of the Explosives and Dangerous Goods Division powers to approve conveyance by boat.

One of the roles of existing transport legislation is to minimise the risk of accidents to vehicles conveying hazardous substances and to assist emergency services in the event of an accident. There is one further initiative, although not a regulatory one, to help ensure that dangers to the public and the environment are minimised following an accident.

The Western Australian Transport Emergency Assistance Scheme (WATEAS) was introduced in 1985 and has been designed to assist those organisations with statutory responsibility in the event of a road transport incident involving hazardous substances. The scheme is working successfully to achieve objectives such as the establishment of co-ordinating mechanisms between Government agencies and the private sector in the transport of dangerous goods, and the provision of concepts and procedures for the handling of transport emergencies involving dangerous goods. Because of the scheme's success, and in the absence of a more appropriate system, the WATEAS is now being used for non-transport chemical emergencies, for which it has not been specifically designed. Although it has worked well, it points to the need for expansion of the WATEAS to a general emergency response scheme or the development of a separate scheme for this purpose."

Rhône-Poulenc will comply with all relevant legislation and regulations in the transportation of materials. [2(i), 2(iv), GP.(1)(11)]

3.2.1 Intermediate Product

Contrary to an assertion in the EPA's Summary and Review of Submissions, the intermediate product will not be significantly more radioactive than monazite. Radiation measurements of the materials made at the La Rochelle processing plant are presented in Attachment 5 of Supporting Document II of the ERMP/Draft EIS. Transportation procedures and safeguards will therefore be similar to those already in place in regard to monazite. [2(i)]

3.2.2 Rare Earths Nitrates

Rare earths nitrates and salts will be produced in the later stages of the project. As indicated in the ERMP/Draft EIS (Section 4.2.5), the precise form of these products will vary, dependent upon market requirements. If any of the products is designated as a hazardous material, it will be packaged, marked and handled in accordance with the appropriate statutory requirements. [2(iv)]

3.2.3 Hazardous Chemicals

As indicated in the ERMP/Draft EIS (Section 8.1.6.2), it is conservatively estimated that an additional 77 truck movements per week on the Pinjarra-Williams Road will result from operation of the Rare Earths Plant.

Of these 77 truck movements, it is estimated that 37 trucks per week will be transporting hazardous materials, consisting of the following:

	Tonnes per annum	
Sulphuric Acid	10,000	
Nitric Acid	12,000	
Hydrochloric Acid	750	
Ammonia	15,000	
Others	1,000	[2(ii)]

3.2.4 Emergency Plans in the Event of Spillage of Hazardous Materials

The proponent will comply with all applicable standards and regulations with regard to emergency procedures in the transportation of hazardous materials. Chemical manufacturers in Western Australia already have appropriate procedures in place for such materials. [2(ii)(iv)GP(11)]

3.2.5 General

As noted in the ERMP/Draft EIS (Section 8.1.6.2), where required, potentially dangerous goods will be transported in purpose-built trucks which will conform to the requirements of the Mines Department's Dangerous Goods (Road Transport) Regulations, 1983.

With regard to upgrading of the Pinjarra-Williams Road, the ERMP/Draft EIS states:

" All truck movements are expected to be during normal business hours Monday to Friday. At the conservative rate of 77 per week, this can be expressed as less than 2 trucks per hour during a normal working week, along the Pinjarra-Williams Road. Many of these trucks are likely to be used for materials haulage to and from the plant site, so even in a worst case situation, this results in less than four truck movements per hour on a working day....

To place this increase in road usage in context, the heavy vehicle component along the Pinjarra-Williams Road will increase from five percent to seven percent. This will have a low impact on the road pavement as discussions with the Main Roads Department have indicated this road is in good condition. The intersection of Napier Road and Pinjarra-Williams Road will be upgraded to cater for increased road usage."

(This upgrading has now been completed at the proponent's expense) [2(iii)]

3.3 RADIATION PROTECTION

The first two commitments to environmental management made by Rhône-Poulenc in the ERMP/Draft EIS (Section 11.0) are as follows:

- " 1. The proponent will comply with the requirements of the draft Commonwealth Code of Practice on Radiation Protection in the Mining and Milling of Radioactive Ores (dated June 1987). [Now the Code of Practice on Radiation Protection in the Mining and Milling of Radioactive Ores 1987].
2. The proponent is committed to the ALARA principle (that radiation doses be kept as low as reasonably achievable, economic and social factors being taken into account)." [3(iv)]

3.3.1 Dust Emissions

At all points where handling of materials will give rise to the potential generation of dust containing radionuclides, appropriate dust collection facilities will be installed.

Dust emissions from the evaporation ponds will be prevented by maintaining all wastes in a wet condition. [3(i)(ii)]

3.3.2 Gas Emissions

Gaseous emissions from both the plant itself and the evaporation ponds will be managed so as to ensure compliance with the provisions of the 1987 Mining and Milling Code. The primary means of management will be:

- o the provision of adequate ventilation to employee working places,
 - o the incorporation of a large buffer zone between the plant and the general public.
- [3(i)(ii)]

3.3.3 Monazite Handling

Monazite will be processed within the plant at about 2 tonnes per hour. Therefore a truck load of monazite coming from a specific mine would be treated in approximately 10 hours. With the current level of knowledge of monazite treatment this is not sufficient time to allow proper adjustment to be made to the process to maximise yields and minimise incidents such as total caking of the front end process. When this occurs there is no other solution than to remove the solidified mass manually. This is obviously not a satisfactory operating condition.

The only alternative solution would be to build storage tanks at least equal in number to the number of existing mines or existing dry plants in the mineral sand industry. This would lead to a minimum of five and, in the future, six or seven silos of large capacity. Rhône-Poulenc estimates that the capital cost involved in building 6 fully automatic silos is in the order of 3 million dollars.

In addition, a strategic stockpile is also necessary within the plant. This stockpile, formed by the accumulation of materials from various origins, can realistically only be packaged in bags. The same difficulties concerning the standardisation of process conditions apply to these various lots and therefore they must be stored and handled separately.

Finally, it will probably be necessary in the future to receive monazite from outside Western Australia. These shipments are normally in bags, and it is therefore necessary to retain a debagging station. The cost of maintaining separate stocks of monazite from various sources in bulk form is prohibitive and the proponent will therefore choose to retain the bag as the main form of monazite shipment.

For these reasons, Rhône-Poulenc currently has no alternative other than to undertake monazite handling in bags. The proponent nonetheless recognises the concerns raised with regard to bag versus bulk handling and will endeavour to develop a set of continuous controls that would enable quicker response times in the process. This would enable the use of a common silo and make the economics of bulk delivery acceptable. A bag receiving system would, however, be retained and used for non-W.A. monazite and strategic stockpile consumption. [3(v)]

3.3.4 Contamination Ex-plant

The proponent has, in the ERMP/Draft EIS, made a commitment that a comprehensive monitoring and health surveillance programme will be implemented, and that monitoring of radiation levels will continue over the life of the project. These programmes will be formulated in collaboration with the appropriate Government authorities, and will (amongst other things) monitor any radioactive contamination that has the potential to enter a food chain via dust deposition onto farmlands, uptake by vegetation, and ingestion by cattle. Unlike pesticides, which accumulate in the tissues of plants and are then concentrated in the tissues of animals consuming those plants, any materials emanating from the plant and containing radionuclides will be inert. This will mean that intake of radionuclides can only occur as a result of ingestion of the dust itself, and so concentration through a food chain will not occur.

The effects of radiation on organisms other than man is a complex issue. Rhône-Poulenc has addressed the broad question of radiation in a number of ways;

- o by indicating that rigorous design, operation and maintenance of the plant will minimise any potential uncontrolled output of radioactive materials
- o by incorporating a substantial buffer zone to the plant, so that any potential impacts beyond the proponent's property are further minimised
- o by its intention to operate the plant in compliance with all appropriate statutory regulations
- o by adopting an approach that the health and safety of humans is the prime consideration with regard to radiation effects.

The effects of radiation on humans have been, and continues to be the subject of extensive research and monitoring worldwide. As the data base with regard to effects on organisms other than man is much less than that for effects on humans, Rhône-Poulenc believes that radiation protection measures for the proposed plant should be designed:

- o in accordance with the ALARA principle
- o to provide the maximum protection for humans
- o in accordance with all relevant statutory requirements.

The proponent considers that such an approach will minimise radiation exposure to organisms other than man. [3(i)(vi)(vii)PP.(1)]

3.3.5 Process Details

- o The control of emissions from the plant are addressed in Sections 3.3.1 and 3.3.2 of this document.
- o Due to reasons of commercial confidentiality process designs cannot be made public, but it is not possible to substitute hydrochloric or sulphuric acid for nitric acid in the process.
- o Some details of the hazardous chemicals to be utilised are given in Section 3.2.3 above. Safeguards in the use of these chemicals are also discussed in Sections 3.2, 3.2.4 and 3.2.5. [PP.(2)(3)(4)]

3.4 GENERAL

3.4.1 Compliance with Statutory Requirements

As outlined in the ERMP/Draft EIS, the proponent will comply with all relevant State statutory requirements. [GP.(1)]

3.4.2 Water Supply

With regard to water supply, Rhône-Poulenc has been granted an initial bore licence for 300,000 m³/annum. This will be sufficient for the Gallium Plant. Performance of the aquifer will be monitored and evaluated in conjunction with the Water Authority of Western Australia. Subject to this, and approval by WAWA, the licence may be increased. If not, alternative sources of water will need to be obtained, e.g. a collection dam for winter runoff from the proponent's property.

Water is recycled wherever possible in the process, in order to reduce both the economic and environmental effects of substantial usage. [GP.(2), GP.(9)]

3.4.3 Effect on Housing

Initial operating staff for the Gallium project will be recruited late in 1988. Staff for the Rare Earths project will be recruited in 1990 and 1991. Hence, a recruiting programme spread over a 3 year period is not expected to put undue pressure on the availability of housing in the region. [GP.(3)]

3.4.4 Decommissioning

Plant decommissioning may be considered in two parts - the process plant itself, and the evaporation ponds. The equipment within the plant will be either dismantled for re-use elsewhere, or scrapped. Non-contaminated plant will be disposed of by normal means (such as recycling, landfill disposal, etc.), whereas contaminated plant and equipment will be transported to the waste disposal facility utilised for the gangue residue, and disposed of in a similar manner to those wastes (i.e. by shallow ground burial). The total quantity will be much less than 1000 tonnes in total. The end use of buildings, hardstandings, etc., will be determined at the time of decommissioning. However, the proponent will demolish all facilities and restore the plant site to its former status of pasture should this be required by the appropriate authorities at the time of decommissioning. Any other decommissioning requirement is likely to be less costly than this alternative.

The decommissioning of the evaporation ponds is dealt with in the ERMP/Draft EIS at a conceptual level, indicating that the ponds will be evaporated dry, capped and vegetated with appropriate species.

The proponent will be guided by the appropriate statutory requirements in force at the time, when addressing this issue in detail. These requirements are currently delineated in the Code of Practice on the Management of Radioactive Wastes from the Mining and Milling of Radioactive Ores 1982, and the associated Guidelines. (GP.(4))

3.4.5 Release of Storm Waters

With regard to the release of storm waters, the proponent will comply with licence conditions that will be imposed by the EPA. (GP.(5))

3.4.6 Water Monitoring Programme

In order to ensure that the pond system operates as designed, the proponent has made a commitment to monitor the groundwater around the evaporation ponds for contaminants leaching from the ponds, discussed in Section 9.3.1 of the ERMP/Draft EIS.

Tracing elements will be used on the water samples such as:-

- o NH_4 or NO_3 used to follow NH_4NO_3
- o PO_4 used to follow $(\text{Ca}_3(\text{PO}_4)_2)$
- o Na used to follow NaCl
- o Ra_{228} used to follow Ra_{228} and Ra_{226} as they follow the same pattern.

The results from the monitoring will be made available to the EPA, and if any leakage from the ponds is occurring, the Authority will be notified forthwith.

3.4.7 The Gallium Project and the Rare Earths Project

The relationship between the Rare Earths Plant and the Gallium Plant are dealt with in the ERMP/Draft EIS as follows:

"1.1 BACKGROUND

Rhône-Poulenc Chimie Australia Pty. Ltd (Rhône-Poulenc) proposes to develop a rare earths treatment plant, and a gallium extraction plant, to be co-located on a site 4km south of Alcoa's alumina refinery at Pinjarra, Western Australia.

Dames & Moore has been commissioned by Rhône-Poulenc to prepare an Environmental Review and Management Programme and Draft Environmental Impact Statement (ERMP/Draft EIS) for the rare earths processing project, and a detailed Notice of Intent (NOI) for the gallium extraction project. This document is the ERMP/Draft EIS and unless otherwise stated, 'the project' refers to the rare earths processing plant only."

and also in Section 3.3 of the ERMP/Draft EIS:

" 3.3 ALTERNATIVE LOCATIONS

3.3.1 Processing Plant

The final choice of Pinjarra [for the Rare Earths Plant site] was strongly influenced by the decision of Rhône-Poulenc to proceed with the proposal to develop a Gallium Plant. The site selection rationale for the Gallium Plant is laid out in the Notice of Intent for that project, which has been approved by the Minister for the Environment. Briefly, the main siting constraint for the Gallium Plant is proximity to an alumina refinery, as the gallium is produced from the process stream (specifically the Bayer liquor) of such a refinery. The refinery with the largest capacity was selected, to allow the maximum potential for gallium extraction, and the Gallium Plant is therefore to be located adjacent to this refinery, at Pinjarra.

The proponent is consequently committed to the development of a major new industrial development at Pinjarra, which requires a number of facilities that could be common to both the Gallium Plant and rare earths processing plant. These include:

- o a system of evaporation ponds,
- o infrastructure facilities such as the provision of water, power, gas and communications,
- o administrative facilities such as offices, laboratory and maintenance workshops.

Substantial economic and environmental benefits will accrue from the co-location of the Gallium and Rare Earths Processing Plants. The economic benefits result from the non-duplication of facilities such as those noted above, and the environmental benefits include:

- o the development of evaporation ponds for effluent disposal at a single location. This will allow the visual impact of the ponds to be restricted to one rather than two sites. The environmental effect of enlarging the ponds to cater for both plants will be much less than would be the case in developing smaller ponds at two locations.
- o the materials that will be disposed of in the ponds are complimentary in so far as the effluent from the Rare Earths Plant is largely alkaline, while the Gallium Plant effluent is largely acidic.
- o the construction and operation of a single pond system will ensure that the resources to be committed to design and monitoring of the ponds, will be concentrated at one location. A single pond system will be more readily managed than would two separate systems. Environmental protection is therefore, enhanced by the plants being located at a single site."

In summary, the Gallium and Rare Earths projects are separate developments that are located on a single site.

The Gallium project has been subjected to the Western Australian environmental impact assessment (EIA) process, and has received the necessary approvals and is in the construction stage.

The Rare Earths project is subject to both Commonwealth and State EIA, and this document is part of that process. The Rare Earths project has not yet received environmental approvals, and construction has not yet begun. [GP.(6)]

3.4.8 Background Radiation Survey

The proponent will undertake an additional background radiation survey at the Pinjarra plant site immediately prior to commissioning. Significantly more sensitive equipment will be available at that time than was utilised in the survey reported in the ERMP/Draft EIS. [GP.(7)]

3.4.9 Data on Particle Sizing of Monazite and Plant Products

Data on particle sizing are given in Section A5.5.4 of Supporting Document 2 to the ERMP/Draft EIS. Further data from rare earths hydroxide produced from Western Australian monazite are presented on Figure 4. [GP.(8)]

3.4.10 Potential for Spread of Dieback

The construction and operation of the Pinjarra plant will not increase the risk of the spread of dieback disease (the soil borne pathogen Phytophthora cinnamomi) because:

- o the plant site area is not in or close to any Dieback quarantine areas,
- o the plant site is located on pasture land cleared of native vegetation,
- o all transport to and from the plant site will be along sealed roads,
- o during operation of the project, there will be no further site works of any significance to the potential spread of dieback disease. [GP.(10)]

3.4.11 Adequacy of Detail in the ERMP/Draft EIS

In preparing documentation for the purposes of environmental impact assessment, proponents face the difficult task of satisfying two mutually exclusive aims:

- o bringing the project to the attention of the public and the appropriate authorities at as early a stage as possible,
- o supplying the maximum amount of data on the project.

This invariably requires that a compromise be made in initiating public review as rapidly as possible, so that there is real potential for public input to the project, and assembling sufficient design data so that it is possible to adequately and accurately describe the project, its environmental impacts and their proposed management.

In the case of the proposed Rare Earths project, the proponent is also constrained by commercial considerations regarding confidentiality. Rhône-Poulenc has made clear to EPA its willingness to provide the Authority with any technical data that may be required, but much process information cannot be released to the public arena where it would be available to the proponent's commercial competitors. [GP.(12)]

4.0 CONCLUSION

The proposed Rhône-Poulenc Rare Earths Processing Plant Project that was the subject of the ERMP/Draft EIS has been substantially modified in that it is now intended that the management of the gangue residue that will be produced by the plant be undertaken by the Western Australian Government. The Health Department of Western Australia is the proponent for an Integrated Waste Disposal Facility, the proposal for which is currently being subjected to Western Australian Environmental Impact Assessment procedures.

The scope and scale of the project that has been considered in this Supplement has therefore been reduced, as the transportation and long-term management of the gangue residue will no longer be the responsibility of Rhône-Poulenc.

This Supplement deals with submissions and comments on the ERMP/Draft EIS relating to those aspects that remain a part of the project. The primary issues relate to:

- o The evaporation ponds system at the Pinjarra plant site
- o Transportation issues
- o Radiation safety
- o General issues

The proponent has, in some cases, been able to provide more definitive information than was available when the ERMP/Draft EIS was prepared. In other cases, the data required in order to finalise some environmental management strategies will not be available until final design of the plant is undertaken, and this will not take place until the necessary environmental approvals are secured. Indeed, some details of environmental management will be refined only when operational data (such as site specific evaporation rates) are available.

However, Rhône-Poulenc believes that the ERMP/Draft EIS, together with this Supplement to the EIS, provide sufficient data on the project, its environmental impacts, and the management of those impacts to demonstrate that the project can be managed so as to be environmentally acceptable. As noted in the ERMP/Draft EIS:

"The proponent is committed to the development and operation of an environmentally sound project."

Rhône-Poulenc will comply with all applicable and appropriate standards and regulations in constructing, operating and eventually decommissioning the proposed project, and intends to co-operate fully with Government authorities such as the Western Australian Environmental Protection Authority and the Department of Mines in developing and implementing detailed environmental management and monitoring strategies.

5.0 REFERENCES

- Allen, A.D. (1976). Outline of the Hydrogeology of the Superficial Formation of the Swan Coastal Plain, West. Australian Geol. Survey Ann. Report 1975.
- Allen, A.D. (1981). Groundwater Resources of the Swan Coastal Plain, near Perth, Western Australia, in Groundwater Resources of the Swan Coastal Plain (1981).
- Bestow, T.T. (1971). The Water Balance in the north Gnangara Area, West. Australia Geol. Survey Ann. Report 1970.
- Davidson, W.A. (1984). A Flow-Net Analysis of the Unconfined Groundwater in the Superficial Formation of the Southern Perth Area, Western Australia: West. Australia Geol. Survey Record 1984/9.
- Department of Conservation and Environment (DCE) (1985). Peel-Harvey Estuarine System Study, Management of the Estuary. Bulletin 195.
- Deeney, A.C. (in press). Geology and Groundwater Resources of the Superficial Formations between Pinjarra and Bunbury: West. Australian Geol. Survey Report.
- Environmental Protection Authority (1987). Legislative Control of Hazardous Substances in Western Australia. Bulletin 276.
- Institution of Engineers Australia (1987). Australian Rainfall and Runoff Text.
- Kinhill Engineers (1988). Peel Inlet and Harvey Estuary Management Strategy, Environmental Review and Management Programme - Stage 2. Department of Agriculture and Department of Marine and Harbours.
- Maunsell & Partners Pty Ltd (1988). Proposed Integrated Hazardous Waste Disposal Facility. Public Environmental Review.
- Mines Department (1983). Dangerous Goods (Road Transport) Regulations.
- Radiation Safety Regulations (1983).
- UNSCEAR (1977). Sources and Effects of Ionizing Radiation. United Nations Scientific Committee on the Effects of Atomic Radiation. Report to the General Assembly, with Annexes. New York. United Nations.

6.0 GLOSSARY

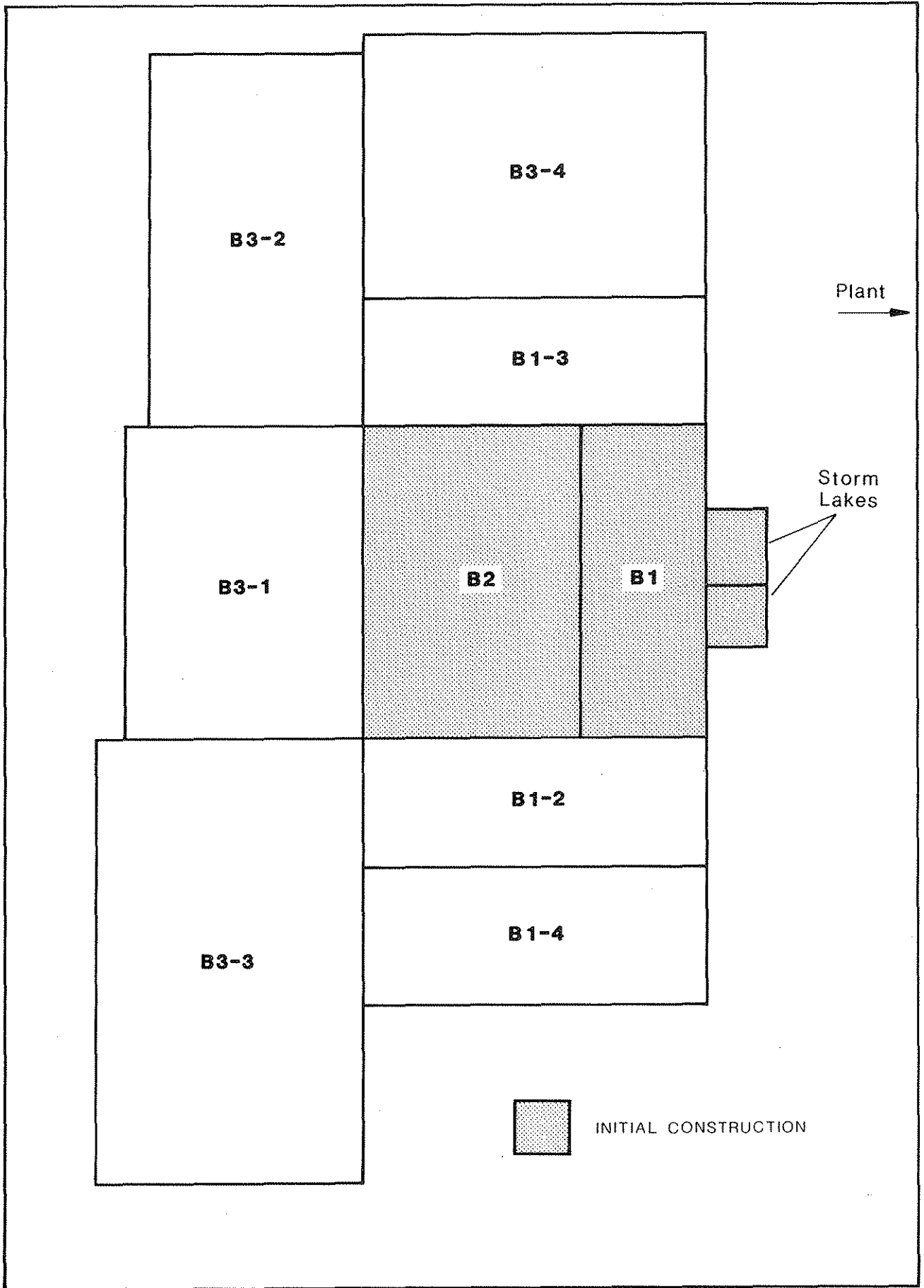
Activity	The number of disintegrations per unit time taking place in a radioactive material.
Aquifer	A geological formation or group of formations capable of receiving, storing and transmitting significant quantities of water that can be pumped.
Bayer liquor	Effluent resulting from the Bayer process for refining alumina. Contains a high proportion of caustic soda with other dissolved compounds. Is a primary input to the Gallium plant.
Becquerel (Bq)	The unit of measurement of radioactive decay defined as one radioactive disintegration per second. The disintegration may occur as a result of emission of an alpha particle or beta particle.
Daughter products	Radionuclides which are formed as a result of radioactive decay of a specified radionuclide.
Decay product	The product of the spontaneous radioactive decay of a nuclide. A substance such as ^{238}U decays through a sequence of steps and has associated with it many successive decay products in a decay series.
Dose	The radiation energy absorbed in a unit mass of material.
Effluent	Liquid industrial waste
Evaporation	Transfer of water from liquid to vapour from soil, vegetation and water bodies.
Freeboard (ponds)	The depth between the maximum height of the water and the top of the embankment.
Gamma radiation	A form of electromagnetic radiation similar to light or X-rays, distinguished by its high energy and penetrating power.
Gangue	The part of the ore that is not the objective in working the ore deposit.
Groundwater	Underground water contained within a saturated zone or rock (aquifer).

Half-life	The time taken for the activity of a radioisotope to decay to half of its original value, that is for half of the atoms present to disintegrate. Half-lives vary from isotope to isotope, some being more than a millionth of a second and some more than a million years.
Half Value Layer	The layer thickness required to reduce radioactivity by 50%.
Isotope	One of two or more forms of an atomic element having the same number of protons but a different number of neutrons. All isotopes of the same element have the same chemical properties, and therefore cannot be separated by chemical means.
Mercalli Scale	Scale used to measure the magnitude of an earthquake. Each whole number represents an increase of 10 times the energy.
Monazite	A mineral containing phosphates of rare earth metals. Chief source of rare earth elements.
Radioactive Radionuclide	Spontaneously emitting radiation by nuclear transformation. A nuclide of an atom that is radioactive.
Radon	The radioactive decay product of radium. It occurs as an inert gas. The predominant isotope, ^{222}Rn , has a half-life of 3.8 days.
Radon daughters	A term applied to the four short-lived decay products of radon gas: ^{218}Po , ^{214}Pb , ^{214}Bi and ^{214}Po .
Rare earth elements	A group of metals with atomic numbers from lanthanum (atomic number 57) to lutetium (71). Yttrium (39), and scandium (21), while not strictly rare earths, are generally grouped with them. Rare earth elements are not especially uncommon. They have very similar chemical and physical properties making separation of individual elements difficult.
Recharge	Rainfall which reaches the water table.



Figures





CONCEPTUAL LAYOUT OF EVAPORATION PONDS

SCHEMATIC SECTION THROUGH THE EVAPORATION POND SYSTEM

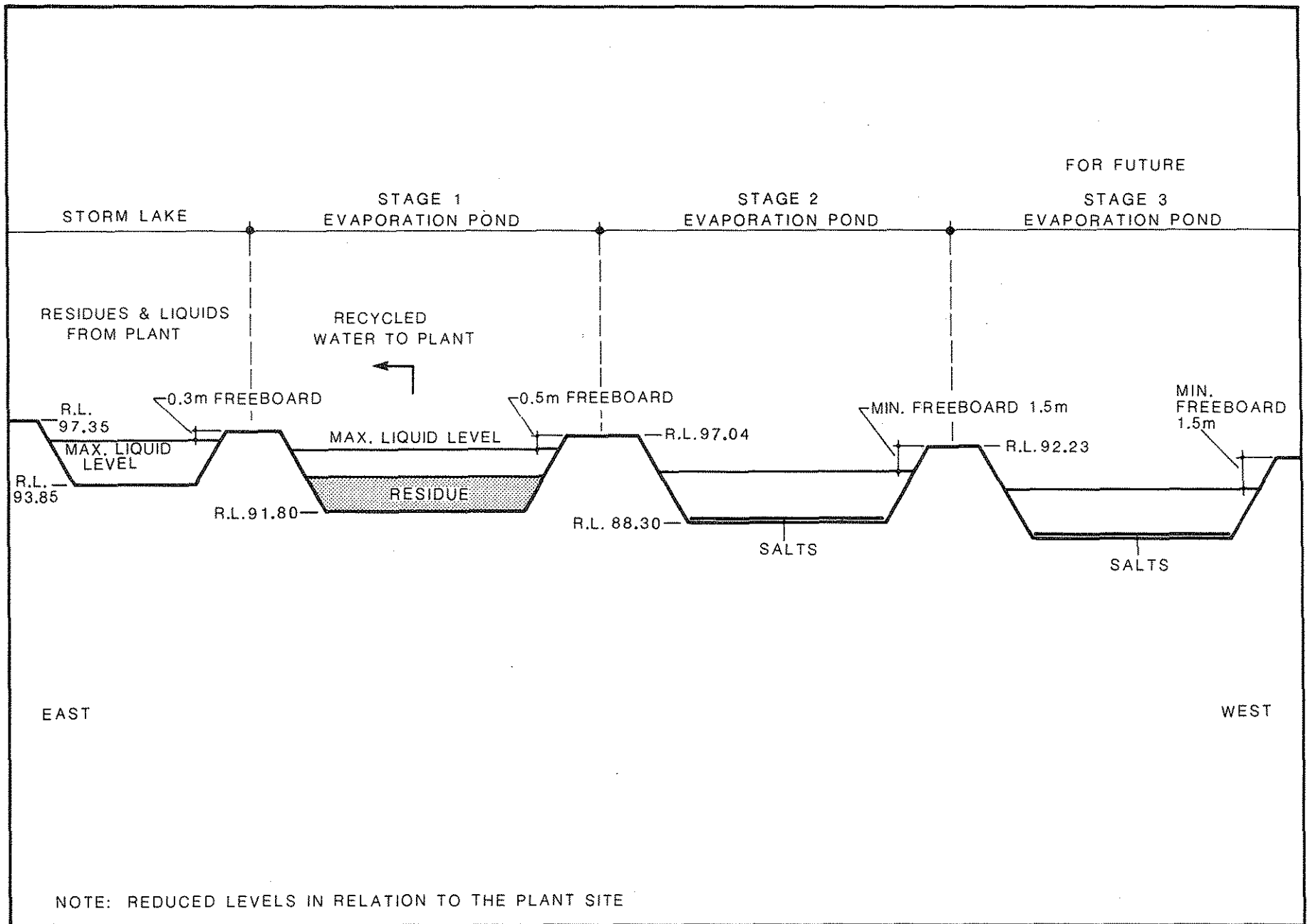
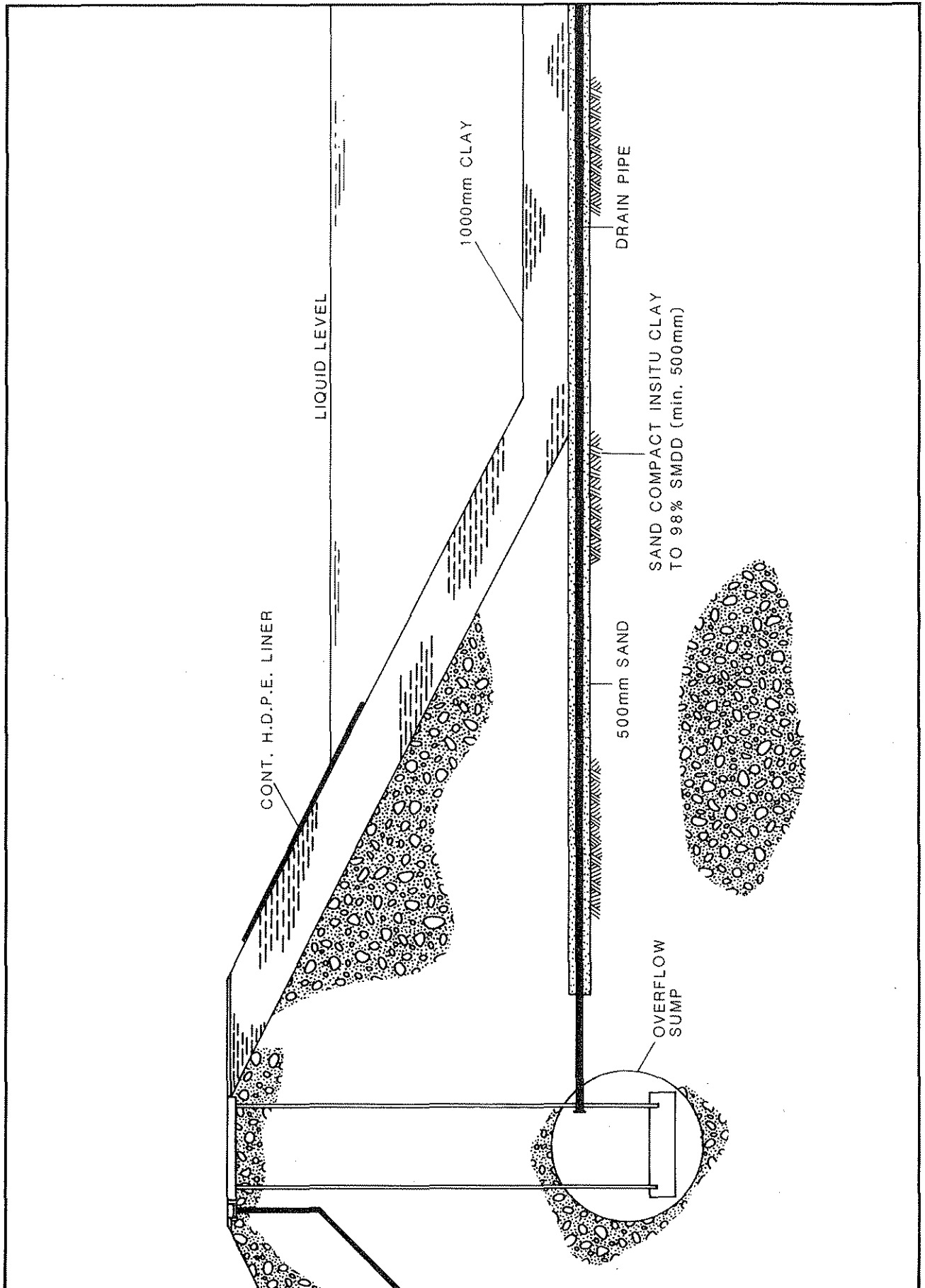
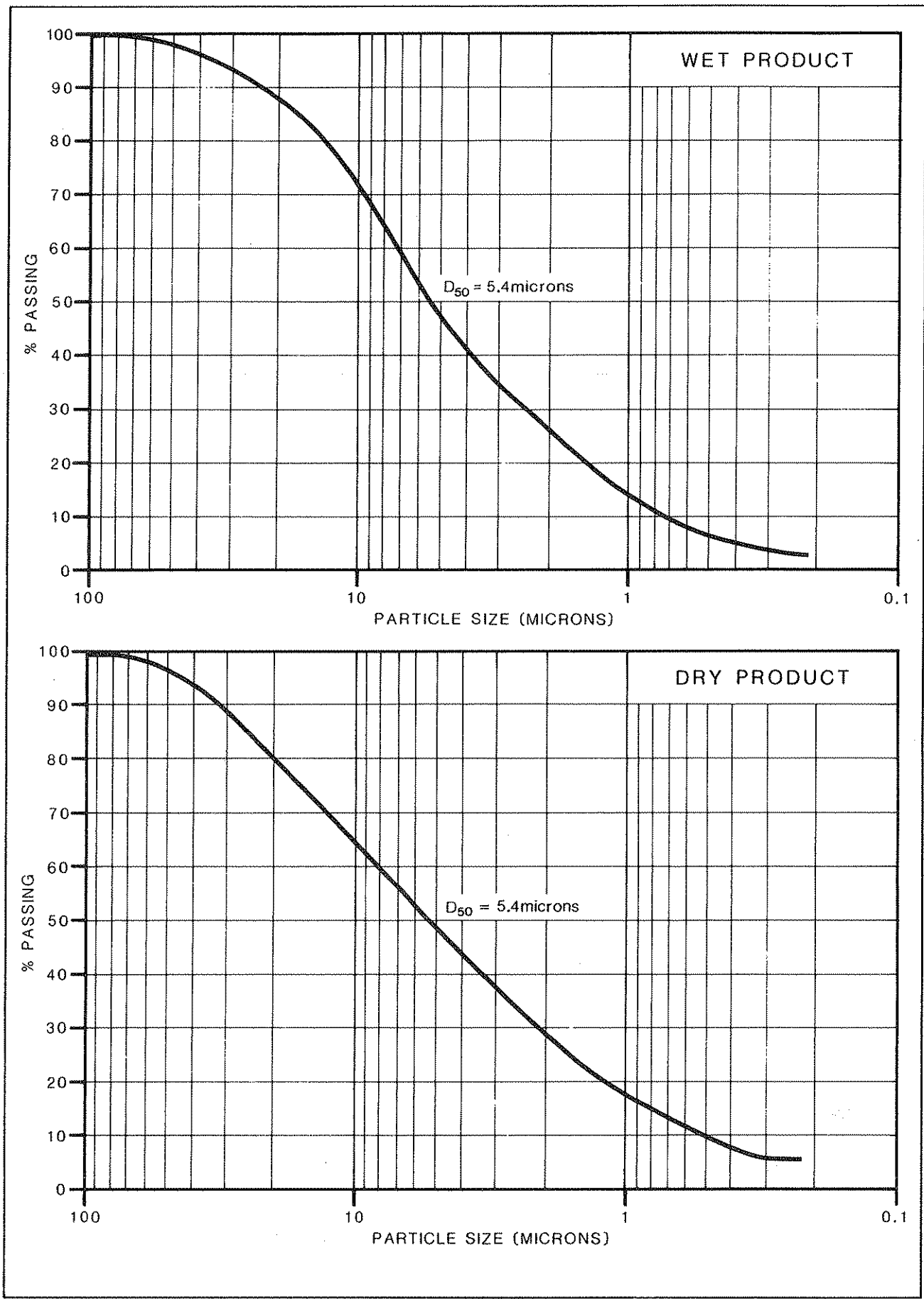


Figure 2
Dames & Moore



CROSS SECTION OF EVAPORATION POND WITH UNDERDRAIN SYSTEM



**INTERMEDIATE PRODUCT [RE(OH)]
PARTICLE SIZE DISTRIBUTION CURVES**

**Figure 4
Dames & Moore**