PROPOSED TRANSPORT OF SODIUM CYANIDE SOLUTION BY RAIL

CSBP AND FARMERS LTD
COOGEE CHEMICALS PTY LTD
AUSTRALIAN INDUSTRY DEVELOPMENT CORPORATION

Report and Recommendations by the Environmental Protection Authority

Environmental Protection Authority
Perth, Western Australia
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SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

The Environmental Protection Authority (EPA) previously assessed a proposal for a 15 000 tonne per annum sodium cyanide plant at Kwinana and the transport of 30% sodium cyanide solution product by road transport from Kwinana to the gold mines within the State (Public Environmental Report, Kinhill Stearns 1986). During its assessment of that proposal, the EPA identified two key issues. These were:

- the risk and hazards associated with the manufacture of sodium cyanide and the implications for the Kwinana area; and

- the potential environmental consequences of transportation and mine site storage and use of sodium cyanide in solution.

After undertaking a detailed analysis, the Authority concluded, in its Assessment Report (EPA Bulletin 274) that the individual risk levels imposed by the proposed plant on residential areas were so low as to be acceptable. Cumulative risk levels (including the contribution by this proposed plant) were also so low as to be acceptable. The EPA, however, was concerned about the proposed road transport of product, given the potential consequences of an accident involving spillage of sodium cyanide solution, particularly in a "defined area of concern".

Consequently the EPA recommended that:

> "The proposal as put forward in the PER not be approved on the grounds that transportation by road of sodium cyanide in solution through the Authority's defined area of concern is environmentally unacceptable. The defined area of concern constitutes that part of the State within 50 km of the Perth GPO plus designated surface and groundwater catchment areas."

Subsequently, the EPA received a further proposal in the form of a Notice of Intent. This proposal involved transportation of sodium cyanide solution in tank containers by rail, from the proposed plant site at Kwinana to rail terminals in the proximity of mine sites which would be using this product. At the rail terminals the tank containers would be lifted onto road vehicles for delivery to the mine sites. This proposal may be summarised as follows:

- a controlled siding and spur line at the proposed plant site at Kwinana, giving access to the existing rail system;

- at the plant site at Kwinana, sodium cyanide solution would be loaded into tank containers ("iso-tainers") secured onto railway wagons;

- the railway wagons would be moved by scheduled Westrail freight services to appropriate rail terminals near to intended markets (these terminals being more than 50 km from the GPO and outside designated water catchment areas);

- at the rail terminals the iso-tainers would be lifted onto road vehicles and locked into position ready for delivery to the mine site;

- after road delivery to the mine site the sodium cyanide solution would be discharged into the customer's storage tank; and

- the empty iso-tainers would then be returned to the rail terminal for return to Kwinana.

The Notice of Intent was forwarded to the Water Authority of Western Australia and to Westrail for their comments on the feasibility and appropriateness of the rail transport proposal. Their comments, together with those of the public (which were provided in response to the original PER), have been considered in preparing this Assessment Report.

The EPA considers that some details were addressed insufficiently in the Notice of Intent. While these in themselves have not prevented the Authority determining the environmental acceptability of the proposal, the EPA expects more detailed plans to be developed to the satisfaction of the Authority and relevant Government agencies. These plans should address:

. containment systems (including, where appropriate, sump and pumping systems) at loading and unloading points;

. specific safeguards for iso-tainers;

. contingency plans for spillages;

. responsibility for transport of sodium cyanide from the plant site to the mine site; and

. mine site storage and handling of sodium cyanide solution.

The EPA believes that rail transport of sodium cyanide solution is safe because the likelihood of an accident leading to a major spill is approximately 5 000 times lower than for a road accident of similar dimensions. The likelihood of a spill incident has been estimated as once in 16 million years for rail, and once in 3030 years by road. Moreover, the iso-tainer would likely remain intact in the event of an accident.

The product should be railed to terminals as close as practicable to the intended markets. Practicability will be determined by issues such as availability of lifting gear for transfer of iso-tainers from rail wagons to road vehicles and environmental sensitivity. The determination will be by the Environmental Protection Authority.

The conclusions and recommendations in Bulletin 274 pertaining to the plant at Kwinana are reiterated here for the sake of completeness. The recommendation relating to the ammonia pipe (number 4 below) has been altered to reflect the decision by the Minister for Environment in Appeal Number 4, and recommendation 6 (below) has been clarified in respect of the timing of its requirements.

The Environmental Protection Authority makes the following conclusions and recommendations.

1. **The Environmental Protection Authority reaffirms its conclusion in Bulletin 274 that transportation by road of sodium cyanide in solution through the Authority's defined area of concern is environmentally unacceptable. The defined area of concern constitutes that part of the State within 50 km of the Perth GPO plus designated surface and groundwater catchment areas.**

2. **The Environmental Protection Authority concludes that it is environmentally acceptable:**

   a. to construct and operate a sodium cyanide plant in the Kwinana region; and

b. to transport sodium cyanide solution by rail through the defined area of concern, to rail terminals which are as close as practicable to the intended markets, subject to:

- the proponents' commitments in the Public Environmental Report, the Notice of Intent, and their responses to public and Government agency comments contained in EPA Bulletin 274 and this Assessment Report; and

- the conclusions and recommendations in this Assessment Report

3. The Environmental Protection Authority recommends that the proponents:

- establish detailed specifications for loading, transfer and unloading areas for iso-tainers at the plant site, rail terminals and mine sites;

- outline specific safeguards for iso-tainers;

- detail mine site storage and handling requirements;

- identify responsibility for the various aspects of transport and transfer operations; and

- prepare contingency plans for dealing with spillages, should they occur,

at all stages of the transport operation;

to the satisfaction of the Authority and of relevant Government agencies.

4. The Environmental Protection Authority recommends that if the plant is located at the proponents' preferred site at Kwinana, then:

- the site layout should be evaluated in a Hazard and Operability Study (HAZOP) for the plant in order to prevent any possibility of contact between any acid storage and the sodium cyanide process/storage; and

- appropriate safeguards for the ammonia pipe be installed;

to the satisfaction of the Authority.

5. The Environmental Protection Authority recommends that the proponents need to prepare a construction stage management report, to be submitted to the EPA before construction commences, and which addresses, among others, the following matters:

- management of stormwater runoff from the site into Cockburn Sound; and

- management of dust and noise from the site.

6. The Environmental Protection Authority recommends that the proponents need to prepare, at the detailed design stage, a comprehensive and integrated hazard and risk management strategy, to the satisfaction of the relevant Government agencies.

7. The Environmental Protection Authority recommends that the proponents should prepare a waste water management report discussing methods of waste water disposal and management which are acceptable to the Authority. This report should be forwarded to the Authority before the commissioning of the plant.

1. INTRODUCTION

The joint partners - CSBP and Farmers Ltd, Coogee Chemicals Pty Ltd and the Australian Industry Development Corporation (the proponents) - propose to establish a plant within the Kwinana industrial area to produce 15 000 tonnes per annum of sodium cyanide solution from natural gas, ammonia and caustic soda.

A Public Environmental Report (PER) was prepared by the proponents and assessed and reported upon by the EPA in May 1987.

In the PER, the proponents proposed to transport the sodium cyanide solution to their markets (gold mines throughout the State) by road vehicles.

During the Authority's assessment of the proposal, it became apparent that there were two key issues involved. These were:

- the risks and hazards associated with the manufacture of sodium cyanide and the implications for the Kwinana area; and

- the potential environmental consequences of transportation and mine-site storage and use of sodium cyanide in solution.

In its assessment of the proposal, the EPA concluded that individual risk levels imposed by the proposed sodium cyanide plant on residential areas were so low as to be acceptable. In addition, the contribution made by the plant to cumulative risk levels did not increase risk levels significantly. The resulting cumulative risk levels are also so low as to be acceptable to the Authority.

In addition, aspects relating to the construction and operation of the plant were environmentally acceptable, subject to the recommendations made in Bulletin 274.

The EPA was very concerned about the proposed method of transportation of sodium cyanide solution. Whilst the EPA recognised the low likelihood of a road accident leading to the discharge of sodium cyanide solution, the potential consequences of any such accident constitute an unacceptable environmental risk within a defined area of particular concern. This area constitutes that part of the State within 50 km of the Perth GPO plus designated surface and groundwater catchment areas (Figure 1). Within this area not only are the risks higher but also the consequences are significantly greater.

"Should an alternative method of transportation through the EPA's defined area of concern be proposed to the EPA and found to be environmentally acceptable, then the Authority considers that the balance of the proposal could proceed subject to:

- the proponents' commitments in the PER and response to public and Government agency comments; and

- the EPA's conclusions and additional recommendations in this Assessment Report." (page 37, Bulletin 274)

Subsequently, the proponents submitted a detailed Notice of Intent, Proposed Sodium Cyanide Plant. Supporting Document on the Use of Rail Transport, which specifically addressed the transport issues raised by EPA in its assessment of the PER. It proposes rail transport for sodium cyanide

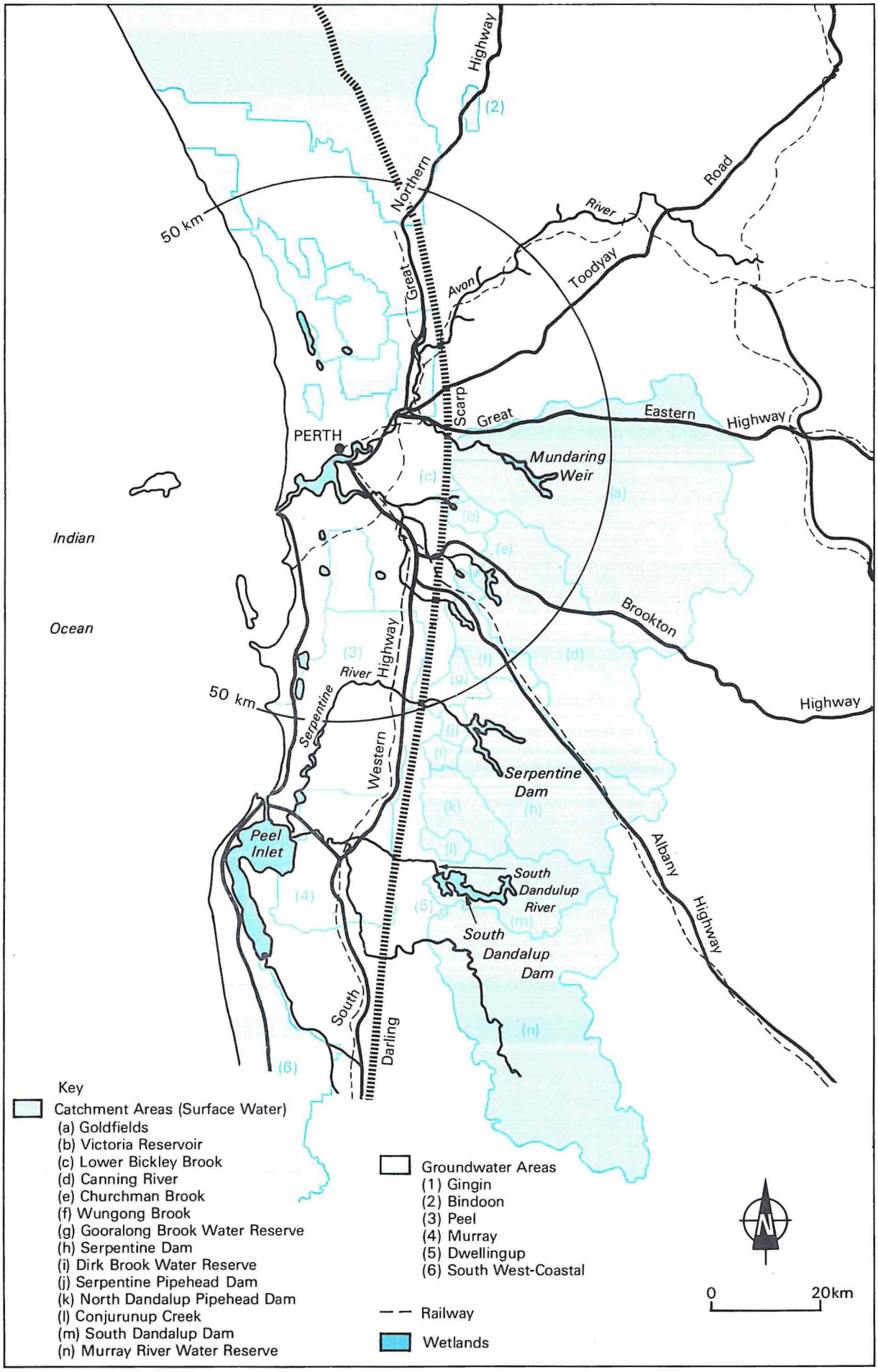

Figure 1. EPA's Defined Area of Concern

solution to specific sidings in the State with road transport from the rail heads to the mine sites.

The Notice of Intent was forwarded to the Water Authority of Western Australia and to Westrail for their comments on the feasibility and appropriateness of the rail transport proposal. Their comments, together with those made by the public in response to the original PER, have been considered in preparing this Assessment Report.

2. THE PROPOSAL

The proposal in the PER is to establish a $15 million plant which would produce 15 000 tonnes per annum (tpa) sodium cyanide solution using 10 000 tpa natural gas, 10 000 tpa ammonia and 10 000 tpa caustic soda. The plant consists of a gas reactor, a cooler, an absorber, a distillation column and an incinerator. The sodium cyanide solution would be stored in two steel tanks, each of 2 000 tonnes capacity. These tanks would be sited on concrete supports surrounded by impermeable bunds. It is proposed that the product solution would be diluted to 30% and transported to various gold mines, within the south-west and eastern goldfields.

The Notice of Intent proposes a combined rail and road transport option, which utilises rail transport through the EPA's "area of concern" and beyond, to appropriate terminals, followed by road transport to specific mine sites. Specifically, the proposal entails the following requirements:

- The construction of a controlled siding and spur line at the proposed plant site at Kwinana, thus giving access to the existing rail system;

- At the Kwinana plant site siding, sodium cyanide solution would be loaded, via delivery hose and coupling, into tank containers ("iso-tainers") secured onto railway wagons. Each wagon holds two 18 000 litre iso-tainers; (see Figure 2)

- The railway wagons would be moved by scheduled Westrail freight services to appropriate railway terminals near to intended markets (these terminals being more than 50 km from the GPO and outside designated water catchment areas (see Figure 3));

- At the railway terminals the iso-tainers would be lifted onto road vehicles and locked into position ready for delivery to the mine site using standard Westrail equipment; (see Figure 4)

- After road delivery to the mine site the sodium cyanide solution would be discharged into the customer's storage tank by pressurising the iso-tainers with compressed air; and

- the empty iso-tainers would then be returned to the railway terminal for return to Kwinana.

The proponents have made the following points to support their argument that rail transport of sodium cyanide solution, as proposed in the Notice of Intent, would be environmentally acceptable:

- The control of operations for road transport may be simpler in principle as only one mode of transport would be involved. The management and control operations for rail transport are better, however, because of

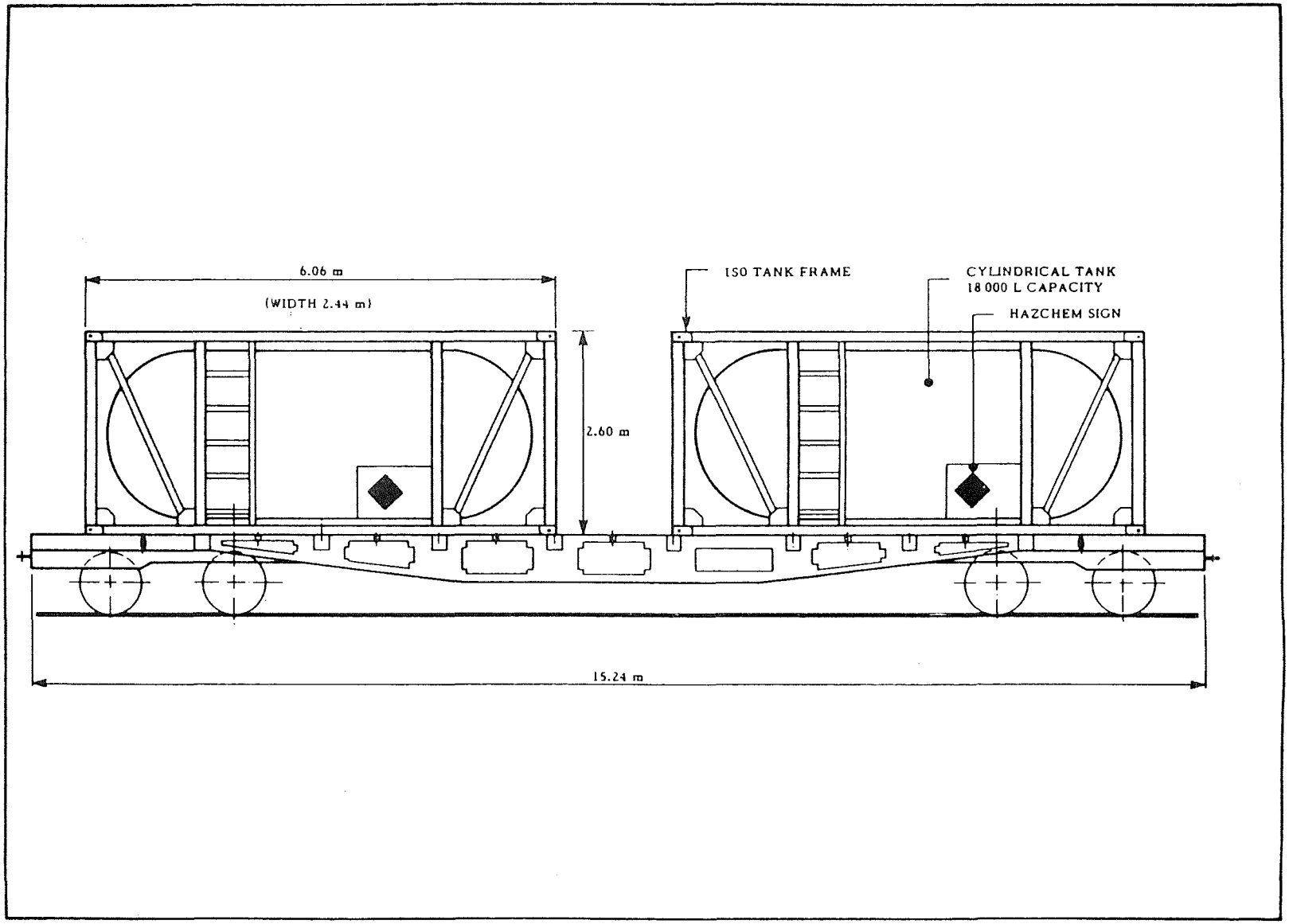

Figure 2: Tank containers (iso-tainers) on rail wagon

Source: Notice of Intent

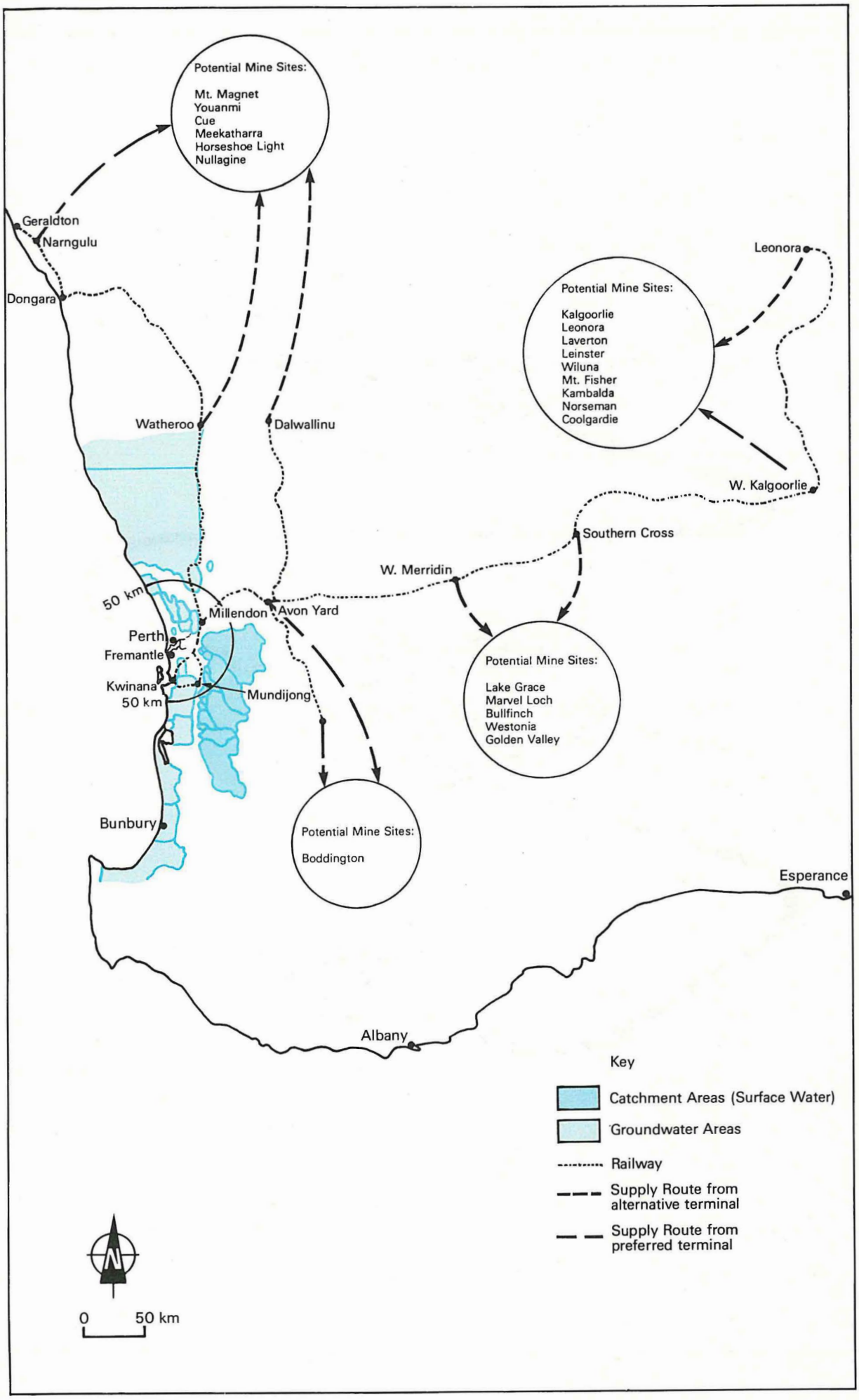

Figure 3. Transport routes beyond the defined area of concern.

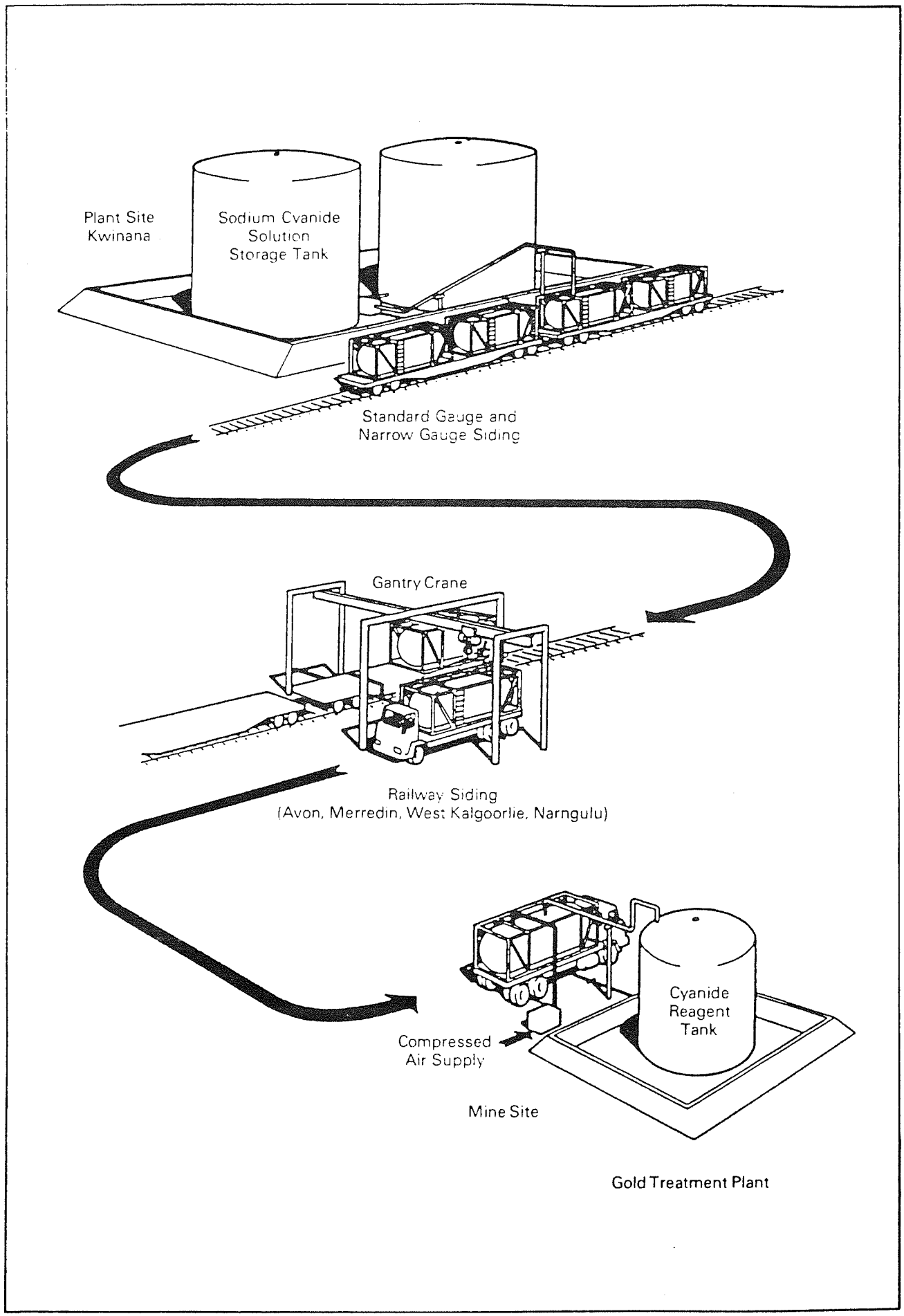

Figure 4: Rail and road transport of sodium cyanide solution

Source: Notice of Intent

strict control over manning levels and hours worked, requirements for train examinations en route and the management back-up of the Westrail organisation, specifically;

- Westrail has a training and development section which has a training programme for the handling of dangerous goods;

- maintenance roads within railway reserves ensure good access on non-public roads for any emergency response action. In addition, the 30 m reserve on either side of the railway tracks provide a buffer zone in the event of a spill; and

- emergency procedures are currently well developed for the road transport required in the modified proposal in the NOI (State Road Transport Emergency Assistance Scheme (1984)). In addition, Westrail has well developed emergency procedures.

In addition, the proponents have utilised results of overseas studies, provided by the EPA, to make estimates of the relative safety of rail and road transport of sodium cyanide solution.

The Dutch TNO organisation has carried out studies on accident and release incidents for road and rail transport of dangerous goods, specifically liquid petroleum gas (LPG), in metropolitan areas. Results from the Netherlands (quoted in a TNO study for the Liquid Fuels Trust Board of New Zealand in 1982) are given in Table 1.

Table 1. Spill frequency estimates

	RAIL TRANSPORT	ROAD TRANSPORT
Accident frequency/100 m	0.10×10^{-10}	0.80×10^{-7}
Release incident frequency/100 m	0.52×10^{-13}	0.28×10^{-9}

Source: TNO Studies (1982a, 1982b)

These figures indicate that the release incident frequency for rail is over 5 000 times lower than for road transport of liquid petroleum gas.

The proponents have assumed that:

- these frequencies are also applicable to carriage of dangerous goods other than LP gas;

- the characteristics of road and rail movements in Perth are similar to those in city areas in the Netherlands; and

- the relevant design characteristics for road and rail vehicles in Western Australia and the Netherlands are comparable.

The proponents then developed figures for the total distance travelled through the metropolitan area for all sodium cyanide solution from their plant assuming:

a. only rail transport;

b. only road transport (for comparative purposes only).

These figures are expressed as "Total distance" in Table 2, and represent the total number of trips multiplied by the distance travelled for each trip through the metropolitan area. These total distances turn out to be very similar (116 000 km for rail and 118 000 km for road). Application of the release incident frequency rates from Table 1 to these total distances, utilising the assumptions above which relate to frequencies, gives the probability (or likelihood) of an event involving a major release of sodium cyanide. The probabilities can be converted into a "frequency of event". Table 2 shows that an accident involving a major release of sodium cyanide solution is expected to occur once in every 16 million years with rail transport, and once in every 3030 years with road transport.

Consequently, the conclusion presented by the proponents is that the likelihood of a major spill of sodium cyanide solution is approximately 5 000 times lower for rail than for road transport.

Table 2. Spill frequency estimates (Perth Metropolitan Area)

	RAIL TRANSPORT	ROAD TRANSPORT
Total distance (movements x km)	116 000	118 000
Probability of event	0.16×10^{-7}	0.33×10^{-3}
Frequency of event (years)	**16 000 000**	**3 030**

Source: Notice of Intent

The EPA, from its own investigations, and from information supplied by the proponents, formulated a number of "scenarios" related to transport modes and potential consequences of spills. This information has been utilised by the proponents in the NOI in summarising the relative merits of the two forms of transport. The following table is taken from the NOI.

Table 3. Comparison of road and rail transport as outlined in the Notice of Intent

FACTOR	ROAD	RAIL
Accident rate	Low	Very low
Environmental consequences of a spill incident	Similar	Similar
Public exposure to an incident		Likely to be much lower
Frequency of spill incident	Low	Much lower
Routing	Potentially more flexible	Better scheduling
Number of transport modes	One	Two

FACTOR	ROAD	RAIL
Control and management of operations	Simpler in principle	Better control,
Operator training	By proponent	By proponent/ Westrail
Access in event of incident	Could be hampered	Likely to be unaffected
Emergency procedures	Well developed	Readily adapted

Source: Notice of Intent

3. ENVIRONMENTAL IMPACTS AND MANAGEMENT

The principal concern regarding the transportation of sodium cyanide solution involves the likely consequences of an accident involving the transport container, whether road or rail. The Authority previously reviewed in detail the likely consequences of a road accident and concluded that these consequences would be environmentally unacceptable within 50 km of the Perth GPO or on designated surface and groundwater catchment areas (see Figure 1).

Table 1 shows that rail is approximately 5 000 times safer than road for LP gas transportation. It is a reasonable assumption that this ratio applies to the transport of other dangerous goods involving the use of comparable tanks (including sodium cyanide solution). The figures developed by the consultants indicate one spill incident (as a result of tank failure in an accident) every 3 030 years for road and one in 16 million years for rail, for the movement of sodium cyanide solution through the Perth metropolitan area. The Authority finds this analysis acceptable, and concludes that the probability of a rail transport incident is so low as to make the rail option environmentally acceptable.

It is essential that all aspects of the transport operation be subject to management and contingency plans, which are agreed as between operators, and the government agencies which monitor those operations. The close involvement of the Explosives and Dangerous Goods Division (Mines Department), State Mining Engineer, Department of Occupational Health Safety and Welfare, the Water Authority of WA, emergency services (including the WA Fire Brigade and the State Emergency Service) is essential. These plans are to cover the loading, transport, transfer and unloading operations, and are to be complementary to any legislative requirements. The plans are to be lodged with EPA prior to the commencement of the project.

In the NOI, the proponents have indicated that they will construct a spur line and rail siding at the proposed plant site. The loading area for sodium cyanide solution requires a contained (bunded) non-porous area with associated sump and pump system. This will enable recovery (and subsequent recycling or neutralisation of any spilled sodium cyanide). The proponent has made a commitment to provide such an area within the proposed plant site.

Appropriate facilities are required at the unloading areas at relevant railway terminals, including appropriate bunding and storm water drainage. These areas should also have appropriate emergency response equipment and supplies available. These terminals are to be as close as practicable to the intended markets. "Practicability" will be determined by issues such as availability of lifting gear for transfer of iso-tainers from rail wagons to road vehicles, and the environmental sensitivity of the area. The determination will be made by the Environmental Protection Authority.

Transport of the iso-tainers from the railway terminals to the mine sites will be by road vehicles. It is necessary for the vehicles, their loads and their drivers to conform with the requirements of the Dangerous Goods (Road Transport) Regulations 1983.

Transfer of the sodium cyanide solution to storage tanks on the mine site will have the same safety requirements as those at the loading bay in Kwinana and will come under the jurisdiction of the State Mining Engineer, as does the subsequent handling of the sodium cyanide.

Contingency plans for dealing with spillages are necessary in all stages of transport and handling. This is particularly so for spillages which may affect water supplies.

Whilst the responsibility for the management of rail transport is quite clear (Westrail), the responsibility for the subsequent road transport is still subject to commercial negotiation. Whatever arrangement is finally agreed upon, it is essential that responsibilities are very clearly defined and (where necessary) delineated.

The iso-tainers (or tank containers) are an integral part of the safe transport of sodium cyanide solution. Further information provided by the proponents shows that:

. even if there were a rail accident involving iso-tainers of sodium cyanide, the container would remain intact, preventing the likelihood of the loss of containment or spill of sodium cyanide solution. This is due to the fact that iso-tainers have the following features:

  - an enclosing steel frame which would provide additional protection to the tank;

  - top filling and discharge which minimises the likelihood of a spill, as may occur with the shear or damage of a bottom tank outlet; and

  - location of all tank nozzles within the iso-tainer frame and protection and strengthening of the tank inlet/outlet, for additional protection in event of a rollover.

The Authority sought information from the Westrail on the details of iso-tainers. Westrail said:

"It is confirmed that the portable tanks, referred to as iso-tainers in the above document, must conform to the ANZR Manual of Standards and Recommended Practices for the Transport of Dangerous and Hazardous Goods and any other International or Australian Standards referred to therein. The portable tanks would be mounted inside an integral framework incorporating top bottom ISO corner pockets and will be suitably enclosed to maximize protection to the tank shell and associated fittings.

Other pertinent requirements for the portable tanks include:

- gross mass 24 tonne (IMO TYPE 1 PORTABLE TANK).

- loading and discharge provision would be located on the top of the tank shell.

- pressure relief devices, contents gauge and appropriate "hazchem" plaques to be fitted." (Westrail Submission)

The EPA finds the above safeguards adequate to ensure protection of the environment, subject to the comments and recommendations below.

The consequences of a major spillage of sodium cyanide solution within 50 km of the GPO and in surface and groundwater catchment areas include drainage to lower ground, discharge to wetlands, and potential evolution of hydrogen cyanide gas (particularly with high summer temperatures, or in contact with weakly acidic water bodies or sewer flows).

The railway line to Avon Yard follows the Avon River, and is 35 metres from the river at its closest point. This distance considerably reduces the possibility of a direct spill into the river. As has already been noted, the likelihood of a spill is so low as to make rail transport a safe option.

Nevertheless, should a spill occur in such an area, the consequences would be the same as if it were a road accident, and there is a need to have very well developed emergency response plans to cater for such contingencies (see below).

In the unlikely event of an accident in which sodium cyanide is spilt, the most probable scenario is that the spill would occur onto the soil in the railway reserve. The proponents have outlined the factors which form the basis for the development of a detailed management programme, to accommodate and manage any incident involving a spill, both in the Public Environmental Report and in the subsequent Notice of of Intent.

In summary, this management programme includes:

- sinking a bore in or near the spill area and pumping out the affected water for neutralization and reinjection back into the aquifer downstream of the spill, until cyanide levels are safe;

- direct injection of sodium hypochlorite or other oxidising agent. However use of direct injection alone could force the spread of cyanide by a piston-type effect;

- use of both pumping and direct injection of hypochlorite, for example injection in the region downstream of the pump-out bore;

- injection of air or oxygen into the soil to maintain aerobic conditions and to oxidise the cyanide; and

- removal of contaminated soil from the site for off-site treatment.

In addition to the above remedial actions, the proponents have made a commitment to implement a monitoring programme, should such a need arise, to check cyanide levels, particularly where the spill was in a water resource area, so that pumping of groundwater could resume when cyanide levels were

safe. These considerations also apply in remote water resource areas, and to road transport as well.

The proponents have also outlined the elements of an extensive emergency plan, which include the following:

- training of operators;
- provision of protective equipment;
- strategic stocks of sodium hypochlorite (or other chemicals) for neutralisation of sodium cyanide;
- handling and transport precautions; and
- communications.

The EPA has been informed by the Water Authority of Western Australia that the proponents should prepare an action plan which specifically refers to remote water supply areas. The Authority concurs with the views put forward by WAWA.

Given the previous assessment by the EPA (Bulletin 274) regarding the proposed site and plant at Kwinana, the relevant recommendations are reiterated here. Recommendation 4 below has been altered in a substantive manner, given that part of an appeal by the proponent on EPA recommendations on the original proposal was upheld by the Minister for the Environment (Appeal number 4). Recommendation 6 below has been clarified in respect of the timing of its requirements.

Consequently the Environmental Protection Authority makes the following conclusions and recommendations.

1. **The Environmental Protection Authority reaffirms its conclusion in Bulletin 274 that transportation by road of sodium cyanide in solution through the Authority's defined area of concern is environmentally unacceptable. The defined area of concern constitutes that part of the State within 50 km of the Perth GPO plus designated surface and groundwater catchment areas.**

2. **The Environmental Protection Authority concludes that it is environmentally acceptable:**

   a. **to construct and operate a sodium cyanide plant in the Kwinana region; and**

   b. **to transport sodium cyanide solution by rail through the defined area of concern, to rail terminals which are as close as practicable to the intended markets, subject to:**

   . **the proponents' commitments in the Public Environmental Report, the Notice of Intent, and their responses to public and Government agency comments contained in EPA Bulletin 274 and this Assessment Report; and**

   . **the conclusions and recommendations in this Assessment Report.**

3. The Environmental Protection Authority recommends that the proponents:

   . establish detailed specifications for loading, transfer and unloading areas for iso-tainers at the plant site, rail terminals and mine sites;

   . outline specific safeguards for iso-tainers;

   . detail mine site storage and handling requirements;

   . identify responsibility for the various aspects of transport and transfer operations; and

   . prepare contingency plans for dealing with spillages, should they occur, at all stages of the transport operation;

   to the satisfaction of the Authority and of relevant Government agencies.

4. The Environmental Protection Authority recommends that if the plant is located at the proponents' preferred site at Kwinana, then:

   . the site layout should be evaluated in a Hazard and Operability Study (HAZOP) for the plant in order to prevent any possibility of contact between any acid storage and the sodium cyanide process/storage; and

   . appropriate safeguards for the ammonia pipe be installed;

   to the satisfaction of the Authority.

5. The Environmental Protection Authority recommends that the proponents need to prepare a construction stage management report, to be submitted to the EPA before construction commences, and which addresses, among other, the following matters:

   . management of stormwater runoff from the site into Cockburn Sound; and

   . management of dust and noise from the site.

6. The Environmental Protection Authority recommends that the proponents need to prepare, at the detailed design stage, a comprehensive and integrated hazard and risk management strategy to the satisfaction of the relevant Government agencies.

7. The Environmental Protection Authority recommends that the proponents should prepare a waste water management report discussing methods of waste water disposal and management which are acceptable to the Authority. This report should be forwarded to the Authority before the commissioning of the plant.

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