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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

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STRATEGIC POLICY ADVICE FOR THE DEVELOPMENT OF THE ALUMINIUM INDUSTRY IN JAMAICA

UC/JAM/90/239/11-51,52,53,54/J13207

JAMAICA

Technical Report

Based on the work of :

Principal Consultant : Ronald W. Moyle

Consultants : Rex C. Bryan

: Hans Gustafsson

: Dr. Andras Eva

Backstopping Officer: T. Grof, Metallurgical Ind. Branch

United Nations Industrial Development Organization,
Vienna

5156

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Project number - UC/JAM/90/239

Title - STRATEGIC POLICY ADVICE FOR THE DEVELOPMENT OF THE ALUMINIUM INDUSTRY IN JAMAICA

ABSTRACT

This project involved a review of the current state of the bauxite/alumina/aluminium products industry in Jamaica, with emphasis on technical and techno-commercial aspects and on the relationship between bauxite/alumina operations and the environment. The objective was to provide advice as to how to effect an improvement in the competitive position of the Industry in Jamaica compared to installations in other parts of the world; and to recommend standards to accompany new Jamaican environmental legislation. Four separate consultants were used who were expert in each of the above fields, and investigations were carried out during visits by these consultants over the period from July to November 1991.

It was observed, that the existing alumina refineries were among the oldest still operating in essentially unmodified form, that excessive bauxite losses were evident in mining, transfer and processing stages and the refineries generally were inefficient in raw material and energy usage. Levels of dust emissions at both bauxite mines, and from alumina activities, and liquid emissions to ground waters appear to be excessive in some instances. Despite these shortcomings the refineries, and in particular the mines, were still reasonably economic to operate and alumina costs were competitive chiefly as a result of intrinsically low bauxite costs into the refineries, and the low wage rate structure. A significant volume of semi and fabricated aluminium products which could be produced locally are currently being imported into Jamaica.

Recommendations for improvements to the management of bauxite reserves aimed at maximizing their utilization were put forward. Overhaul and modernization of existing alumina refineries was recommended in order to reduce operating costs. Further opportunities for extending the production of non-metallic grades of alumina should be investigated. Environmental standards for emissions were recommended to complement recently passed Jamaican environmental legislation, and aspects of implementation including measurement of emissions were discussed. An opportunity was recognized, and recommendations put forward, for an expansion of semi and finished products in Jamaica to reduce dependence on imported products in this area.

A checklist of policy initiatives and action items is appended to assist the formulation of programs which might be based on some or all of the foregoing recommendations.

GLOSSARY OF TECHNICAL TERMS AND ABBREVIATIONS

ao	alumina
aluminium	aluminum
aluminum	aluminium
al	aluminium (ingot)
boehmite	AlO(OH)
bx	bauxite
GDP	Gross Domestic Product
Gibbsite	$Al(OH)_3$
GNP	Gross National Product
goethite	$HFeO_2$
gpm	gramme per litre
JBI	Jamaica Bauxite Institute
monohydrate alumina	AlOH
MT	metric ton (2204 lb)
natron	sodium
ppm	parts per million by weight
se	semi-finished and finished aluminium products
semi(s)	semi-finished aluminium product
tpa	tonne per annum
trihydrate alumina	$Al(OH)_3$
USD	United States Dollar
US$	United States Dollar
J$	Jamaican Dollar

INTRODUCTION

Jamaica, the third largest island in the Carribean, has currently the only truly viable bauxite/alumina industry in the region, although there are very substantial developments of this kind established on the South American continent.

The economy of Jamaica is dependent to a significant extent upon the bauxite/alumina industry for its export earnings, about 60% of export earnings being derived from the sale of bauxite and alumina.

The industry was established in Jamaica about forty years ago based on the reserves of high grade bauxite found on the island. It was financed by principally North American interests using technology established "in- house" by what was essentially an industry closed to outsiders.

The industry is not a significant employer (having regard to it's size) either directly or indirectly in the Jamaican economy. As a sector the mining and quarrying industry, of which the Bauxite industry forms the major part, employed only 0.6% of the countries workforce, while generating 7.5% of Gross Domestic Product (1988 data). The conversion of bauxite to alumina offers little better prospect of employment to the workforce, despite efforts to increase the level of participation of the Jamaican workforce in the Industry.

The foregoing is set against a background of modest GNP growth and high population increase, for between the years 1980 and 1990, the GNP has been estimated (1) to have fallen, in real terms by 0.4% per annum while over the same period the population has increased by an annual average of 1.2% pa.

(1) - World Bank estimates - 1990.

The foregoing has resulted in a series of devaluations of the Jamaican dollar against its hard currency trading partners leading up to the floating of the J$ in September 1991.

The largest earner of foreign exchange and best growth industry based on recent past performance is tourism. However despite this there was in 1989 a trade deficit of US$572.4m with a current account deficit of US$295.5m.

Principal among Jamaican exports was bauxite and alumina, however set against these exports was the need to import expensive mineral fuels used for bauxite recovery and processing to alumina.

The aluminium semi and finished products industry in Jamaica is possessed of some anomalies as regards the imbalance in the export/imports of the range of products and intermediate and finished products derived from the industry. Redress of these imbalances is necessary if the objective of advancing Jamaica as a developing nation is to be realized.

The bauxite/alumina industry in Jamaica started about 40 years ago. It was developed during the 50's and 60's by mainly North American interests to mine bauxite and refine alumina for export. Since that time the same interests have participated in the development of major facilities for bauxite mining and alumina production at other locations throughout the world. Each of these facilities has been designed around the character of the bauxite peculiar to the area concerned as it relates to it's suitability for alumina production. Other parameters which have influenced investment decisions have been geographic and economic and socio-economic factors.

There is a concern that the Jamaican plants which are much older may be suffering from higher cost structures when compared with the more modern and generally larger plants that have been erected elsewhere in more recent times.

This has particular significance for a country which relies so heavily on its export earnings from the bauxite and alumina industry such as Jamaica does, because during times of low world demand for aluminium, alumina stocks increase to unacceptable levels and production must be curtailed. Because alumina plants cannot be economically throttled back, it is sometimes necessary in these circumstances to close temporarily one or more refineries. In selecting which refinery to shut down in order to relieve the oversupply situation, it is most often the cost of production which is the determining factor in arriving at this decision. It is the threat of such a possibility, with its implications as regards reduction in cash flow and the inability of Government to budget for the future with confidence, which can have a drastic effect on the economic security of a country.

As part of this assignment by UN consultants, a report was called for as to the state of competitiveness of the Jamaican bauxite and alumina industry against others, particularly those facilities that have been erected more recently in the world. In particular recommendations were sought as to what could be done to the Jamaican plants to improve their competitiveness as against facilities elsewhere, in order to ensure that the threat referred to in the previous paragraph may be removed.

A feature of recently developed bauxite deposits in other parts of the world is that they have mostly been located remote from areas of high population density, and sometimes in areas almost devoid of population. Despite this, in many instances there has been vigorous opposition to the setting up of these industries on environmental grounds. In recent times it has been the exception rather than the rule that either, the quality of life of a significant proportion of the population, or the livelihood derived from another industry has been at issue in relation to bauxite/alumina activities.

The situation in Jamaica is almost entirely the reverse of the above. The industry has been in place for a considerable period of time so that the biological adaptation of flora and fauna by natural selection has passed through sufficient generations so that a kind of equilibrium has been reached with the industrial processes with which they cohabit the environment.

The environmental problems of most immediate concern in Jamaica are the increasing pollution of ground waters by massive amounts of liquid wastes from alumina refining, and the emissions of dust and alumina from both bauxite mining and alumina refining activities. These pose a direct threat to both the quality of life, and possibly to the health of the inhabitants of the island, and a diminution in the prospects for development and extension of the tourism industry of what is generally accepted as one of the most beautiful islands in the world.

The authorities in Jamaica face the difficult task of "clawing back" some of the ground which has been lost by the entrenchment of what would be unacceptable environmental practices by the operators of some of the Jamaican alumina plants if they were to be proposed for new refineries in more developed countries. The enlistment of authoritative opinion and comment from a UN engaged consultant, may go some way towards assisting that process.

The way in which bauxite is mined in Jamaica is unusual when compared to the methods employed in most of the bauxite mines which have been developed elsewhere over the last 20 years. The occurrence of the bauxite in deep troughs formed in the underlying bed of limestone has meant that a full recovery of processable ore is virtually impossible. Furthermore the use of inefficient and sometimes inappropriate equipment has tended to exacerbate the problem of achieving an acceptable level of ore recovery.

A system of taxation on the activities of the industry is in force by which a levy is imposed on the amount of bauxite withdrawn. The way this is assessed is by means of a back calculation from the amount of alumina shipped. Such a procedure has not been effective in ensuring the miners remove all the processable ore from a pit before it is closed. The net result has been, firstly that bauxite reserves are being consumed faster than the production of alumina would appear to warrant, and secondly that a considerable amount of processable ore remains in the ground beneath sites which have been released from mining as having been "exhausted" and which have accordingly been closed, regenerated and returned for farming activities.

Recommendations were sought as to how to redress the above shortcomings. In order to achieve this end the task was divided into the areas of

Bauxite Utilization
Alumina Productivity
Environmental Matters
Semi and Finished Aluminium Products

Separate consultants were selected for each of the foregoing facets of the industry based on their appropriate areas of expertise. A list of the names of the consultants and a copy of the job description for each is appended as annexure 1.

Each consultant visited the Island under the auspices of the UNIDO office in Jamaica and during these stays, mine and refinery inspections and discussions as deemed appropriate were arranged and conducted by the Jamaican Bauxite Institute.

A summary of the key contact personnel instrumental in securing access to information and worksites is given in annexure 2.

Reports were prepared independently by each consultant and approved individually by the sponsoring UNIDO organization. A report aimed at consolidating views and recommendations from each of these reports into a unified overview which would hopefully provide the authorities in Jamaica with directions for future development of the industry there was prepared by a principal consultant, who was coincidentally also the consultant on alumina productivity.

I - STRUCTURE OF THE INDUSTRY

The bauxite/alumina/aluminium industry is an integrated but technologically diverse set of operations which are comprised of the following fundamental activities;

bauxite mining
alumina refining
aluminium smelting
semi-finished products and metal fabrication,

Each of the foregoing processes leads on to the next with key aluminium containing raw material passing from one process to the next

The requirements for efficient operation of each is very different so that rarely are all the above activities found together in one location.

Bauxite and Alumina tend to be located at or close to the source of the bauxite ore because of the costs of transporting the bulky and moist ore. Smelting is invariably located close to a source of low cost electrical energy. While semis and finished products tend to be close to the markets into which they are to be sold, namely in the building, transport industries and in packaging.

Jamaica has excellent reserves of mineable bauxite and enjoys most of the natural advantages required for economic alumina refining. It has no source of low cost electrical energy and therefore is not a suitable location for an aluminium smelter.

On the other hand as a country with a population of 2 million people with a reasonable standard of living, it is a significant consumer of aluminium products throughout the building, transport, and packaging sectors of the economy. Furthermore it is located adjacent to a region of considerable economic growth, namely continental South America.

Hitherto trade patterns in semi-finished and fabricated aluminium products show that trade in these products, as with bauxite and alumina, has taken place largely with the northern hemishere. With the industrial expansion that the South American countries are experiencing the possibility exists of developing opportunities for trade in semi-finished and fabricated aluminium products if Jamaica is able to expand upon its base of knowledge and expertise in this area. Jamaican workforce currently possesses a range of diverse skills and there is a potential for these to be developed further.

II - ALUMINA OVERSUPPLY AND REFINERY CLOSURE

Because of the seriousness of the effects of plant closure on the economy of a country which relies as heavily for hard currency earnings on its bauxite and alumina industry as does Jamaica, the following brief discussion in relation to the above topic may be helpful.

To follow the economic reasoning behind decisions to shut down one kind of plant as against another when stockpiles become too large, it is necessary to understand the way in which ownership of alumina plants may be structured so as to have the effect of reducing the likelihood of closure in difficult times.

In a situation of oversupply of alumina, the laws of supply and demand result in a fall in price. The reduced price may be below what some refineries are able to produce the alumina for. If this is the situation there may be a case for closing such a refinery down and restarting it again when prices rise again. This will depend on whether the amortized mothballing costs plus restartup costs are reasonable.

Some of the worlds largest refineries are owned by consortia, in which the operation of the refinery is conducted on behalf of its members by a separately established company. Under such an arrangement the owners are entitled to a share of alumina output, and are billed with the operating costs of the refinery for that share, in proportion to their share of ownership in the consortium.

The supply contracts for alumina under which the members of the consortium are bound are generally of the "take or pay" kind. The basis of this form of contract is that the consortium member agrees to accept his "share" of the alumina processed by the refinery on the basis of his percentage of ownership, assuming the refinery continues to operate at all times at full capacity. However in the event that a member is unable to accept his full "share" of alumina, he is obliged under the terms of the contract to pay an amount to the operating company equivalent to the fixed costs associated with that proportion of entitlement which he seeks to forego. The purpose of this provision is to ensure that the other consortium members, who continue to take their full allocation of alumina, are not disadvantaged by having to pay that share of the fixed operating costs normally accruing to the defaulting member.

This arrangement has the effect of making it more attractive, when faced with an oversupply of alumina, for a consortium member to continue to take his full entitlements from these plants, and to reduce shipments from smaller older plants such as those which operate in Jamaica. The rationale for this is as follows.

If the member reduces his "take" from a consortium plant to zero, he is still obliged to pay all fixed cash operating costs associated with that tonnage for as long as his take is reduced. These will usually be significantly higher in the case of new plants with large outstanding loans and therefore a high interest component of operating cost, than for older refineries where loans have been fully amortized. On the other hand by choosing to close a refinery which does not have these provisions, the costs involved are those associated with shutdown and restartup, plus any ongoing mothballing costs. If these are less than the forementioned fixed costs, which they usually are, then the smaller and older plant is the one which will be closed.

The Jamaican plants which are all older tend to be candidates for closure on this basis. These plants are smaller on average and therefore more easily shut down and brought onto line again. Also the lower wage rates and more flexible labour conditions applicable to the Jamaican plants are also factors which increase the likelihood of this happening.

A further factor in favour of maintaining newer plants at full output at the expense of the old is the income taxation benefits which attach to depreciation provisions in these plants and which are available to the owning company in the country of incorporation. Older plants for which the depreciation provisions have been used up do not enjoy this benefit.

The above effects serve to render the newer and more efficient consortium plants virtually proof against recessionary shutdown as the consortium members are locked into accepting alumina from this source rather than from plants which operate without such an arrangement.

Similar arrangements can be applied in the establishment of consortia for the mining and beneficiation of bauxite, with similar advantages (and disadvantages) to the above.

The ownership and financial structure of a bauxite/alumina facility is usually established prior to any committment to proceed with such a project. Thus there appears little opportunity for the introduction of any arrangements based on the foregoing to the industry as it stands in Jamaica at present.

However should the opportunity arise in the future for a new greenfield facility tc be erected in Jamiaca, it is to be recommended that those charged with the responsibility for representing the interests of the Government in the matter, become apprised of the range of financing and ownership options that are now available. They should also endeavour to establish the degree of attractiveness of each to the prospective protagonists, and the reasons behind this, prior to commencing serious negotiations with interested parties.

On a less ambitious note, it should be recognized that any significant capital expenditure spent on a mine or refinery is accommpanied by implied borrowings through the gearing and capital raising arrangements of the owning company. This together with the tax depreciation benefits alluded to above means that any subsequent significant period of closure of that plant will impose a greater financial penalty on a company that has spent capital in this way than on one that has not. Hence there is a natural resistance to shutting down such a plant.

III - OVERVIEW OF PROJECT RESULTS

The following is a summary of conclusions of each facet of the project based on a reading of the individual consultants reports. This summary has involved selecting only the most significant or relevant issues; approaches which may assist in their resolution are proposed.

In drawing together data from the various consultants reports into this consolidated report, a policy has been adopted of refraining from making comment on views expressed by individual consultants as regards to the opinions which they express in their reports. Instead this writer's views are expressed independently of any opinions contained in these reports. The reader may in some instances discern a difference in viewpoint or emphasis between what is presented in this consolidation report and what has been provided in the individual consultant's report.

The intention is to enable the reader to observe that there is such a difference, and be able to examine that difference in the light of the data presented. The value in this approach is that it provides the reader with the opportunity of making up his own mind on the matter. It should be noted that in most instances these differences do not amount to a question of fact but rather of interpretation of a situation in the light of the consultant's own experience.

It is important therefore in order to obtain a balanced view of the subject matter covered in this document, that the reader reviews alongside the summaries which follow, any alternative or additional views or comments that may be presented in the individual consultant's reports.

A - Bauxite Utilization

The principal problems which have been identified in the development and efficient use of the bauxite resource are as follows

Accuracy of assessment of reserves

Poor recovery of minable bauxite due to ;

poor mining practices in relation to ore located with geometrical constraints

presence of marginal ore particularly in relation to it's boemitic content

Concern that reported bauxite usage is not truly indicative of that involved in the process for the production of alumina, but includes mining and stockpile losses including losses from alumina stockpiles as well.

The tendency for unreasonable pressure to be brought to bare on government agencies for premature pit closure before the minable ore from the pit is fully exhausted.

Recommendations made with the object of addressing these areas of concern are as follows

The setting up of a comprehensive database in relation to the minable bauxite reserves on the Island. The use of computer services for this purpose is recommended in order that it may interact with existing micro computer mapping of reserves currently carried out.

In order to encourage the more complete recovery of processable ore under geometrical constraints, the use of innovative solutions is recommended, such as the JBI becoming involved in evaluating and recommending technical solutions to difficult recovery problems and the greater use of contract mining.

The stockpiling of high boemitic ore for prospective export to suitable high temperature refineries for possible use as a sweetener to that process.

Separation of administrative functions associated with reserves estimation and issuance of mine closure certificates, so as to avoid a tendency to early closure of some pits.

Relaxation of bauxite levy on marginal ore to act as an incentive for its recovery for processing. Some clarification of the way in which the 40 year agreement operates in this area is required.

Trialing, and if successful, implementation of recent technically advanced geostatistical techniques such as Kriging and Variography and Ground Penetrating Radar in order to improve grade and tonnages estimates.

Substitution of a direct measure of estimating bauxite consumption for the indirect method currently in use, namely that of deriving same from alumina shipments by an inferred and probably inflated conversion factor.

More accurate assessment of the bauxite alumina ratio for both ore reserves and mined bauxites, preferably by use of simulated digestion to be carried out by an authoritative laboratory set up to operate independently of all interested parties.

Application of JBI knowledge and skills in more direct forms of supervision of bauxite mining and recovery practices.

The development of a mobile chemical laboratory to be used for environmental testing and to be available for moving quickly to persistent environmental trouble spots. This facility could be used to produce "on-the-spot" results which could be available for immediate negotiation with an alleged offending party.

B - Alumina Productivity

Observations of the productivity and efficiency of this industry in Jamaica are as follows;

Jamaican bauxite is amongst the cheapest in the world to mine and transport to the refineries however overall bauxite losses during mining, transport, stockpiling and processing within the refinery all appear higher than would result if more modern and appropriate technology were used.

Refineries are aging both in design and operating practices and are of relatively small capacity compared to the more recently built mega-capacity complexes erected in other parts of the world.

Labour costs per unit of alumina produced are low by world standards, but not as low as pay scales would suggest. This is because the older and smaller plants require more manning than modern more automated refineries.

Energy costs are high because of a total dependence on oil imports for boiler house, electrical and calcination energy.

Caustic soda losses are excessive by world standards. To some extent these may be affected by a desire to conserve energy, however inappropriate plant design and poor mud washing and disposal arrangements are the main reasons for this.

Maintenance costs are higher than average for alumina plants because of their age and the design of the plants. Wage rates are a positive factor in keeping these in check.

Overhead, supervision and provisioning costs are higher than average because of the smaller size of the plants and the reluctance of the operators to rely on local infrastructure for services in this regard.

The following were the recommendations made with the object of improving the financial viability of bauxite/alumina operations in Jamaica

Encourage the introduction of certain process improvements chiefly;

sweetening of bauxite feed streams and the predigestion of bauxite

mud washing and disposal, particularly as it relates to the recovery of soda values therefrom

improved and updated instrumentation, particularly as regards to evapourator, precipitation control and mud washing

Ensure that new alumina facilities and refinery extensions are based upon larger units of production with modern instrumentation and effective procedures for losses recovery.

Encourage the development of specialty alumina production and examine the technical feasibility of producing within some of the older and smaller plants a range of other products from bauxite and alumina

Re-examine the prospects for an alternative source of energy to oil. The prospects for coal or gas should be reviewed.

Embark upon a long term strategy of improving the skills of the existing and potential workforce of the industry in Jamaica.

Take steps to improve the ability of the existing infrastructure to be able to more effectively perform as a support base for the industry in Jamaica

Encorporate into environmental legislation interactive provisions designed to ensure that losses in process streams that are pollutants are pursued and reduced for both environmental as well as economics reasons.

C - Semi and Fabricated Aluminium Products

The principal observations made with regard to semi and finished aluminium products in Jamaica are as follows

An excess of imports over exports of semi and fabricated products

An undercapacity to produce in Jamaica as against local demand, all semi and finished products except extrusions.

Local consumption of a significant volume of products which are sourced from hard currency areas which could be readily produced locally in Jamaica.

Opportunities for developing export business in semi and fabricated aluminium products with neighbouring countries in the region

The availability within Jamaica of a range of skills and resources which would be applicable to semi and fabricated aluminium products and which are at present being under utilized.

An imbalance in the aluminium industry in Jamaica of capital intensive investment (in mining and alumina production) against a dearth of lower capital intensive but more labour intensive investment (such as in some semi and finished products).

Recommendations for redressing the above situation are as follows;

Market research in detail the semi and finished aluminium product markets in Jamiaca with a view to interesting local and overseas entrepreneurs in investing in new capacity in this area.

Evaluation of opportunities for trade in aluminium semi and finished products with neighbouring countries

Construction, once markets have been confirmed, of a combination drawing/press forging operation of 800 tpa capacity at a total capital cost of the order of US$6.2 million.

The construction of a diecasting facility using predominantly recycled aluminium of 500 tpa capacity for a total capital cost of US$2.6 million.

D - The Environment

The task with regard to the environment was undertaken using a fresh approach by a consultant who has not previously had an association with the bauxite and alumina industry. Consequently an independent view of pollutants and their likely effects was obtained.

The areas investigated, and for which recommendations were made were as follows;

Identification of deleterious components of emissions

Nomination of maximum acceptable standards for pollutants

Indications on strategies and techniqes for measurement

Critique the recent report, "Alpart Mud Lake Risk Assessment, vol 1" by Gurr and Associates Inc.

The chief pollutants were identified as;

Dust from bauxite and from alumina refining, monitoring of which is currently carried out on a piecemeal basis

Oxides of sulphur and nitrogen together with carbon dioxide from combustion of fuel oils for steam raising and for calcination in alumina refineries, virtually none of which is currently monitored

Sodium in the form of soluole and insoluble compounds released in waste liquors and in red mud which is ponded. Each of these eventually finds its way via the soil into ground waters. These are currently monitored using wells drilled into the ground waters at a number of locations

Noise arising principally from bauxite transport operations, which has not been subject to any extensive monitoring

As a result of a review of additional data available from environmental authorities in California (USA) Canada and Sweden, appropriate standards were recommended for dust emissions, for water quality, and for noise levels.

In the case of water quality it was recommended that the standards proposed by the Underground Water Authority and the Jamaican Bauxite Institute be relaxed in relation to nitrate levels (from 20 ppm to 45 ppm) and tightened in relation to total dissolved solids (from 600 ppm to 500 ppm)

As regards techniques to be used for measurement of pollutant levels in emissions, the framework of a regimen was supplied by the consultant from which, in co-operation with the operators of the plants, it should be possible to devise a detailed monitoring procedure which would enable the above measurements to be carried out. When compared against the aforementioned standards any discrepancies detected could form the basis of negotiations with the organization concerned toward the objective of achieving compliance.

The report entitled "Alpart Mud Lake Risk Assessment - Vol 1 by Gurr and Associates aws reviewed and the following is a summary of the comments made thereon;

The omission of base data from the above report means that the opportunity is unavailable for meaningful comment to be made on the technical interpretations presented in the report.

It is desirable to include an estimate of the total amount of sodium released from the plant, both soluble and insoluble, so as to endeavour to account for its whereabouts as fully as possible. There is a concern that a hidden reservior of sodium may exist that is at present chemically bound in insoluble form, but which may have the potential for subsequent release to the ground waters if soil conditions change.

The reference to the possibility of an as yet undetected sodium plume elsewhere in the ground waters is disturbing.

The reasoning behind the conclusion that the South Mud Lake will lower emissions appears to be inadequately supported by the extent of detail provided, particularly as to the type of ponding construction proposed.

Additional data and publications by various Australian Government authorities dealing specifically with the bauxite alumina industry in that country are appended.

IV - FUTURE STRATEGIES FOR THE INDUSTRY IN JAMAICA

Introduction

To enable a smooth running of the economy of a country such as Jamaica, two factors are of fundamental importance. Firstly the achievement from year to year of a smooth income flow (from bauxite and alumina levy and royalties), and secondly a consistent level of employment.

Until recent times a stable local bauxite and alumina industry had met both of these ideals admirably.

However with the temporary closure of the Alpart and Clarendon refineries in the recent past, which occurred reportedly because of a buildup wordwide of alumina stocks against a background of reduced aluminium consumption, the sudden disruption to the Jamaican hard currency cash flow position would have required some short term budgetiary readjustment.

Moreover the uncertainty created by the prospect that at some future time during a situation of excess world alumina production, there was the liklihood of a similar occurence taking place at short notice was sufficient for measures to be sought to avoid the possibility of this occurring again.

For a discussion of some contributing factors and recommendations for the future the reader is referred to the previous section.

There is no smelting of alumina to aluminium in Jamaica at present because of the lack of the prime ingredient to make such a project viable, namely a source of low cost electric energy. This situation is not seen as being likely to change in the near future.

The presence of some semi-fabricated manufacturing in Jamaica is an indication of the commencement of some form of integration of the industry in Jamaica. However it is noted that there is still a considerable volume of semi-finished and fabricated aluminium products which are imported. Many of these could be successfully manufactured in Jamaica and such a course would represent a further move in the direction of independence from high priced imports.

The effect of the various stages in the production of aluminium on the economy in their response to the business cycle is of relevance in the context of the economy of Jamaica. The extent and speed of response to stimuli occurring as a result of swings in the business cycle are quite different when it comes to how they affect alumina refining as against the manufacture of semi-finished and fabricated products.

The Effect of the Business Cycle

In the case of alumina, this is most sensitive to the level of the stockpile of this commodity. A buildup of the stockpile will occur as result of a downturn in consumption in the industries which use aluminium, namely transport and building. However there may be a considerable delay before the size of the stockpile "flags" the need for a turndown in production, almost to the point where general consumption of the end products may be starting to rise from a recessionary low.

The oversupply situation is invariably accompanied by a depression in price of the commodity which is passed on to the ingot price. This tends to act as a stimulus for the semis producer to increase production in order to sell at a lower price because his raw material costs have been lowered as a result.

The overall effect can be that at the time cutbacks are taking place in alumina refining, the semi and fabricated business is starting to pick up. As a result there tends to be a dampening of the effects of the business cycle which can even-up overall cash flow somewhat during difficult times in the business cycle.

Another important aspect of the semis and fabricated products business is that it lends itself to rapid accommodation to changes of economic climate. This arises out of the ability in a well run small organization to apply the principles of "just in time" supply and delivery to inventory control. This fact together with the more labour intensive nature of the operation (as against the very capital intensive nature of alumina refining) means that from this viewpoint it offers a better fit to the Jamaican economic environment than would alumina refining if the latter were devoid of the over-riding natural advantage of the bauxite resource.

Employment Level Effects

The interaction of levels of employment is significant when considering bauxite/alumina as against semis. The capital intensive nature of bauxite/alumina relative to semis means that on an equivalent tonnage basis, job creation engendered by an expansion of alumina capacity is not as great as that from the startup of a new semi or finished products facility. However because the magnitude of alumina operations in Jamaica swamps that of any likely expansion of capacity of semi/fabricated products, any reasonable expansion of same would not be translated into a significant growth in number of employees in the short term.

Major Policy Thrusts

Summing up the recommendations which flow from this report which may be expected to have a direct beneficial effect on the Jamaican balance of payments, these are;

An improvement in productivity and possibly the range of products from existing alumina refineries and their associated mines, plus any expansions or new plants that may be expected to flow from this,

An expansion of suitable semi and finished products manufacture so as to reduce the volume of high cost imports to Jamaica and to introduce the possibility of exporting some of these products.

An improvement in environmental control of bauxite/alumina operations would be expected in the long run to benefit the Tourism industry.

Prospective Financial Benefits

In order to illustrate the possible effects that this strategy could have on cash flow derived from the aluminium industry in Jamaica, the tonnages and sales revenues which might be expected to result from these activities are represented in figures 1 and 2.

For the purposes of estimation, the data represented therein is based upon existing tonnages for bauxite, alumina, and semis, and on average prices for these products in the marketplace. The assumption is made that the productivity of the alumina branch of the industry is increased by 10%, and that the tonnages of semi and finished products produced locally is increased by the amount recommended in the appropriate consultants report. In both cases the prices for existing tonnages are assumed to apply to the additional tonnage.

FIGURE 1

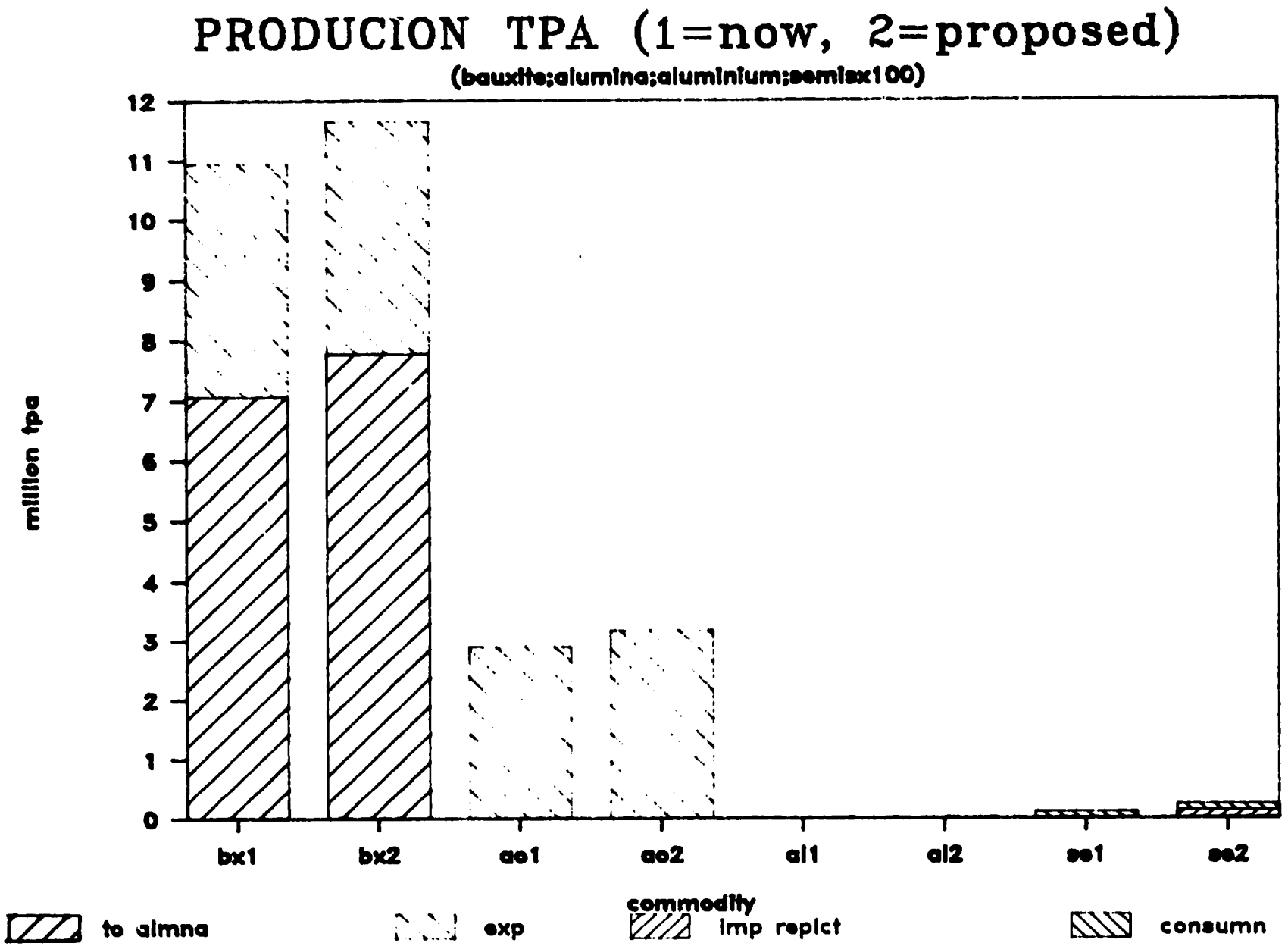
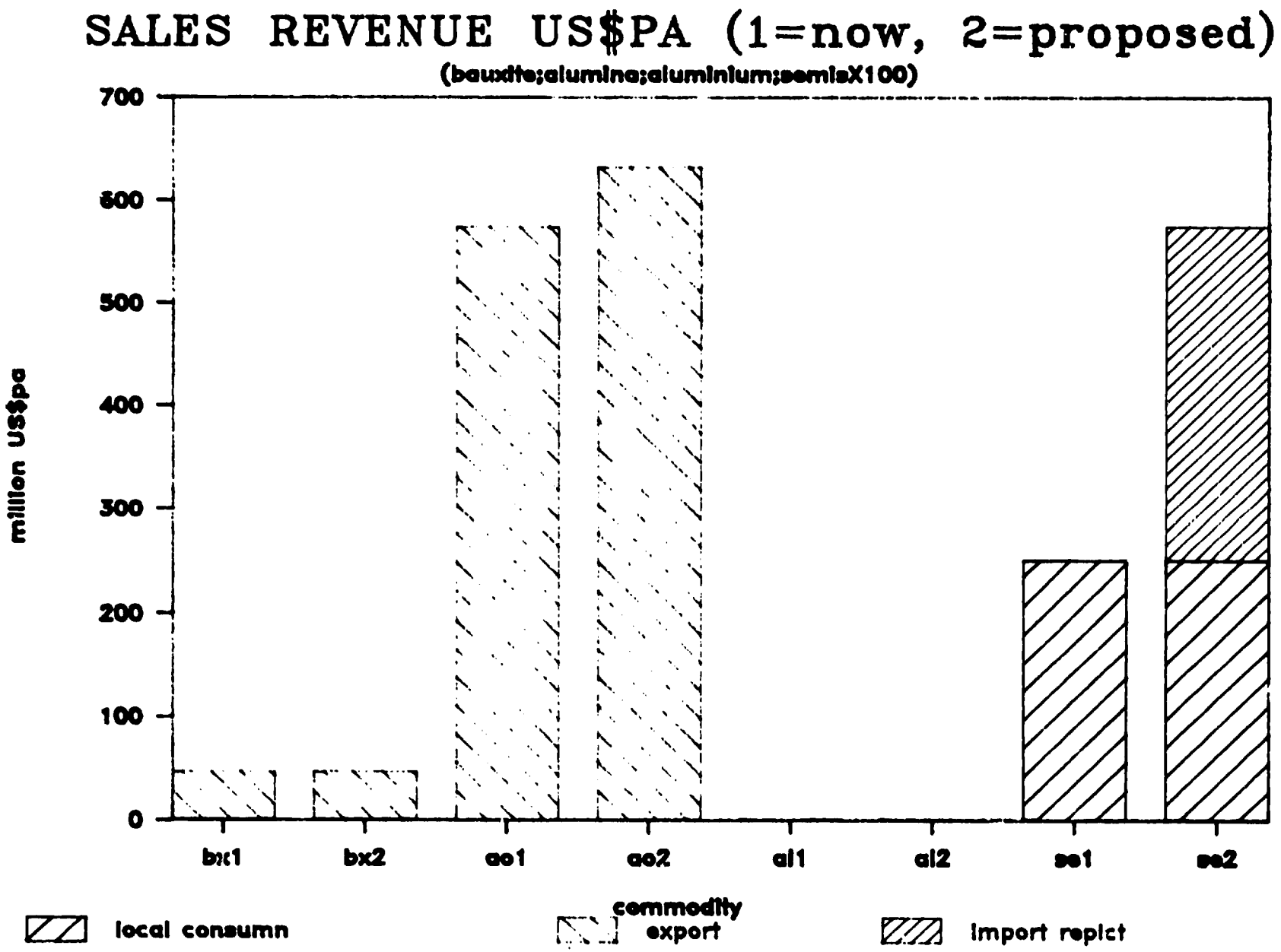

PRODUCION TPA (1=now, 2=proposed)
(bauxite;alumina;aluminium;semisx100)
million tpa
12
11
10
9
8
7
6
5
4
3
2
1
0
bx1
bx2
ao1
ao2
al1
al2
se1
se2
commodity
to almna
exp
imp replct
consumn

FIGURE 2


SALES REVENUE US$PA (1=now, 2=proposed)
(bauxite;alumina;aluminium;semisX100)
million US$pa
700
600
500
400
300
200
100
0
bx1
bx2
ao1
ao2
al1
al2
se1
se2
local consumn
commodity export
import replct

BAUXITE/ALUMINA/ALUMINIUM PRODUCTS TONNES AND REVENUES - CURRENT & POTENTIAL

VOLUME

(million tpa for all except semis etc which are 10,000 tpa)

	TRANSFER FOR PROCESS	EXPORTED	IMPORT REPLACEMENT	LOCAL CONSUMPTION
BAUXITE				
current	7.06	3.87	0	0
proposed	7.766	3.87	0	0
ALUMINA				
current	0	2.87	0	0
proposed	0	3.157	0	0
ALUMINIUM				
current	0	0	0	0
proposed	0	0	0	0
SEMI & FINISHED PRODUCTS				
current	0	6	0	0.1
proposed	0	0	0.13	0.1

	ASSUMED UNIT RATES	REVENUE		
		(US$million pa except semis etc which are US$10,000 pa)		
	(US$/tonne)	EXPORTED	IMPORT REPLACEMENT	LOCAL CONSUMPTION
BAUXITE				
current	11.9	46	0	0
proposed	11.9	46	0	0
ALUMINA				
current	200	574	0	0
proposed	200	631.4	0	0
ALUMINIUM				
current		0	0	0
proposed		0	0	0
SEMI & FINISHED PRODUCTS				
current	2500	0	0	250
proposed	2500	0	325	250

The data represented in the above figures are gross sales tonnages and revenues in US$ terms, and as such do not represent cash income to the Government or peoples of Jamaica. However it is to be expected that economic benefits will flow from these, directly in the form of increased Government levies, taxes and Royalties and indirectly through the provision of local goods and services.

It is not recommended in the first instance that export of semis and finished products from Jamaica should be targetted as an initial objective. A move in this direction would not be considered wise before a sound domestic market had been established. The means by which domestic markets for semi and finished aluminium products in Jamaica can be protected from predatory pricing practices that importers may seek to employ to protect their existing markets is within the power and competence of the Government of Jamaica to implement if the necessity arises.

As regards the question of exports, for a country to be a potential export market, it must be one in which the Jamaica product possesses a real competitive advantage, and against which the risk that artificial trade barriers or sanctions would be erected is minimal.

An extension of production process capacity would be required to service potential exports of these products. This would require that a range of additional service activities would need to be in place before an effective export business could function successfully. Agreements or understandings in relation to trade, and a stable local currency are among Government regulated inputs that are required, while a broader range of industry and marketting skills within the industry itself need to be developed over those required to service the domestic market.

Annexure 1

LIST OF CONSULTANTS

Name of Consultant	Project Number and Title
Rex C Bryan	UC/JAM/90/239/11-51/J13207 - Consultant on Bauxite Utilization
Ronald W Moyle	UC/JAM/90/239/11-52/J13207 - Team Leader and Consultant on Productivity in the Alumina Industry
Dr Andras Eva	UC/JAM/90/239/11-53/J13207 - Consultant on Production and Marketing of Semi- and Finished Products of Aluminium.
Hans Gustafsson	UC/JAM/90/239/11-54/J13207 - Consultant on The Environment and Environmental Protection.

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

JOB DESCRIPTION

UC/JAM/90/239/11-51/J13207

Post Title Consultant on Bauxite Utilization

Duration 1.5 months

Date required November 1990

Duty station Kingston, Jamaica

Purpose of the project

Contribute to the increase of productivity of the existing facilities through better utilization of the current bauxite and alumina production capacity and its various inputs.

Duties The consultant should develop the following:

- Prepare on the basis of existing information a comparative analysis and assessment of Jamaican bauxites vis-a-vis other major bauxite producers in terms inter alia of:

  i. Chemical composition
  ii. Mineralogy
  iii. Geology
  iv. Accessibility

- Assess present bauxite reserves with a view to enhancing the national utilization of the bauxite reserves.

- Evaluate the technical capabilities of the Jamaican Bauxite Institute in the allocation and administration of the bauxite reserves.

- Develop guidelines for the establishment of a alternative models of reserve allocation and utilization.

Qualifications Geologist and/or Specialist on mining and raw materials resource development. At least 10 years experience working in this area with a well recognized international organization.

Language English

Background Information

The bauxite/alumina sector represents the largest industrial sub-sector in the Jamaican economy accounting for approximately 10% of gross domestic product, close to 60% of export earnings, the highest concentration of technical and skilled workers and a major base of support for other sectors and sub-sectors in the national economy (railway, construction, engineering, maintenance and repair services, etc.).

The industry is based on Jamaica's second (to limestone) largest mineral resource, namely bauxite which covers over the third of the land surface and in terms of volume represents more than one billion tons of recoverable ore.

Up to 1971, Jamaica was the largest bauxite producer in the world. Currently the island ranks third in bauxite production (behind Australia and Guinea) and fourth in the case of alumina.

The bauxite/alumina industry of Jamaica is presently being exposed to the world-wide restructuring process of this industry. The main elements determining the restructuring process are:

i) the availability and cost of energy;
ii) the location of bauxite;
iii) environmental considerations;
iv) the changing intensity of metal use; and
v) the dominating role of high technology in developing new metal composites and other materials and the new engineering solutions which are changing the structure of end-use markets.

While it is difficult to precisely predict the shape of the world aluminium industry over the next 10-15 years, it is also clear that the new trends already emerging will, to a very large degree, determine the future structure of the industry.

The world-wide restructuring process of the bauxite/alumina industry which took place in the 1980s had a critical impact on the Jamaican national economy due to the relevant role of the aluminium industry in generating foreign exchange earnings. The critical decline of the international aluminium industry in the years 1984-86 resulted in the closure of one of the two companies producing bauxite and two of the four refineries producing alumina.

This experience exposed the need for strengthening the capacity of Jamaica to adequately plan for and adjust to the changes in the international aluminium industry and to adequately take advantage of opportunities when they arise. Jamaica therefore has a vested interest to develop a broader strategic policy approach capable of taking into consideration in an integrated manner the structural changes and opportunities emerging in the aluminium industry world-wide.

The aluminium industry of Jamaica, in order to make full use of its potentials at the national, regional and international levels, should develop a strategic policy framework based primarily on:

i) Restructuring and increasing the productivity of the existing facilities;

ii) Improving the present horizontal and vertical integration of the industry;
iii) Diversifying the industry;
iv) Overcoming the environmental constraints that are limiting the socio-economic development of the industry.

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

JOB DESCRIPTION

UC/JAM/90/239/11-52/J13207

Post Title Team Leader and Consultant on Productivity in the Aluminia Industry

Duration 2.0 months

Date required November 1990

Duty station Kingston, Jamaica

Purpose of the project

Contribute to the increase of productivity of the existing facilities through better utilization of the current bauxite and alumina production capacity and its various inputs.

Duties The consultant should develop the following:

- Diagnosis of the productivity situation of the four alumina plants. For this purpose an analysis of existing reports on the alumina plants should be undertaken.

- Analyse the impact as well as possibilities of increasing productivity, on the basis of the following:

  i. Energy, efficiency in energy utilization and/or use of alternate resources.

  ii. Equipment and instrumentation. Equipment situation, technological level in comparison with similar plants world wide.

  iii. Process technology. Situation and possibilities of increasing efficiency.

  iv. Manpower. Skills and training requirements.

  v. Waste disposal. Improvement of methods for waste disposal.

  vi. Port and storage facilities. Assessment of these facilities of the four alumina plants.

vii. Possibilities of introduction of the production of co- and by-products, aluminium hydrate and alumina.

- Based on the reports of the consultants 11-01, 11-03 and 11-04 and his/her own, prepare a consolidated report and proposal for

  a) strategic policy framework for the coherent development of the Jamaican aluminium industry for the short, medium and long terms;

  b) programme for restructuring and increasing the global productivity of existing facilities;

  c) programme for horizontal and vertical integration of the aluminium industry taking into consideration regional complimentarities;

  d) programme of diversification of industry and its product-mix;

  e) programme for the protection of environment.

Qualifications Industrial engineer or metallurgist with a minimum experience of 10 years working in the aluminium industry basically in the area of increasing the productivity and efficiency of existing alumina plants.

Language English

Background Information

The bauxite/alumina sector represents the largest industrial sub-sector in the Jamaican economy accounting for approximately 10% of gross domestic product, close to 60% of export earnings, the highest concentration of technical and skilled workers and a major base of support for other sectors and sub-sectors in the national economy (railway, construction, engineering, maintenance and repair services, etc.).

The industry is based on Jamaica's second (to limestone) largest mineral resource, namely bauxite which covers over the third of the land surface and in terms of volume represents more than one billion tons of recoverable ore.

Up to 1971, Jamaica was the largest bauxite producer in the world. Currently the island ranks third in bauxite production (behind Australia and Guinea) and fourth in the case of alumina.

The bauxite/alumina industry of Jamaica is presently being exposed to the world-wide restructuring process of this industry. The main elements determining the restructuring process are:

i) the availability and cost of energy;
ii) the location of bauxite;
iii) environmental considerations;
iv) the changing intensity of metal use; and

v) the dominating role of high technology in developing new metal composites and other materials and the new engineering solutions which are changing the structure of end-use markets.

While it is difficult to precisely predict the shape of the world aluminium industry over the next 10-15 years, it is also clear that the new trends already emerging will, to a very large degree, determine the future structure of the industry.

The world-wide restructuring process of the bauxite/alumina industry which took place in the 1980s had a critical impact on the Jamaican national economy due to the relevant role of the aluminium industry in generating foreign exchange earnings. The critical decline of the international aluminium industry in the years 1984-86 resulted in the closure of one of the two companies producing bauxite and two of the four refineries producing alumina.

This experience exposed the need for strengthening the capacity of Jamaica to adequately plan for and adjust to the changes in the international aluminium industry and to adequately take advantage of opportunities when they arise. Jamaica therefore has a vested interest to develop a broader strategic policy approach capable of taking into consideration in an integrated manner the structural changes and opportunities emerging in the aluminium industry world-wide.

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i) Restructuring and increasing the productivity of the existing facilities;
ii) Improving the present horizontal and vertical integration of the industry;
iii) Diversifying the industry;
iv) Overcoming the environmental constraints that are limiting the socio-economic development of the industry.

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

JOB DESCRIPTION

UC/JAM/90/239/11-53/J13207

Post Title Consultant on Production and Marketing of Semi- and Finished Products of Aluminium

Duration 1.0 months

Date required November 1990

Duty station Kingston, Jamaica

Purpose of the project

Contribute to the increase of productivity of the existing facilities through better utilization of the current bauxite and alumina production capacity and its various inputs.

Duties The consultant should develop the following:

- Analyse on the basis of existing information the local and regional production and consumption of primary, semi-finished and finished aluminium products, to determine the future demand for these products at the local and regional levels, and optimum methods of demand-supply harmonization.

- Assessment of the current production capabilities in terms of:

  i. range of products (primary aluminium, semi-finished and finished)
  ii. quality
  iii. production technology and efficiency
  iv. marketing strategy.

- Determine possibilities of fabrication of primary aluminium, semi-finished and finished products.

- Establish guidelines for an investment programme in the field of semi-finished and finished products.

Qualifications Industrial engineer or metallurgist with a minimum experience of 10 years in the fabrication of semi-finished and finished products of aluminium.

Language English

Background Information

The bauxite/alumina sector represents the largest industrial sub-sector in the Jamaican economy accounting for approximately 10% of gross domestic product, close to 60% of export earnings, the highest concentration of technical and skilled workers and a major base of support for other sectors and sub-sectors in the national economy (railway, construction, engineering, maintenance and repair services, etc.).

The industry is based on Jamaica's second (to limestone) largest mineral resource, namely bauxite which covers over the third of the land surface and in terms of volume represents more than one billion tons of recoverable ore.

Up to 1971, Jamaica was the largest bauxite producer in the world. Currently the island ranks third in bauxite production (behind Australia and Guinea) and fourth in the case of alumina.

The bauxite/alumina industry of Jamaica is presently being exposed to the world-wide restructuring process of this industry. The main elements determining the restructuring process are:

i) the availability and cost of energy;
ii) the location of bauxite;
iii) environmental considerations;
iv) the changing intensity of metal use; and
v) the dominating role of high technology in developing new metal composites and other materials and the new engineering solutions which are changing the structure of end-use markets.

While it is difficult to precisely predict the shape of the world aluminium industry over the next 10-15 years, it is also clear that the new trends already emerging will, to a very large degree, determine the future structure of the industry.

The world-wide restructuring process of the bauxite/alumina industry which took place in the 1980s had a critical impact on the Jamaican national economy due to the relevant role of the aluminium industry in generating foreign exchange earnings. The critical decline of the international aluminium industry in the years 1984-86 resulted in the closure of one of the two companies producing bauxite and two of the four refineries producing alumina.

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i) Restructuring and increasing the productivity of the existing facilities;
ii) Improving the present horizontal and vertical integration of the industry;
iii) Diversifying the industry;
iv) Overcoming the environmental constraints that are limiting the socio-economic development of the industry.

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

JOB DESCRIPTION

UC/JAM/90/239/11-54/J13207

Post Title Consultant on Environment and Environmental Protection

Duration 1.0 months

Date required November 1990

Duty station Kingston, Jamaica

Purpose of the project

Contribute to the increase of productivity of the existing facilities through better utilization of the current bauxite and alumina production capacity and its various inputs.

Duties The consultant should develop the following:

- Prepare standards of environmental monitoring, control and protection in areas connected to the bauxite/alumina industry in Jamaica.
- Recommend environmental monitoring techniques with a view to implementing a monitoring programme. Proposal for the acquisition of monitoring equipment.
- Outline measures for optimal utilization of bauxite areas.
- Propose measures for the improvement of national legislation in the area of environmental protection.

Qualifications Specialist in environment and environmental monitoring, control and protection in areas of mining andindustrial activity. The consultant should have a minimum of ten years of experience in these fields.

Language English

Background Information

The bauxite/alumina sector represents the largest industrial sub-sector in the Jamaican economy accounting for approximately 10% of gross domestic product, close to 60% of export earnings, the highest concentration of technical and skilled workers and a major base of support for other sectors

and sub-sectors in the national economy (railway, construction. engineering, maintenance and repair services, etc.).

The industry is based on Jamaica's second (to limestone) largest mineral resource, namely bauxite which covers over the third of the land surface and in terms of volume represents more than one billion tons of recoverable ore.

Up to 1971, Jamaica was the largest bauxite producer in the world. Currently the island ranks third in bauxite production (behind Australia and Guinea) and fourth in the case of alumina.

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iii) environmental considerations;
iv) the changing intensity of metal use; and
v) the dominating role of high technology in developing new metal composites and other materials and the new engineering solutions which are changing the structure of end-use markets.

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i) Restructuring and increasing the productivity of the existing facilities;
ii) Improving the present horizontal and vertical integration of the industry;
iii) Diversifying the industry;
iv) Overcoming the environmental constraints that are limiting the socio-economic development of the industry.

Annexure 2

LIST OF KEY PROJECT PERSONNEL

UNIDO Vienna International Centre

Dr Tamas Grof	Industrial Development Officer, Metallurgical Branch.

UNIDO Office, Jamaica

Mr Cristian Gillen	Country Director for Bahamas, Bermuda, Cayman Islands, Dominican Republic, Haiti, Jamaica and Turks & Caicos Islands.

JAMAICAN BAUXITE INSTITUTE

Dr Carlton Davis	Director and Chief Executive Officer
Mr Dennis Morrison	Director, Economics and Projects
Mr Parris Lyew-Ayee	Senior Director Bauxite Reserves, Land Use Planning and Environmental Management.

together with

Mr Wilmon Wallen-Bryan

Mr Michael Mitchell

Mr Worrell Lyew-You

Annexure 3a

Synopsis of Consultants Report on BAUXITE UTILIZATION

Guaranteeing the future availability of Jamaica bauxite reserves will require active planning and guidance by the Jamaican Government. The following tasks are recommended:

- Set policies which will encourage the optimum exploitation of bauxite reserves.

- Produce detailed land utilization plans containing bauxite inventories integrated with other critical land use, legal and environmental data.

- Establish an agency with the clear authority to regulate the bauxite mining industry, including the authority to issue and revoke mining permits, levy fines and inspect all aspects of the mining process.

- Encourage and promote research of new measurement, mining, reclamation, estimation and waste management technologies as applied to the bauxite/alumina industry.

- Establish environmental standards, and develop technical abilities to sample and analyze environmental data independent of the bauxite/alumina industry.

Jamaica's economic future is tied in a large degree to it's reserves of bauxite. This report seeks to examine and produce recommendations on the technical, economic and policy issues whereby this resource can be utilized to the best advantage of Jamaica.

RESERVES

In 1990, just under a hundred million metric tons of bauxite was produced worldwide against an overall reserve base of 22,500 million tons. Additionally, 102,795 million tons are currently classified as resources.

JAMAICA BAUXITE COMPARISON

Jamaica has over 2,000 million tons of bauxite in reserve with an additional 800,000,000 tons as a resource.

Jamaica has 8.9 percent of the world's bauxite reserves and in 1990 supplied 11.4 percent of the world's production. The key to the efficient use of the resource is the mining of these insitu reserves, without significant liabilities being incurred such as loss of agricultural lands, loss in tourism, contamination of water or air, etc.

Jamaica has a high ranking by those factors which are desirable in setting up an industry. These include the freedom from political unrest, a stable exchange rate, minimum restriction on repatriation of capital and profit, freedom from restrictions on investment, and absence of corruption in government.

- Positive Aspects of Jamaican Bauxite

In summary, the following points make Jamaica a strong competitor vis-a-vis other bauxite rich countries:

- Stable political environment
- Good infrastructure of roads, communication and power
- Proximity to markets
- Access to high quality of labor
- Ease of mining with limited strip requirements, short haulage distances
- Ore with known metallurgical properties.

- Negative Aspects of Jamaican Bauxite

Compared to the bauxite reserves of Brazil and Australia - Jamaican bauxite is not remote from human settlements. This places an additional cost burden on Jamaican bauxite miners in a variety of ways.

- Bauxite mining companies must become involved in land acquisition and consolidation of mining areas.

- Before mining, any individual must be relocated. When a large population is involved, such a relocation means at times the planning and construction of a new community.

- Operating mining equipment in inhabited areas requires the building of mining access roads, staging areas etc.

- Greater level of scrutiny of mining, remediation and discharge of wastes.

Jamaican bauxite is probably least competitive with other major suppliers with regard to mining within populated areas. The potential for the loss of large amounts of bauxite by uncontrolled subdivision, was and is, of great concern.

Established in 1976 as a quasi-governmental organization, the Jamaica Bauxite Institute's (JBI), primary task is to act as a technical advisor to the Jamaican Government with issues related to the bauxite/alumina industry. Following the consolidation of company reserves, JBI took on the task of supporting the Ministry of Mines and the Department of Agriculture in coordinating the mining reserve issue. To do so, the JBI set forth the following goals:

- Lands required for mining were allocated to various mining companies based on their then forty-year requirements.

- The forty-year bauxite reserve was divided up into blocks of five year reserve capacity which were to be worked through sequentially.

- All other bauxite lands were to be used for agricultural purposes.

- Re-settlement was to be planned jointly between the Government and the Companies. This was to ensure that those re-located would be guaranteed of a high quality of life.

- Plans were made to guide the future use of mined-out and reclaimed land.

These five points acknowledge that there is a logical sequence to be followed if the returns from Jamaica's bauxite lands are to be maximized. The general sequence is to use the mine reserve areas for agriculture, then mining, and finally, rehabilitation back to agriculture etc.

The plan defined other potential land uses to be coordinated with the Companies' mining plans for a medium term (5 years) and a long term (20 years).

The five-year blocks are still considered exclusively for mining. Beyond five years, the blocks are made available for agriculture, provided that the crops chosen should be scheduled to be harvested before mining. Within this medium time frame, no permanent structures or capital intensive development should be allowed. Within the medium and long term mining reserves, constant monitoring must be done to control any sub-divisions which would remove these reserves from the mining base. This last paragraph implies a decision process which requires close communication with each company.

A process for careful use of bauxite reserves is shown below. The demands for integrated information becomes apparent as one moves through the process.

Recommendations for the organization of the future resource management by the JBI should include

- That the system utilize modern computers to speed the process.

- That computer systems utilize an information data base such as a Geographical Information System (GIS) format.

- That the GIS produce the requisite maps and reports, to facilitate land use decisions.

- That due to its experience, JBI be selected to set up, operate and maintain the system.

- That the GIS system created, be an open resource for both government and industry.

- That the JBI and the companies pool their information resources, so as to produce a decision tool useful to government and industry.

- That the present equipment and software be upgraded to be powerful enough to allow for real-time access of the GIS information.

In conjunction with existing

- Micro-computer mapping capabilities of bauxite reserves.
- Archived maps and documents containing the location of roads, buildings and mining claims.
- Experience in interpreting aerial photographs.
- Skill in digitizing topographic maps.

This equipment, staff and skills can be used as the foundation to implement this GIS database. However, additional resources will be needed to implement such a system.

MINING COMPANY PERSPECTIVE ON GIS

The response from mining company executives regarding the prospective of a GIS data base was quite favourable.

- Such a system would promote efficiency and optimization of planning. There would be improved ore pit identification and volume estimates, essential to overall planning and any relocation of population could be planned far in advance.

- With such a system, bauxite reserves of an area could be extracted and processed efficiently. After mining, the reclamation and restoration efforts could be conducted on a timely basis. During the total cycle, disruption of local residents could be minimized and a good working relationship with the Government of Jamaica would be enhanced.

- Attributes required on the GIS maps would be:

    1. Property records
    2. Reserve estimates
    3. Mine planning information
    4. Mining operations information
    5. Reclamation information

- The system would require this basic flow of information:

- The bauxite reserves would be the foundation information of the whole GIS system.

- The environmental planning group would require information from all the phases of the mining and plant operations.

EXPLOITING MARGINAL RESERVES

Marginal Ore due to Geometrical Constraints

During several visits to ongoing bauxite mining operations, the following cases were noted:

Significant amounts of bauxite are left behind because it is too difficult or expensive to remove with the available equipment.

Consideration should be given to encouraging innovative technical solutions to what are essentially difficult mining problems.

Encouragement for the use of contract miners with special capabilities operating under an incentive scheme with regard to difficult to access deposits should be considered by the Government. Alternatively the onus may be placed on the mining companies to ensure the recovery of difficult to mine bauxite by an appropriately designed bonus penalty scheme.

In this context the JBI should be encouraged to act as a clearinghouse for technological solutions.

Marginal Ore due to Unsuitable Parameters

Bauxite can also be of marginal economic value due to its chemical/geological makeup. The boehmite content is critical for low temperature digestion plants. Currently high boehmite ore is abandoned, and is essentially lost. It is recommended that the Government encourage the stockpiling of such marginal reserves with a view to their export to suitable refineries that are able to accept this ore.

BAUXITE PARAMETERS DO NOT MEET CURRENT TECHNICAL SPECIFICATIONS

The Effect of Marginal Ore:

An increase in taxation of ore insitu or an increase in royalty will tend to make the mining companies more selective in the ore they choose to mine and therefore the proportion of marginal ore may be expected to increase. In essence, a mining company will preferentially move laterally, versus a policy maker's desired vertical direction.

Poor estimation of an in-place reserve can have the same effect.

MOVING SIDEWAYS INSTEAD OF DOWN...ECONOMICS AND INFORMATION

An additional incentive to move on to a new location may be a misconception that additional reserves are almost inexhaustible. This perception may have come from a misinterpretation of the forty year agreement. There seems to be a widely held belief that if a mining area is exhausted, the Government will grant additional reserves.

It is important that the Government clarify the forty year agreement.

ADVANCES IN TECHNOLOGY

Importance of good estimations

One of the points of the last section was that inaccurate reserve estimation can reduce the efficiency of exploitation, in that an orebody may be prematurely abandoned.

With such inaccuracies, over and underestimation can occur. Mining engineers, are generally conservative in their estimates, and have developed corrections so that inherent inaccuracies will not result in errors occurring on the high side. A study by the JBI in 1981 showed that reductions approaching 60% of the recoverable ore were attributable to this cause.

- Kriging and Geostatistics

Geostatistical techniques of variography and kriging using powerful computers can significantly improve grade and tonnages from reserve estimation.

Ground Penetrating Radar

Even with the limitation that GPR is unable to detect Al_2O_3, GPR shows great promise and is worthy of further study despite limitations with regard to depth of penetration.

To make GPR a universally accepted tool, the Government should support industry in their continuing research and development.

The Government can be in effect a clearinghouse for technological advances, assisting their communication throughout industry.

REGULATORY INSTRUMENTS

The goal of achieving greater efficiency through methods such as taxation or royalty charges will most likely be ineffective or even counterproductive. As has been shown previously, instead of reducing, such a policy will serve to increase the quantity of marginal ore left in place.

Surprisingly, a greater taxation on reserves may, in fact, increase investment on the alumina processing side..

An additional observation is that most policy instruments directed at producing a more efficient bauxite operation, will generally be ineffectual from the alumina product end, because of the value differential between alumina and bauxite.

Therefore, any regulatory instrument striving for greater productivity on the mining side must be based on other principles.

Governmental figures for the amount of bauxite mined is not a measured amount, but a back calculation from product shipped. The conversion factor of number of tons of bauxite to produce one ton of alumina for example is in reality a negotiated number. As a consequence it is impossible to determined how much ore was left in the pit or lost in each step of the mining/alumina process.

Loss of bauxite at all stages through the complete cycle of mining to transport.The summation of these losses constitutes the total level of bauxite loss.

For taxation purposes, the most available measure of tonnage is from the freighter manifest.

The present day system of bauxite equivalency ignores any losses of bauxite in the system. All mining and processing losses are born by the Jamaican government. Recommendations are:

- Research in how to stimulate mining practices with little wasted ore.

- Research must be done in how best to measure the true conversion factor.

- The true conversion factor be tracked and used for information and taxation purposes.

- It is anticipated that obtaining the true conversion factor will require direct observations and measurements at the pit level, discussed in the next section

- A Government representative must be able recognize appropriate mining practices, and can discriminate bauxite from waste.

- A Government representative has the authority to issue fines or penalties for non- compliance.

- There should be direct communication between front end planning and pit closure inspections.

Inspectors should be given much more training, and there should be formal arrangements to coordinate the issuance of pit closure certificates with the Ministry of Agriculture or the Jamaican Bauxite Institute.

ENVIRONMENT

The Natural Resources Conservation Authority Act (NRCA) passed in 1991 is a broadly based legislative tool focused on the environment.

The Act establishes the Natural Resources Conservation Authority, with functions of managing the physical environment to ensure the conservation, protection and proper use of Jamaica's natural resources.

The Authority has been charged with the task of formulating standards and codes of practice to be observed for the improvement and maintenance of the environment, including the release of substances into the environment in connection with any works, activity or undertaking.

The bill is comparable to legislation within the U.S., Canada and Europe, on which environmental issues have had a profound impact on the mining industry.

Significant portions of the provisions relate to bauxite mining and alumina processing and strong measures are foreshadowed involving the prospect of heavy fines and imprisonment..

This legislation stands to become a major influence in determining what and how bauxite is mined and processed.

Standard methods in measurement and analysis:

The task of the Government will be to establish allowable level for each pollutant and to set in place the capacity to perform on-site measurements. The Government must select sampling protocols, analytical techniques, averaging methods and reporting methods for these measurements.

The Jamaican government must select measurement and sampling protocols to which industry must conform. In summary, it is recommended that the Jamaican Government, through a selected agency:

- Specify acceptable parameter emission levels.
- Specify measurement and analytical techniques.
- Specify reporting standards.
- Acquire the equipment and expertise to monitor these parameters unilaterally.

This last point can be addressed with the acquisition of a mobile environmental laboratory which can be scheduled to monitor the bauxite/alumina industry.

Annexure 3b

Synopsis of Consultants Report on PRODUCTIVITY IN THE ALUMINA INDUSTRY

Comparison of Competitiveness

The following are the key specific cost elements in the production of alumina:

A) Bauxite into refinery;

B) Energy;

C) Caustic Soda;

D) Labour; and

E) Other

Based on refineries costs of operation in Jamaica in 1990, a comparison with other major low cost-of-production refineries located outside Jamaica shows that Jamaican refineries fit into a ranking by cost category as follows:

Bauxite Costs (including freight, Royalties and levies)

On the basis per dry tonne of bauxite mined, Jamaican mines deliver bauxite to refineries in Jamaica at costs on a par with the lowest cost producer outside Jamaica. The Worsley refinery in western Australia is believed to have costs which are higher because of costs associated with their 51 km cable belt from mine to refinery (compared with Alpart's 14 km cable belt).

When considered on the basis of cost of bauxite per tonne of alumina produced, Jamaican bauxites/refinery combinations are lower cost than Australian bauxite refineries on the basis of a more advantageous bauxite to alumina ratio. The margin of cost advantage on this basis is perhaps of the order of 0- 15% of alumina production cost based on costs applying during 1990.

Energy Costs

Jamaican refinery average unit energy consumptions based on a gigjoule per tonne of alumina basis is one of the highest by world standards. The Alpart refinery has been particularly disadvantaged in this regard and whereas an expansion of alumina kiln capacity using lower energy consuming fluid bed calciners would be expected to lower the rate somewhat, this refinery is expected to remain inferior to many others in this regard.

The practice of Jamaican refineries of calcining their own limestone using small kilns does not assist their competitive energy positions. The prospect of one calcination kiln to service two or more refineries is a possibility, however there are difficulties associated with the transport of quicklime that would need to be overcome.

The main reasons for high energy consumption appear to be:

1) Retention of high energy consumption rotary kilns for the calcination of alumina. Retrofitting of rotary kilns reduces energy consumption but not to the level achieved by fluid bed calciners);

2) The small size of vessels in the Jamaican plants relative to more modern plants means that heat losses are higher;

3) The changes that have taken place since the plants were designed in the compositions of process streams, means that heat exchange equipment is no longer optimally sized as in more modern plants designed with a greater emphasis on heat recovery. In this regard, the plants are understood from time to time to have difficulty with process control arising in part from changes in feed bauxite composition.

4) Management policy and practice as regards heat retention and recovery in the context of the fixed plant design/layout is probably the result of an operator's cost/benefit analysis which comes down on the side of not preventing minor heat "leaks".

The Jamaican plants rely exclusively on the purchase of fuel oil as an energy source. They are therefore subject to fluctuations in oil prices. By comparison, plants located in Australia and elsewhere have been able to negotiate long term contracts for natural gas and for coal whereby a high degree of stability has been achieved in energy costs.

The foregoing contributes to a higher "risk profile" as regards operating costs for Jamaican refineries.

Caustic Soda Consumption

The rate of consumption of caustic soda used in processing of Jamaican bauxites is significantly higher than would be anticipated from consumptions in some similarly sized refineries worldwide.

Caustic soda consumption is heavily dependent on the characteristics of the bauxite processed. Jamaican bauxites processed locally suffer from a higher volume of mud compared to say Boke bauxite

However there is some evidence to indicate that mud from some Jamaican bauxites is easier to dewater than some others. The progress being made toward dry mud stacking may effect both a higher recovery of caustic soda as well as present a viable alternative to ponded mud disposal systems.

Jamaican plants do not recover as much of the avoidable caustic losses as plants in other countries. This is due to :

1) the capacity and design of mud washing facilities which are less effective than would be deemed adequate by modern standards;

2) the loss of excessive amounts of soda during descaling activities, losses of process liquor during malfunction of evapourating equipment, and the dilution effects of water losses from water sealed glands in process pumps.

The direct cost penalties faced by Jamaican plants as a result of avoidable plus unavoidable losses relative to best practice elsewhere appears to be of the order of US$15 - 25 per ton alumina when compared to a refinery based on Boke bauxite. These losses are principally due to aged and non-optimized plant design and inadequate instrumentation leading to intermittent plant malfunction.

Delivered price for caustic soda is relatively low in Jamaica compared to Australian refineries due to the proximity of US producers and low freight rates in the region. Actual prices in each case however, will depend on existing negotiated contracts.

Labour Costs

Labour productivity in Jamaican refineries is lower than that in other leading world refineries. This is due to the smaller size of some of the equipment in Jamaica arising from its old design and the lesser reliance on automated operation.

The labour productivity in Jamaican refineries is between 50 and 65% of that in Australian refineries. However, this is more than compensated for by the relatively low wage rates in US$ terms paid to Jamaican nationals.

In 1990, wage rates were about 20-25% of those paid in US$ and 25-30% of those in Australia.

The net effect is that labour costs in Jamaican refineries are among the lowest in the world. After allowing for US expatriate salaries, labour costs appear in 1990 to be on par with the best Australian plants in this regard.

Recent exchange rate movements September/October 1991 have now effectively moved Jamaican labour costs down below those of Australia. The ensuing months will determine to what extent wages increases may erode this competitive advantage.

Other Costs

Current policies of Jamaican refinery management places heavy reliance on provisioning their operations from bases in the USA. This comes with an administrative cost penalty.

The markedly different nature of mining operations together with the smaller scale of operations and older plants in Jamaica as against Australia imposes significantly higher costs for Jamaican operations. Thus it is estimated that "other" costs for Jamaican plants are 40 - 70% higher than those for Australian plants

The policy of provisioning directly from USA also tends to deprive the Jamaican economy of the flow-on effect of hard currency expenditures on-shore and provides little encouragement for the growth of Jamaican infrastructure to provide these goods and services.

Measures to improve Competitiveness in Jamaican Refineries

Measures for improving energy efficiency should include the following

Upgrade and retrofit alumina kilns

Use larger vessel size as appropriate

Improve equipment insulation

Reduce the quantity and temperature of hot waste discharges

Increase the use of process heat interchange.

The use of alternative sources of energy such as coal and gas should be investigated.

Review the interaction of energy efficiency with plant water balance and caustic soda consumption/losses and establish the requirements for a revision of the instrumentation and control systems needed to improve control in this area.

A general update of refinery instrumentation is required and in particular the appropriateness of the present level and type of instrumentation for current raw material specifications and required outputs. An intensified level of instrumentation in critical processing areas coupled with greater automatic control should be installed.

Specialized control loops should be retuned where appropriate.

Where an increase in plant capacity by addition of vessels or where a new refinery or stream is to be added, the size of vessels and unit process streams should be made as large as practicable to ensure economies of capital and operating cost.

Pre-digesters should be considered for installation ahead of normal digesters in the digester train to improve desilication together with the use a sweetening stream to the digesters of high gibbsitic bauxite in order to increase throughput where higher boemitic bauxites are currently used.

Carry out studies to optimize the retention time during precipitation.

The efficiency of liquor filtration in Kelly filters should be compared against that of sand filters using local materials.

If caustic soda were to be replaced as a raw material by soda ash, a significant cost saving might be realized. The economics of causticization of soda ash in the local environment needs to be investigated. Also the prospects for increasing recovery of soda values from red mud using dry mud stacking techniques need to be investigated.

Training programmes aimed at improving work skills in the labour force should be looked at; a levy might be considered on refineries that do not conduct adequate internally run programmes as part of a scheme of incentives and rewards to encourage refinery operators to introduce such training programmes.

Review the potential for losses in stockpiing of raw materials, intermediates and products. Rationalize these where possible. Carry out a review of waste disposal methods to ensure significant losses of materials are not occurring.

Other Bauxite and Alumina Initiatives

Review markets, both domestic and export for various grades of specialty aluminas. Investigate the characteristics of local bauxites and aluminas to establish their suitability to meet specialty alumina market requirements. Review the economics of extending the range and volume of production of these products in Jamaican refineries.

Review the market for low cost water treatment chemicals based on crude alum (aluminium sulphate) produced directly from low iron bauxite (or alumina hydrate), both domestically and in neighbouring countries (including USA). Investigate the chemical composition of local bauxites and the degree of reactivity with sulphuric acid therewith to establish whether a water treatment alum could be produced which would meet the specifications laid down for water treatment by the appropriate authorities in the above markets. If a successful match can be found, investigate the economics of setting up a plant to produce and market water treatment chemicals based on this product.

Determine whether gallium concentration build up in circulating refinery liquors in existing refineries is sufficient to warrant the installation of a gallium recovery biproduct plant and if so investigate the economics of its production. Review the compositions of all bauxite reserves on the island to determine whether a rcovery plant may be possible at some future time.

Annexure 3c

Synopsis of Consultants Report on PRODUCTION AND MARKETING OF SEMI AND FINISHED PRODUCTS OF ALUMINIUM

Introduction

The aluminium industry is of prime importance in the Jamaican economy accounting for about 10 % of GDP and 75 % of earnings from domestic exports. In its vertical structure, however, there are weak points also and, in addition, there is no smelter phase at all. These facts together with the restructuring process that took place in this field world-wide make the liklihood of structural change inevitable in the local aluminium industry, too. On the basis of a strong bauxite/alumina sector and having regard to the worldwide trend of changes towards more efficient technologies and products with higher value-added contents, Jamaica should make efforts to create a more diversified but, at the same time, a more integrated productive system.

In connection with these efforts UNIDO has been supporting a project that would help in identifying effective actions and measures for further development by industry segment.

Supply - Demand Balance

The basis of developing the downstream processing sectors is to seek to bring into balance both local and regional supply and demand for semi finished and finished products by establishing new fabrication facilities within Jamaica.

This will serve to replace imported semis requiring the expenditure of, in many cases hard currency, with locally made items. Where possible the use of locally recovered scrap as raw material should be contemplated.

The manufacture of high value-added products will employ locally available skills to better effect and the possibility of achieving exports will serve to improve the country's overseas trade balance in critical hard currency areas.

In this respect it is important to set up mechanisms for establishing trade relations with countries within the region, and where possible with anticipated key export trading partners, for the purposes of securing and maintaining regional and international trade and industry co-operation.

In this way safeguards and assurances may be sought to protect against possible predatory pricing practices by others within the region which may undermine an otherwise well founded development and investment programme.

Existing Semis Capacity

Currently all activities in this area are confined to only one company which produces extrusions and corrugated sheets and which has a capacity of 1000 tpa of these products. The balance of semis consumed in Jamaica are imported. These total in excess of 5000 tpa.

Rolled products represent the major part of this total although drawn, forged and cast items are also present in significant quantities.

The only products for which excess production capacity exists in Jamaica and which can therefore be offered for export purposes are extrusions.

Analyses of import-export data shows that in the case of imports, these are sourced predominantly from non-regional areas, while exports are made principally to countries within the region.

Whereas the establishment of rolling facilities would be the most desirable for the purpose of redressing the supply demand imbalance, the economic viability of such a project is questionable and construction of such a plant has not been recommended by the consultant.

The installation of production capacity for drawing, forging and die-casting is considered more economically viable in the Jamaican situation.

Existing Fabricated Products

Four facilities in Jamaica produce almost exclusively for the structural and building industry markets.

The major part of other finished goods are imported (about 1500 tpa)

Exports of aluminium are relatively small and are sold mainly in regional markets.

The majority of imported items come from non-regional areas.

To satisfy supply and demand, new fabricating capacity is required to produce items which are

capable of being exported, preferably to hard currency areas

which will replace products currently imported, thereby conserving scarce reserves of hard currency for more strategic purposes

Analysis has revealed that bolting elements (screws, nuts, rivets, nails), welding/metal spraying wires and rods as well as sheet-formed parts are the kinds of the items which will satisfy these requirements as well as being economically feasible to produce.

Proposed Additional Semi and Finished Production Capacity

There appears room for two additional aluminium fabricating plants in the Jamaican economy. The first is a drawing/press-forging plant together with some special processing facilities. The second is a die-casting facility.

Their candidature for selection has been reinforced by the fact that they are both labour intensive as opposed to capital intensive.

The plants selected and their key attributes are as follows;

Drawing Press Forging Plant

Capacity 800tpa

of which 500 tpa is drawn products (ie rods, tubes, welding/spraying wires, bolting elements)

and 300 tpa are forging and press forging

Fixed capital - 5.1 million USD

Working capital - 1.1 million USD

Breakeven Output - 60% of full output

Diecasting Shop

The key feature of this facility is that its operation is based on the use as a raw material of locally collected aluminium scrap (about 600-700 ton is available annually in Jamaica.

Capacity 500tpa

of which 400 tpa is gravity die casting

and 100 tpa pressure die casting

Fixed capital - 2.2 million USD

Working capital - 0.4 million USD

Breakeven Output - 50% of full output

Annexure 3d

Synopsis of The Consultants Report on THE ENVIRONMENT AND ENVIRONMENTAL PROTECTION

BASIS FOR ENVIRONMENTAL STANDARDS

The purpose of this report is the preparation of a basis for the establishment of environmental standards and regulations for air and water quality for the Jamaica bauxite/alumina industry.

The Underground Water Authority and the Jamaica Bauxite Institute have carried out an investigation and prepared a report, "Interim standards, ambient water quality", July 1991.

This paper is based on a number of publications by respected authorities in the environmental sphere. The paper includes proposed concentration limits (Interim standards) for ambient water quality in Jamaica.

The contribution of the environmental consultant in this area has been to expand the number of authorities surveyed and to incorporate their recommendations into the survey. The new authorities surveyed were

-State Water Quality Control Board, California (SWQCB), 1963
-Canadian Council of Resource and Environment Ministers, March 1987
-Swedish National Food Administration, 1989

Key environmental elements which are covered in this study are water, air and noise.

Water

The main pollution of the ground water in Jamaica arises out of the loss from the alumina refineries of what can only be described as massive amounts of sodium in the form of both soluble sodium hydroxide/carbonate and sodium aluminates, as well as insoluble sodium alumino-silicates.

The soluble values are likely to have a direct effect on the both the sodium content of the ground water as well as it's alkalinity, however it is also likely to have an effect on other undesirable components of waters by virtue of it's effect on soil pH and consequent possibility of release of other pollutant ions into the ground waters.

The presence of insoluble sodium alumino-silicates in the soil which while these are generally considered to be inert, nevertheless represents a reservoir of sodium which by some reaction with future environments different to those currently present, has the potential to release additional quantities of sodium in soluble form into an already polluted ground water reservoir.

The two purposes to which water is currently put in terms of human habitation is the supply of potable water for human consumption as well as to industry, and for the it's use for irrigation of cultivated and natural agricultural and pastoral activities.

In comparing the new information which has been brought to light by the current work with that contained in the paper referred to above which has been prepared by the UWI and the JBI, the conclusions and recommendations of that report are fully supported. In only two minor areas is it suggested that the recommendations of that report be varied.

The first is in the level of nitrate, which it is recommended should be increased from 20 ppm to a level of 45 ppm. The second is the level of total dissolved solids in the water which it is recommended should be reduced from 600 ppm to 500 ppm. Neither of these components would be affected directly by the pollutants being emitted by the bauxite and alumina industry as it currently operates in Jamaica.

Considering both population density and rate of population growth throughout the island and the reliance that the population places on underground water for domestic and irrigation purposes, it is vital that every endeavour be made to ensure that the underground water be retained in an unpolluted state.

Air

Major world problems of air pollution currently being addressed in international forums are;

-Protection of the ozone layer
-Limitation of climate changes
-Measures against air pollution transfer between countries

These are not the problems which are the principle ones besetting the bauxite industry in Jamaica. Rather these are problems having local consequences, having a much more immediate effect. They are consequently much more pressing, however the benefits flowing from measures to combat the problem will be much more immediate in their forthcoming.

The emissions to air which are of concern from an environmental point of view are sulfur oxides, nitrogen oxides, dust and to a lesser extent, alumina plant odours.

All of the above apply to Alumina refinery operations, however the main problem besetting bauxite mining is the dust problem.

The main consequences in the context of the Jamaican situation of high levels of gaseous emissions of oxides of sulfur is in agriculture, whereas oxides of nitrogen are most likely to effect the pH of water supplies.

There does not appear to be any evidence of major effects from the release of either of these pollutants, however it is recommended that monitoring of sulpur emissions from boiler house and calcination plant stacks be carried out as a matter of routine to ensure standards are being adherred to.

Dust

Bauxite and red mud dust emissions are being monitored on an needs basis at sites close to residential areas. It is proposed that this work should be extented and that the equipment used for the measurements be of a standard type which is recognized internationally.

Guide lines for dust emissions which might be used are

> 1000 g/100 m² and 30 days, not acceptable
< 700 g/100 m² and 30 days, tolerable

Noise

. The following standards are used for noise emissions close to residential areas, schools or hospitals are suggested as a guide for industry already in operation. For new industrial installations the values should be lowered by 5 dBA to encourage use of "Best Available Technology"

Daytime	07-18	55 dBA
Evening	18-22	50 "
Night	22-07	45 "

The NRCA Act is the legislative instrument by which environmental control is to be achieved. The question is whether firm or targetted standards or merely guide lines should be used in its implementation. The precedent of measurement of levels of emissions being largely in the hands of the refinery operators makes the task ahead for the administrators of the Act to bring into effect higher standards recommended more difficult.

By a combination of moral persuasion and the gradual introduction of a graded penalty system over a period of time it should be possible to effect the required improvements in environmental performance by the industry in Jamaica.

As a counter to adverse reaction by the industry to penalty provisions in the environmental code, certain concessions as regards bauxite leases or alumina expansion rights could be tied to the achievement of targetted environmental performance standards.

ENVIRONMENTAL MONITORING TECHNIQUES

"Recommend environmental monitoring techniques with a view to implementing a monitoring programme."

The choice of monitoring techniques will normally go hand in hand with the implementation of a monitoring program. Attention will be given to some general aspects of the environmental control of industrial plants to which the monitoring techniques are subordinated. A brief description of the environmental impacts of the bauxite industry in Jamaica is as follows.

The environmental impacts of the Jamaican Bauxite Industry

Bauxite Mining

Mining is carried out in generally small though deep pits which have previously been under use for small scale agriculture. Considerable time and expense is incurred by the mining companies and JBI in transferring the farmers temporarily or permanently to other areas in a manner designed to be satisfactory for all concerned.

The rehabilitation of the land after mining involves filling the pits with adjacent lime stone and covering the reclaimed pits with 6 to 18 inch of top soil. A majority of the the rehabilitated land is planted with grass (African star) for future grazing of cattle. Some testing areas are further developed to include sealed water ponds for irrigation and growing of vegetables, corn, fruit etc. A few of these areas allow the farmers to continue to grow the same type of crop as they used to before mining took place. Most of the areas however only allow grazing of cattle to which few farmers are accustomed.

Prior to mining the soil was the most suited for small farming. The reason for this was that the depth of bauxite ensured that moisture was retained by the soil. The reclaimed areas have only a small depth of soil beneath the surface and water retention is as a result poor, making it difficult to grow anything but African star without irrigation.

The plan by the JBI plan to carry out an agricultural program with the assistance of Israel to cover among other things an investigation of the depth of top soil needed to grow differant crops is praiseworthy.

It is policy not to revisit rehabilitated areas to reopen them for further mining.

Dust from roads in the mining areas is tackled in a variety of ways. Alpart use water, Jamalcan, Ewarton use Bunker C oil, Jamalco use $CaCl_2$ to be spread on the road surface. Visually Bunker C oil gave the best result. Evaporation reduces the effectiveness of water.

It is important to standardize the techniques of monitoring of dust for all companies for purposes of comparison and to enable the use of a single standard.

Alumina Refineries

The following are the significant emissions which currently take place to atmosphere:

-dust
-sulfur oxides
-nitrogen oxides
-carbon dioxide

Virtually no monitoring is currently carried out.

Emissions to ground waters arise from the plant and red mud lakes.

The latter is a difficult and unique problem. Red mud amounts to approximately the same tonnage as the production of alumina. ie between 0,5-1,0 Mt/yr for each plant. The red mud is pumped out to mud lakes and the clear water is normally recirculated via clear water ponds. Alpart do not recirculate water, but pump process water from ground water wells close to the plant.

The greatest environmental problem arises from the leakage of water with dissolved products from red mud ponds to the ground water.

Early mud lakes were constructed without any sealing. Today this solution is no longer accepted and the development of other solutions are being sought.

Jamalcan are developing a variation of dry stacking at Ewarton. The dry stacking system consist of 5 separate lakes. The bottom and sides of each lake are sealed off by a 2 ft layer of clay. The dry stacking process requires a mud with a minimum of water for stacking, here about 28-30 % solids.

Dry mud is bulldozed and stacked dry to a considerable height to save space. Clear water from the dams is collected and recirculated to the process.

Ground water emmissions are monitored via ground water wells.

Jamalco use sealed mud lakes with 20 m high dam walls. Dusting from the dry surface is a problem and thise must be kept moist. Despite the claimed sealing of the lakes monitoring should be carried out on a routine basis. Today no monitoring is taking place.

Alpart are using an unsealed lake for their mud disposal. Contamination with high sodium concentrations in ground water downstream of the North and South lakes have forced the company to stop mud disposal to the North lake. Over the next 5-7 years the company is projecting a new mud lake downstream of the South lake. They are planning to dispose a 'thick' mud with 20-23 % solids in an unsealed dam construction hoping that the mud itself will seal off the bottom of the dam. It is strongly recommended that before implementation the company should be required to carry out research and perform field tests.

The company has been monitoring the ground water north and south of the North and South lakes. This together with an independant investigation of the Alpart mud lake expansion has resulted in recommendations for the future mud lake disposal.

Control of industrial plants

General. A control program should consist of two parts;
control of industrial plants
and
control of recipients.

Control of industrial plants.

Two aspects are needed. Obediance to the standards. Interactions between emissions and production activities.

Impact on the environment.

A control program should be set up to achieve this. Usually control aspects are taken up early so that the control program can be operational at plant startup

The following should be regarded as essential to the content of the program

Description of the operation.

Situation plans and process schedules should be included.

Directions, standards and guide lines as prescribed by the NRCA Act, and valid for this specific plant should be included.

The control program should be carried out in such a way as to fit into daily routines and should contain specifications on monitoring and measuring points, parameters, methods and monitoring equipment to be used.

Control of emissions to water

The control strategy must include all water outlets, including process outlets, temporary overflows, day water outlets and cooling water outlets. Measurements should be adapted to type of emission and to standards applicable.

Process outlets should normally be monitored continously by flowmeters and automatically flow actuated samplers. Analyses can be made on daily, weekly or monthly bases depending on the accuracy needed. Temporary overflows should be monitored in the same way as process outlets. Outlets of day water and cooling water may be monitored in connection with regular inspections.

Control of outlets and leakages from waste deposits and their impact on the environment:

Waste water outlets and leakages, diffuse dust etc from waste deposits and their impacts on the environment should be monitored. A separate sampling and monitoring program similar to what has been described above for air and water should be prepared for each waste deposit.

Hazardous waste should be identified and treated separately.

The following should be included in a control program:

-Control of the handling of chemicals and listing of chemicals used
-Control of the handling of raw materials
-Operational control journals containing data likely to impact on the environment
-Inspections. These should complement the running inspections performed by the company. Frequency and scope of inspections should be specified. Frequency is normally once a year.

COMMENTS ON ALPART MUD DISPOSAL REPORT

The report 'Alpart, North Mud Lake risk assessment, volume I - report' by Gurr & Associates, Inc. was commented on in the following terms

Geophysical interpretations are limited by the availability of known parameters which the field data can be referred against. Details of these parameters are not included in the report.

The report is supported by the conclusions drawn by the hydrogeolcgical and the geophysical studies, however two remarks seem appropriate:

1 The amount of natron deposited in the lakes needs to be known in order to estimate the amount of sodium that will dissolve once the sodium concentration in the water is lowered.

2 ref p. 144 of the report, 'Another explanation for the restricted sodium plume is that a deeper plume is developing in the thick aquifer under the plant and the mud lake'. The basis and implications of this statement require elaboration. The possibilities which are opened up if this statement is even partially true warrant detailed investigation.

The data and reasoning supporting the conclusion that the likely impact of the future South Lake Thick Mud will lower the emissions of sodium substantially is not presented in the report. This is one of the crucial questions and and it is recommended that further field testing accompanied by supportive research needs to undertaken before the decision to permit the lake to be used for mud collection is implemented.

Annexure 4

CHECKLIST OF POLICY INITIATIVES AND PROPOSED ACTIONS

The following action items are derived from the individual consultant's reports. The items therefrom have been augmented as considered appropriate. The resultant list should not be considered exhaustive.

A - BAUXITE UTILIZATION

Overall Recommendations

1 - Set out policy initiatives based on optimum utilization of bauxite resource.

2 - Develop detailed procedures for implementing this policy supported by legislation incorporating incentives and penalties keyed to achieved level of performance.

3 - Extend and broaden the scope of the existing reserves database. Incorporate Land Utilization Plans.

4 - Establish an organization with the responsibility and authority to ensure policy and procedures are correctly implemented.

Specific Recommendations

5 - Extend use of computers

6 - Use GIS format to log data and generate maps

7 - Jamaican Bauxite Institute to control and operate system

8 - System access to be broadly available

9 - Refineries to contribute data and resources to the system

10 - System should enable real time access

11 - Develop interpretive and mapping skills within the JBI.

12 - Develop database to contain comprehensive data such as;
property records
reserves estimation
mine plan and progress information
reclamation information

13 - JBI to take pro-active role in development of mining culture based on technological innovation

14 - Increase proportion of contract mining

15 - Investigation and implementation as appropriate of Variography, Kriging and Ground Penetrating radar.

16 - Establishment of true bauxite to alumina conversion factors experimentally by JBI (laboratory bomb digestion techniques) for use as performance yardstick and for taxation purposes

17 - Government appointed representatives be further educated in recognition of wasteful mining practices and empowered to penalize and fine as appropriate

18 - More direct communication between mine planning and pit closure personnel

B - ALUMINA PRODUCTIVITY

1 - Measures for improving energy efficiency are as follows;

a - Upgrade and retrofit alumina kilns

b - Use larger vessel size as appropriate

c - Improve equipment insulation

d - Reduce the quantity and temperature of hot waste discharges

e - Increase the use of process heat interchange.

2 - Investigate the use of alternative sources of energy ie coal and gas.

3 - Review the interaction of energy efficiency with plant water balance and caustic soda consumption/losses.

4 - General update of Refinery instrumentation and in particular:

5 - Review the appropriateness of existing instrumentation to revised plant outputs. Intensify the level of instrumentation in critical processing areas

6 - In conjunction with item 5 review the level of automatic control and increase as appropriate for sensitive processing areas.

7 - Review and retune the operation of any specialized control loops. Revise or install these where appropriate.

8 - Increase as appropriate the size of unit process streams.

9 - Install predigesters ahead of normal digesters to improve desilication.

10 - Use a sweetening stream to the digesters of high Gibbsitic bauxite.

11 - Review the efficiency of liquor filtration in Kelly filters as against sand filters.

12 - Carry out studies to optimize the retention time during precipitation.

13 - Investigate the economics of causticization of soda ash.

14 - Pursue the recovery of soda values from red mud using dry mud stacking techniques.

15 - Develop training programmes to improve work skills in the labour force

16 - Implement an incentives and rewards structure to reinforce the training programme.

17 - Carry out a review of waste disposal methods in conjunction with the refinery operators.

18 - Review the potential for losses in stockpiing of raw materials, intermediates and products. Rationalize where possible.

19 - Review the markets, both domestic and export for various grades of specialty aluminas.

20 - Investigate the characteristics of local bauxites and aluminas to establish their suitability to meet any specialty alumina market requirements.

21 - Review the economics of extending the range and volume of production of these products in Jamaican refineries

22 - Determine whether gallium concentration build up in circulating refinery liquors is sufficient to warrant the installation of a gallium recovery biproduct plant and if so investigate the economics of its recovery.

23 - Determine the market for water treatment chemicals based on crude alum (aluminium sulphate) produced directly from low iron bauxite or alumina hydrate, both domestically and in neighbouring countries.

24 - Investigate the economics of setting up a plant to produce and market water treatment chemicals based on this alum.

C - SEMI AND FINISHED ALUMINIUM PRODUCTS

1 - Endeavour to achieve supply demand balance within Jamaica for semi and finished aluminium products.

2 - Seek to increase value added of products made in Jamaica.

3 - Develop export potential of products using local market as production base.

4 - Establish basis of trade with countries which could represent a potential export market for Jamaican made products.

5 - Legislate as required to protect local markets from imports.

6 - Encourage a capacity increase of 800 tpa in drawing press-forging facilities onshore in Jamaica

7 - Encourage the establishment of a diecasting facility of 500 tpa capacity in Jamaica.

8 - Analyse trends in import/export data critically to establish further prospects for local manufacture.

9 - Ensure the latest principles of "just-in-time" raw materials and products delivery are implemented throughout the industry to ensure competitiveness with offshore operations.

10 - Delay any plans for the installation of an aluminium rolling facility until the size of the operation becomes larger.

E - ENVIRONMENTAL MANAGEMENT

1 - Establish contact with major environmentally aware countries to maintain up-to-date information on appropriate regulations in these countries.

2 - Control liquor emissions at the source rather than where the environmental effect is observed.

3 - Establish on a needs basis the frequency of the various tests, and investigate the desirability of casual and "unannounced" testing.

4 - Amend water quality standards as suggested in table provided in the report text.

5 - Establish dust and noise monitoring techniques in conjunction with monitoring programme as appropriate.

6 - Regulate standards for dust on the basis of guideline figures provided in report text.

7 - Regulate standards for noise on the basis of guideline figures provided in report text.

8 - Exercise judgement with regard to whether to nominate emission standards as firm targets or guidelines.

9 - Use of moral persuasion on refinery operators to assist gaining environmental compliance.

10 - Development of both incentives and penalties to encourage compliance

11 - Any new facility must have a proper environmental impact statement prepared prior to receiving permission to proceed.

12 - Selectively monitor alumina refineries and particularly red mud effluents.

13 - Advise and encourage operators in the use of dry mud stacking techniques. Apply less arduous monitoring regimes to refineries that use well designed red mud operations

14 - Require any newly planned facility to meet the more rigorous standards of contemporaries in other parts of the world

15 - Encourage the development of pro-active attitudes toward remedying emissions arising from production activities.

16 - Exhaustively identify all active sources of pollution and secure adequate monitoring equipment to the associated plant items.

17 - Provide special attention as appropriate to hazardous wastes.

18 - Ensure adequate control and accountability for all chemicals and raw materials which may have the potential to enter or become pollutant streams.

19 - Secure access to necessary operating data. Where possible this should be done directly from operating journals of the refineries. Edited data may be suspect.

20 - Secure the right to accompany for the purpose of environmental inspection, operating personnel on some regular operating inspections - (perhaps on the basis of once each year).

21 - Establish with the operators the scope and levels of such inspections and ensure they are rigorously conducted.

GUIDELINES FOR AN

ENVIRONMENTAL IMPACT STATEMENT

PROPOSED ALUMINA REFINERY

WEIPA - QUEENSLAND

PREPARED BY

Environmental Assessment Branch,
Commonwealth Department of the Arts, Sport,
the Environment, Tourism and Territories

and

Queensland Department of the Premier,
Economic and Trade Development

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CONTENTS

GUIDELINES FOR AN ENVIRONMENTAL IMPACT STATEMENT FOR A PROPOSED ALUMINA REFINERY AT WEIPA QUEENSLAND

A. INTRODUCTION

1. Background

The Commonwealth and Queensland Governments have agreed that one environmental impact statement (EIS) should be prepared to cover the requirements of both Governments under the Commonwealth Environment Protection (Impact of Proposals) Act 1974 and the State Development and Public Works Organisation Act 1971 - 1981 of Queensland.

Similar objectives are contained in each Act. The object of the Commonwealth Act is to ensure that matters affecting the environment to a significant extent are fully examined and taken into account in decisions by the Australian Government. The Queensland Act aims to ensure that, in any development, proper account is taken of environmental effects.

In preparing an environmental impact statement to help achieve this objective, the proponent should bear in mind the following aims of the EIS and public review process:

- to provide a source of information from which interested individuals and groups may gain an understanding of the proposal, the need for the proposal, the alternatives, the environment which it would affect, the impacts that may occur and the measures to be taken to minimise these impacts;

- to provide a forum for public consultation and informed comment on the proposal; and

- to provide a framework in which decision-makers can consider the environmental aspects of the proposal in parallel with economic, technical and other factors.

Although these guidelines for the EIS are issued under both the Commonwealth and Queensland Acts, the Administrative Procedures under the Commonwealth Act provide guidance on the preparation of documentation, public review and the assessment process. A draft EIS prepared by the proponent will be released for a period of public comment after which the proponent will be required to prepare a final EIS taking into account comments received. The responsible Commonwealth and Queensland Departments will then prepare assessment reports.

2. General Content, Format and Style

The Administrative Procedures under the Commonwealth Act provide guidance on the public review and assessment process. Paragraph 4.1 of the Administrative Procedures lists the fundamental content of any EIS. The following paragraphs describe in more detail those matters it is considered should be addressed in this EIS.

The document should give priority to the major issues associated with the proposal. Matters of lesser concern should be dealt with only to the extent required to demonstrate that they have been considered.

The EIS should present a scientific analysis based on the results of available research, studies and data as appropriate, with further research being conducted where necessary. In the EIS the description of the existing environment and the discussion of impacts should include a critical evaluation of the adequacy of the available data and the implications of deficiencies in present knowledge on environmental assessments made in the study.

An essential element of the EIS is the discussion of alternatives, their environmental impacts and the reasons for the choice of the preferred option. The study must include an adequate coverage of the reasons, environmental and other, for the elimination of prudent and feasible alternative sites and courses of action.

The main text of the EIS should be written in a clear, concise style that is easily understood by the general reader. The use of technical jargon should be avoided wherever possible. Detailed technical information, necessary to support the main text should be included as appendices to the main text so that the EIS is complete and self contained.

The documentation should include references and a list of individuals and organisations consulted. Relevant maps and illustrations should be included in either the main text or in appendices as appropriate. The structure of the document should follow the general format and headings used in the following guidelines. Cross referencing should be used to avoid unnecessary duplication of text.

The EIS should specifically address the impact on, and concerns of, Aboriginal communities and traditional custodians of the region with respect to the proposal. These include social impact on existing communities and traditional custodians, physical impact on land and effect on the cultural and heritage values including sacred and secret sites. In these matters there should be close liaison with traditional Aboriginals of the region. Detailed records of the consultations and expert opinion on these matters should be reported.

If work on the proposed land use study or conservation study for the peninsula is sufficiently advanced during the course of the EIS, an assessment should be made of the consistency of the alumina refinery with any findings of that (or those) study(ies) or any policy guidelines formulated on land usage. Such assessment should be appropriate to the level of information, findings, or policy guidelines available from such land use or conservation study programs, such that progress on drafting the EIS is not restricted. Close liaison should be maintained during the course of the EIS process with the Department of the Arts, Sport, the Environment, Tourism and Territories and the Queensland Department of the Premier, Economic and Trade Development, and with other authorities undertaking specific components of the land use study.

B. CONTENT OF THE EIS

1. Summary

Paragraph 5.2 of the Administrative Procedures under the Commonwealth Act requires an EIS to include a clear, concise summary of the matters dealt with by the document. This summary should allow the reader to quickly obtain a clear understanding of the proposal and its environmental implications. The summary should include:

- the title of the proposal;
- the name and address of the proponent;
- a statement of the objectives of the proposal;
- a brief discussion of the background to and need for the proposal;
- an outline of the proposal;
- a brief discussion of the alternatives, and reasons for the selection of the preferred option;
- a brief description of the environment of the area(s) that will be affected by the proposal;
- a description of the major environmental impacts of the proposal; and
- a statement of the monitoring procedures, environmental protection measures and safeguards proposed.

2. Introduction

The main body of the EIS should be introduced with a clear definition of the proposal and its objectives. The introduction should also briefly describe the studies, surveys and consultations that have been used in the EIS (detailed material from these sources should be included as appendices). An outline of the structure of the study should also be included in this part of the document.

3. Background and need for the proposal

This section of the study provides the background to the need for an alumina refinery at Weipa. For example, the following points should be included:

- the present market situation for bauxite and alumina, the predicted growth in demand, and economics of the proposed system; and

- the scale and scope of future development in the industry, including government (Commonwealth and State) planning policies.

4. Legislative and Government Policy Framework

The EIS should identify the requirements that must be met of all Commonwealth, Queensland and local government legislation and policies relevant to the proposed development.

5. Alternatives

Alternative courses of action should be discussed in sufficient detail to make clear why the preferred option was selected. The alternative for not proceeding with the proposal must also be considered.

The basis for a comparison of alternatives should not only be in terms of the physical environment of the development, social and economic impacts should also be considered. The basis for comparison should be a cost-benefit analysis which should compare the economic, social and environmental factors of both the proposal and all the alternatives.

6. Description of the Proposal

Describe the proposed development, using maps, figures and diagrams where appropriate.

6.1 Project description, siting and infrastructure

All components of the proposal should be described in detail. Matters which need to be addressed include:

- a description of the project site;
- details of proposed development schedule. Include expected timing of stages if appropriate;
- details of the structures, equipment and facilities, during both the construction and operating phases of the project;
- a full description of the port facilities to be constructed and the handling equipment to be employed;
- details of the transportation requirements (roads and air) for the project;
- details of the refining processes;

- list all materials used and produced in the refining process and any ancillary processes (for example, power generation, water treatment) including raw materials, reagents, fuel and water, intermediate products and final products, by products and wastes;

- details of design criteria for structures including their ability to withstand cyclonic weather conditions, such as high winds, flooding and storm surge.

- describe how the proposal will meet any Standards, Codes of Practice or legislation which apply to the storage or handling of combustible, flammable or hazardous substances;

- the power requirements of the proposal, and the source of power supply should be described in detail. If the proposal requires the construction of a new power station (whether oil, gas or coal fired) it will need to be described in a separate chapter which addresses all the above criteria; and

- consideration of the visual impact of the proposal.

6.2 Manufacturing Processes and their Wastes

Describe the processes from a chemical engineering perspective, including the unit operations and chemical reactions. In this context, "processes" means all activities that modify properties of materials: therefore it includes services such as:

- water treatment
- process reagent production
- steam and power generation
- water cooling
- waste handling and disposal

In these descriptions:

- Include expected quantities, compositions, and operating conditions such as temperature, pressure, pH.
- List quantities and compositions of all materials to be used in processes on site.
- Give similar information for all products, by-products and wastes. Include wastes in all forms - solids, liquids, gases, slurries, sludges.
- Quantities should be in consistent units (for example, avoid mixing tonnes per year and kilograms per hour).

. Give mass balances and flowsheets:

- to illustrate the text; and

- to show how quantities and compositions of wastes are consistent with quantities and compositions of:
  . input materials, and
  . products and by-products.

Appendix A gives guidance on level of detail for mass balances and flowsheets.

State sources of input materials and how they will be transported to site.

Waste Management Methods

"Waste management" here means everything done to minimise quantity of a waste, or its strength, or difficulty of handling and disposal, or its effects on surroundings.

"Wastes" means all materials of no value or of doubtful value: therefore, it includes:

. wastes from manufacturing processes;

. wastes from services such as cooling towers, steam generation;

. wastes from construction activities, such as rain-water runoff, residues from chemical cleaning of plant before commissioning;

. domestic sewage and domestic/office refuse;

. wastes produced under unusual conditions, such as plant start-up, maintenance shut-down, periodic cleaning; and

. industrial wastes that would result from accidents, such as leaks from bulk storage, fires, explosions.

Describe proposed methods aimed specifically at:

. minimising quantities of raw materials needed;

. avoiding or minimising waste generation;

. minimising difficulties in treatment or disposal of waste.

Include methods such as:

. selection of processes and equipment;

. selection of process reagents;

. recycling within the site;

. re-use outside the site;

- segregation of incompatible wastes at source; and
- contingency planning and personnel training.

Details of any alternative waste disposal methods should be provided. This should include alternative disposal sites for all wastes as well as disposal methods and processing of wastes that could be undertaken before disposal.

For emissions to atmosphere, give the following details:

- A site layout plan which shows all sources of emissions and their locations. Include safety relief and fugitive emissions. For each source, give the details shown in the attached table (marked Appendix B).
- Methods to be used to control emissions. Include emissions produced by "worst-case" operating conditions.
- Methods to be used during construction to control particulates (mainly dust and smoke) from activities such as site clearing, earthmoving and vehicle movements.

For liquid wastes, give the following details:

- A table showing an inventory of the sources, plus the quantity and quality of each waste. Describe quality in terms of physical and chemical characteristics that indicate whether water is suitable for a given use.
- Proposed methods of handling, treating and disposing of each waste.
- For wastes to be treated, proposed quality of each output from treatment (treated waste and residues).
- If waste is to be disposed of by discharge to natural waters, a map showing proposed outfall route and discharge location. Also discuss whether outfall can be submerged below local low-water datum (to maximise initial dilution).
- If waste is to be disposed of by spreading on land, an indication of how the scheme will be designed, including design criteria.
- Means of containing leaks at bulk liquid storage tanks and large process vessels. Also discuss how material contained can be disposed of.
- Means of handling rain water runoff which becomes contaminated by materials on site (such as lime, oil, caustic liquids). Discuss collection of it for use as water supply.

- Means of handling waste-water from firefighting, especially at bulk storages for fuels and chemicals.

For solid wastes, give the following information:

- A table showing an inventory of sources and general description of each.
- For process wastes (including those from plant services, gas cleaning and liquid waste treatment), indication of quantity and quality.
- Proposed means of final disposal of each waste.

6.3 Water Demand

Make a determination of water demand for the project, including a detailing of daily or seasonal peak demand requirements and a means of meeting the water demand including source of water, infrastructure, and forecast reliability of supply taking into account other existing and proposed uses.

Statement of the details of the forecast water consumption by the workforce, both construction and operational, including daily and monthly peak demand and total annual requirements. Means of meeting the water demand including source of water, infrastructure, and forecast reliability of supply taking into account other existing and proposed uses.

6.4 Stormwater

Provide a description of the proposed site stormwater drainage system and its proposed disposal arrangements. Examination of practical means to avoid allowing runoff to be contaminated with raw materials or products should be carried out.

6.5 Employment and Training

The following matters should be addressed:

(i) the scope of employment opportunities during the building and operation of the refinery;

(ii) the adequacy of the present training requirement in Weipa, in particular skills development for apprentices using innovative on and off-the-job training techniques suitable for a remote location similar to that being trialled by some Central Queensland coal companies in the Emerald region and the Stanwell Power Station;

(iii) the need to provide for vocational education and training and any enterprise training during the building and operation of the refinery; and

(iv) the vocational and training infrastructure that would be required to support the building and operation of the refinery.

6.5.1 Project Workforce

Estimates should be provided of the number of employment positions which are expected to be filled by persons currently residing in, respectively, the local region, the balance of Queensland and outside of Queensland. Any changes over time in employment numbers or employment mix should be clearly indicated.

As a guide, this information could be presented in the form of a table as outlined below:-

Workforce drawn from	Direct Project Employment	Project Induced Employment	
		In Region	In Balance Of QLD
Region Balance of QLD Outside of QLD			
Total			

Separate tables would need to be provided for the construction and operations phases of the project.

6.5.2 Workforce/Population Statistics

(i) Construction Workforce

(a) Build up of the workforce by quarterly periods, including location, if separate locations are involved.

(b) Source of recruitment of workforce, for example, external, existing, contracted workforce. Statement of existing workforce and capacity to absorb growth,

in relation to proposals for source of recruitment, including assumptions made and reasons for those assumptions.

(c) Permanency rate/turnover of workforce.

(d) Demographic characteristics of the workforce, and to include the following data

- numbers of single and married workers, and reasons for the assumptions behind this single/married split.

- married workers with children and average family size, including reasons for assumptions.

- age profile of workforce, if possible, to allow some indication of whether children will be preschool, primary or secondary students, and associated assumptions.

(e) Estimated overlap within the workforce as a result of two-income families.

(ii) Operation Workforce

(a), (b), (c), (d) and (e) as for 6.5.2 (i) above.

(iii) Service Component Workforce

(a) employment and population multiplier effect arising from the project. (This includes any indirect effects).

(b), (c), (d) and (e) as for 6.5.2 (i) above.

(f) Estimated timing of impact of service component.

(g) Services where growth will occur.

(iv) Government Component Workforce

(a) Estimate of the number and timing of personnel involved with other aspects of the project, for example, additional education or health personnel directly involved.

(b), (c), (d) and (e) as for 6.5.1 (i) above.

6.5.3 Housing

Statement of details of the manner in which the company proposes to accommodate its workforce, both construction and operational, the timing and location of such housing, and how the company sees this as fitting into the existing town structure, where applicable.

(a) Sub-division projects, if applicable, to include the following:

A plan of proposed sub-division; rate of housing construction either on a quarterly basis or by contract number and completion date; occupancy basis, for example, home ownership or rental; construction authority, for example, the company, local entrepreneurs, etc.

(b) Hostels

(c) Caravan parks

(d) Existing Housing

(e) Privately boarded.

Details such as numbers to be housed, occupancy basis, location, timing, construction authority and management basis for (b) and (c) above. Details of numbers to be housed and location of existing housing for (d) and (e) above.

6.5.4 Student Yield

Where possible, the company should give their estimate of the anticipated number of students, by primary, secondary, preschool breakdown, stating the assumptions underlying these estimates and the reasons for these assumptions.

7. Existing Environment

This section should contain a detailed description of the environment of the site of the proposed refinery, the areas through which the proposed transport routes pass, loading sites, waste dumping sites and any alternatives discussed in the study. Trends should be discussed where appropriate.

Particular reference should be made to any parts of the study area that have high conservation values, species or communities which are rare or endangered, and any community groups that are likely to be significantly affected by the proposal.

Separate sections should delineate the following:

7.1 Tenure

Identify any Crown land or Crown tenures including Reserves which are either directly involved in the project or affected by the project.

7.2 Terrain

(a) Discuss the topography of the site in both its existing and post-mining forms.

(b) Discuss the geology of the area.

(c) Describe and map the soils of the area.

7.3 Land Use and Land Capability

Describe and map the land-use, agricultural land suitability and fisheries habitat of the site and surrounding areas.

7.4 Climate

Details of meteorological data, including:

(a) Wind speed and direction presented as average annual, seasonal, and monthly wind roses and tables.

(b) Diurnal variation of wind speed and direction plotted for each month of the year.

(c) Diurnal variation of mixing heights and ambient temperatures plotted for each of the four seasons.

(d) Data on precipitation, evaporation, and humidity.

(e) Incidence of cyclones.

Any expected variations in meteorological conditions between the data monitoring site and the proposed site should be discussed.

7.5 Flora, Fauna and Ecosystems

- the general biology and ecology of the area;
- a description of the major habitats and communities which are present in the proposed site and any proposed dumping areas;
- include a vegetation map showing structural formations and species composition at a suitable scale and a list of species growing on the site. A more detailed map (at a scale of 1:25 000) of the existing mangrove vegetation should be produced.

- the conservation status of biota found in the study area;

- reaction of the ecosystem to disturbance (where possible using the impact of previous disturbance to similar communities as examples);

- importance of biological relationships, for example species, communities or habitats of particular importance to other ecosystems, because of their productivity, role in nutrient recycling, or the provision of breeding areas; and

- the economic importance of these natural systems.

7.6 Surface and Groundwaters

An overview description is required of the water resources (including, where relevant, both surface and groundwaters) in the region of the project, with an outline of their significance to the river catchment system in which they occur and to groundwater recharge. Details of surface and groundwaters should be included as set out below.

(a) Surface Waters

(i) A map and description of existing surface drainage patterns in and around the project area;

(ii) Variations in flows (for example, seasonal) and/or tidal variations, as appropriate;

(iii) Incidence of flooding;

(iv) biological characteristics; and

(v) existing background quality of waters in the project area. This should be detailed in terms of seasonal, tidal and diurnal variations in water quality. These variations should be determined for as long a period as possible, preferably to cover seasonal conditions.

(b) Ground Waters

(i) Details of groundwater, including any aquifers, in the region of the project site; these should include:-

- information on hydro-geology of the area;

- profiles showing depths to aquifers, depths of aquifers and widths of aquifers;

- groundwater flow directions;

- recharge areas and mechanisms; and

- existing quality of ground waters giving details of ionic composition.

(ii) A map showing locations (and, if applicable, registered numbers) of any existing groundwater supply sources (bores, wells, excavations) in the vicinity of the project area and the depths to which these have been sunk;

(iii) Purposes for which groundwater is currently used for the various supply sources.

(c) Water Supply and Sewage

(i) Present uses of water, existing water supply infrastructure (including water treatment) and present water demand including monthly and total annual peak and total demands;

(ii) Existing means of sewage and existing infrastructure; and

(iii) Impacts of existing water use or sewage disposal on surface or groundwaters or other ultimate receiving environment.

7.7 Marine and Estuarine Areas

Describe the marine and estuarine areas in terms of seabed composition, seabed stability, winds, waves, currents, tides, temperatures and turbidity. Water quality should be discussed in terms of seasonal, tidal and diurnal variations. These variations should be determined for as long a period as possible, preferably to cover seasonal conditions.

Define in detail the nature and extent of existing maritime features of the site including littoral and sublittoral lands, waterways, tidally affected lands, coral and rocky reefs and maritime and other wetland vegetation (salt marshes, seagrasses, mangroves)

(a) within the proposed area of development, and

(b) in the region adjacent to the proposal.

The principal fish, crustaceans and molluscs adjacent to the development area should be listed and, their current and potential fisheries importance (recreational, commercial, aquaculture, etc.) in both the local and regional context identified and their present abundance assessed.

Data on field observations is to be accompanied by information on sampling methods and substantiation of the efficiency of those methods. Specifically, the level of confidence which can be placed in abundance estimates needs to be addressed.

7.8 Demography and Social Environment

The social environment should be described in detail. The study should include the following:

- history of the area;
- contemporary land use and ownership of land;
- population and community structure including Aboriginal communities and traditional custodians of the region;
- the roles and responsibilities of traditional custodianship of land in the region;
- traditional use of local resources, both terrestrial and marine for food, spiritual or cultural purposes;
- community attitudes;
- health, economic and educational status of residents of the area;
- local employment patterns;
- potential of the local community to meet the demands for an increase to the company's workforce; and
- sources of authority, communications and consultations in determining any of the above.
- The existing infrastructure (roads, housing, schooling, electricity, water, sewage, solid waste, recreation, shopping and other tertiary services) should be described.
- A history of the establishment of Weipa South (Napranum) including an account of Church and Governmental policies of the time.
- A history of the relations between Mining Companies and Aborigines of the area.
- A history of relations between Comalco and Napranum people.
- A detailed demographic, social and economic profile of Napranum and Aboriginal and Torres Strait Islander residents of Weipa including (but not limited to):

(i) Composition on age, sex and place-of-origin bases.

(ii) Health, mortality and morbidity statistics.

(iii) Employment, income and housing correlations with the above age/sex/origin statistics.

(iv) Articulation with Weipa and with Comalco in social, economic and political terms, including an analysis of social and racial relations between Napranum residents and those of Weipa.

(v) Present social and economic infrastructure at Napranum.

(vi) Present levels of skills and educational standards.

(vii) The role and relative significance of fishing, hunting and other such subsistence activities to Napranum residents, including an assessment of the economic and social benefits of such use to the subsistence economy of Napranum people.

(viii) A detailed analysis of the values, aspirations and life-styles of Napranum residents.

- Detailed mapping of the contemporary economic and social uses of the local and regional environment by Napranum people, with the results to remain the property of appropriate Aboriginal people, such as traditional owners.

- Mapping of sites of cultural, religious, economic, social and historical significance in the areas potentially affected by the refinery (to remain the property of traditional owners).

- The establishment of those with legitimate interests in both Aboriginal traditional and contemporary terms in the various alternative proposed development areas.

- An assessment of the cumulative impacts on Napranum of the establishment of Weipa township, including (but not limited to):

  (i) The ability of Napranum Aboriginal people to maintain and live in accordance with their own various cultures and mores.

  (ii) The relationships (if any) between the demographic, health and other statistics referred to above and the establishment of Weipa north township.

(iii) An assessment of the present impact on Napranum residents use of the landscape by that of Weipa residents.

(iv) The social and cultural viability of Napranum.

7.9 Archaeology and Cultural Heritage

Aboriginal and European sites of archaeological or heritage significance must be identified and described. Input from the Australian Heritage Commission, traditional Aboriginal groups, and local historical organisations should be included.

7.10 Air Quality

Appraise the existing air quality at the proposed site using all relevant air quality data and meteorological observations.

7.11 Noise Environment

Describe the existing noise climate in the project area.

7.12 Transport

This section should give a detailed description of the existing transport infrastructure including loading facilities and an analysis of traffic.

8. Environmental, Social and Economic Impacts

8.1 Environmental Impact

This section of the EIS must clearly identify the potential impacts of the proposal on the natural environment in all of the areas likely to be effected by the proposal. The study should include direct and indirect, short-term and long-term, temporary and irreversible, adverse and beneficial effects, and, where possible, these effects should be quantified. The reliability of models and predictions used in the study should also be discussed.

As far as is possible groups effected by either biophysical or socio-economic impacts, or those expressing particular concerns over the proposal, should be identified and the costs and benefits to each of these groups should be described and quantified. These costs and benefits should be projected over the life of the project.

In particular the report should include:

- impacts of waste disposal on land.
- erosion control plans for mining, construction of the plant and during the lifetime of the refinery.
- a plan of the clearing to take into account changes in hydrology. Trees may also be retained for use as windbreaks, as the red earths located on the proposed site may be susceptible to wind erosion.
- a plan for the rehabilitation of mined area. The plan should incorporate ground cover protection and drainage works.
- a description and projected contour map illustrating the proposed reinstated land form and drainage system for the disturbed areas after completion of the proposed mining operations.
- a description of the potential post-mining land use options including the limiting factors to the establishment of potential land uses and the selection and implementation of a preferred option. Detail the rehabilitation technique proposed to achieve and maintain the preferred option.
- detail on suitable top soil, storage areas and rehabilitation techniques proposed to seal off hostile subsoil and create a suitable soil profile to achieve and maintain the preferred land use. Soil conservation measures to protect the proposed land uses should be designed and located.
- examine impacts on the estuarine crocodile population and the potential interactions between crocodiles and the increased number of humans in the Weipa region.

8.1.1 Surface and Groundwaters

Surface Waters

Assess the potential impact of the project on the surface waters in the catchment area containing the project and also in the surface waters in the vicinity of any proposed liquid effluent discharge point (directly or indirectly) into Embley River. Except in simple situations, discuss whether these assessments are based on modelling techniques.

The report should:

(i) Evaluate changes to the flow regime of surface waters resulting from the alteration of drainage networks (including the creation of impoundments), the abstraction of water, or the discharge of waste water.

(ii) Discuss the effects of the chemical and physical properties of any waste water at the point of entering natural surface waters, including seepage of leachate from ash and red mud disposal sites.

(iii) Evaluate the pattern of dispersion and likely concentration of effluent and leachate constituents at given distances from the point of discharge. The site of effluent discharge (or spillage) should be assessed to determine if it is in the best location for minimising pollution effects.

(iv) Discuss the toxicity of effluent and leachate constituents on the aquatic flora and fauna.

(v) Taking account of the potential toxicity of effluent and leachate, together with the effect of any other changes to properties of the water, the potential impact of waste water discharge, runoff and seepage on the beneficial uses of the aquatic environment should be evaluated, with specific reference to habitats and/or species of particular commercial, recreational or scientific value.

(vi) A pollution risk analysis should be completed which analyses the toxicity of the effluent and likely interactions with human use.

Ground Waters

Evaluate the potential impact of the proposed project on the ground water regime, including the following:

(i) Changes to the flow direction, water level or interconnection of aquifers resulting from project works.

(ii) Chemical and physical properties of waste water (including leachate) at the point of entering the ground water.

(iii) The pattern of dispersion and likely concentrations of waste waters constituents at given distances from the point of discharge.

(iv) The potential impact of the waste water discharge on the uses of ground water taking into account relevant water quality criteria for existing uses.

Water Supply

Impacts of waste disposal and of the forecast water demand of the plant and its attendant workforce, both construction and operational, on existing water uses and supply, including water quality and reliability of supply and the need for new infrastructure.

8.1.2 Marine and Estuarine Areas

Studies assessing the impact of this proposal shall identify and quantify:

(i) the areas of different types of maritime and freshwater habitats which will be lost including -

* mangrove and saltmarsh vegetation
* intertidal and subtidal seagrass beds
* intertidal and subtidal algae beds
* intertidal and shallow water mudflats
* shell inshore reefs (rocky and coralline) and sand banks
* riverine and riparian vegetation.

and any habitat areas which will be rehabilitated or created as a direct or indirect result of these proposals;

(ii) immediate and longer term effects on existing or potential fisheries of any loss or modification of tidal, intertidal, subtidal and riverine lands;

(iii) disruption to recreational and commercial fishermen (including local aboriginal fishing communities) resulting from infrastructure development and vessel and vehicle traffic associated with construction and operational phases of the proposal;

(iv) benefits to recreational and commercial fishermen (including local aboriginal fishing communities) resulting from provision of infrastructure or other aspects of the proposal;

(v) measures to minimise disturbances resulting from dredging (for example, resuspension of potentially toxic sediments, increased turbidity, changes to current patterns and hence shallow water habitats) both during the construction phase and during any maintenance of facilities (details should be provided of the likely frequency of maintenance dredging);

(vi) measures to minimise impacts on the maritime environment of any accidental spillage of fuel, coal, oil, caustic soda, sulphuric acid and refined products at the import/export wharf facility and during transport to/from the refinery;

(vii) details of the location of all discharges (including sewage, stormwater runoff from the Baker process bounded area and overflows from settling ponds) from proposed facilities, the temperature and chemical composition of such discharges (including nutrient levels) and measures to ensure that the characteristics of these discharges do not exceed those of receiving waters;

(viii) details of the location of freshwater bores and justification that further depletion of the shallow freshwater aquifers will not result in changes in the existing flow rates or salinity of rivers and creeks on the site and in the adjacent area or on marine and other wetland vegetation supported by the water table;

(ix) the source of supply of limestone requirements of the refinery should be advised and any impacts of this mining activity on marine, estuarine, or freshwater fisheries or fisheries resources at that location described;

(x) any increased risk of oil spills within the existing port area resulting from increased vessel traffic should be discussed and measures to minimise such risks described.

(xi) the toxicity of pollutants on aquatic flora and fauna with reference to the effects on the marine life in the area. Also examine toxicity to humans. This information should include bio-degradation of pollutants (including time for degradation), where pollutants may be carried to, whether any pollutants may degrade into toxic end products and whether the pollutants or their end products, could be expected to accumulate in biological tissue and thus concentrate up the food chain.

Consultation

It is a requirement of the Department of Primary Industries that consultation be initiated with the Queensland Commercial Fishermen's Organisation, Queensland Sport and Recreational Fishing Council and local fishing clubs for provision of written comments on the proposal. These comments must be incorporated in the assessment regarding any disruption of the existing fish habitat and its dependent fisheries and amenity.

8.1.3 Management of Noise Emissions

Describe the major noise sources and give estimates of their unattenuated noise emissions. Express values of noise emission in terms of either sound power level or sound pressure level at a reference distance - preferably as component values in the frequency range 31.5 Hz to 8 kHz.

Give values of sound pressure level in dB(A), in terms of L_{10}, L_{90} and L_{eq}; state the measuring period of each value.

For each major noise source, describe the means of attenuation, and indicate the expected reduction in noise level.

8.1.4 Effects on Air Quality

(a) Construction Phase

The report should describe the techniques to be used during the construction phase for controlling emissions of dust arising from site clearing, earth movement and vehicular movements. It should indicate methods proposed for the disposal of vegetation and construction waste.

(b) Normal Operations

The following details should be provided regarding air emissions that will occur during normal operation of the proposed plant:

(i) A site layout of the proposed alumina refinery clearly indicating the locations and designations of all emission sources (process, safety relief and fugitive) and the locations of stockpiles of raw materials and waste products, conveyor belts and loading/unloading facilities.

(ii) Emission rates and concentrations of all identified pollutants emitted from each designated source should be provided as in the table shown in Appendix B. If emissions are expected to vary significantly with quality of raw materials or plant operating conditions the details should be given.

(iii) Methods to be used to control emissions should be described.

(c) Atypical Situations

The following details should be provided regarding air emissions that will occur during atypical situations, for example, power failures, startup and shutdown of equipment, fires, explosions and rupture of tanks:

(i) The emission concentrations and rates and the likelihood of occurrence of major atypical occurrences which could lead to emissions to atmosphere. This should be presented in a separate Table in the same format as Appendix B.

(ii) Contours of ground level concentrations expected under a range of meteorological conditions, including worst case conditions.

(iii) The possible health implications that may be involved in exposure to the above atypical emissions and the need for public safety arrangements.

(iv) Measures that would be taken to control, alleviate and stop such atypical emissions and a time span in which these control operations could take place. Provide details of emergency and backup safety procedures in the event of a mishap leading to the emission of any toxic materials or gases.

(d) Predicted Effects of the Proposal on Air Quality

The following details should be provided regarding effects of air emissions on ambient air quality:

- Predicted maximum one-hour, 24-hour, monthly and annual average pollutant concentrations downwind of the proposed alumina refinery for all gaseous and particulate emissions. Predicted maximum concentrations should be derived from calculations covering an appropriate range of atmospheric stability categories, mixing heights, wind speeds and downwind distances. Predictions should be made for both normal and expected maximum emission operating conditions and the worst case meteorological conditions should be identified.

- Specific predictions of ground level concentrations for receptors in Napranum and Weipa should be made. Predicted ground level pollutant concentrations should be compared to relevant air quality goals and standards, for example those of the Australian and New Zealand Environment Council (ANZEC), United States Environmental Protection Authority (USEPA), or other appropriate environmental criteria. It is preferred that at least one year of site-specific meteorological data should be used as input to a short-term dispersion model to predict annual frequency distributions of one-hour average ground level concentrations of pollutants at each of the specific receptor sites.

  A full description of the dispersion models used for calculating ground level concentrations and a sensitivity analysis of each model to the variations in the input parameters.

(e) Possible effects of emissions, under normal and atypical situations, on surrounding vegetation should be discussed. Monitoring of vegetation for these effects should be detailed.

8.1.5 Transport

The study should include the impact of any increase in shipping on the waters of the gulf as well as the port of Weipa, including any requirement for additional dredging (both frequency and additional depth or width of channel) of approaches to the port. The study should also include an assessment of the impact of increased road and air traffic.

(a) Roads

The delivery of construction materials must be addressed, in particular the impact on the Peninsula Developmental Road and on the access roads to Normanton and Karumba should be quantified. The impact of the wet season on road conditions, limitations of road access and resultant damage by road transport during construction need to be addressed.

The study needs to identify whether there will be any change during the construction or operation of the refinery on the material supply, and quantify any impact of delivery of plant and equipment road freighted into the site.

The specific requirements for and impact of materials delivery, including aggregate, during construction and operation should be addressed. Details of outsize or overweight loads using land access shall be detailed.

An assessment of worker requirements for land access in both the construction and operation phases would be beneficial in assessing the impact of the project.

(b) Port Facilities

It is inevitable that dredging works will be associated with the extension of the Lorim Point Wharf hence an analysis of the amount of material to be removed, the disposal site(s) and any possible effects on marine life and seagrass areas would need to be investigated. Additionally, an analysis of the effects of extending the Lorim Point Wharf on sedimentation patterns of Jackson Channel should also be analysed.

The potential hazards from increased seaborne imports of caustic soda, acid and oil into the Harbour will need to be addressed and procedures to counter any emergency that may arise from such importation should be outlined.

(c) Air Traffic

The report should describe the impact of the proposal upon existing air traffic services to the site and the need for, and impact of, possible future upgrading of airport facilities should the refinery proceed.

8.2 Social Impact

The study must describe the social impacts of the proposal, both positive and negative. The socio-psychological effect on traditional Aboriginal people with respect to physical changes to land, perceived threats to sites of significance and changes to life-styles must be addressed. The impact of any additional workforce that must be brought in from outside the area on the present community should be assessed.

The ability of the present infrastructure to meet additional demands must be described with emphasis given to the capacity (and lead times) of the State and Local Government authorities to meet additional demands for services such as health and medical, educational, welfare, recreational, social and cultural.

Construction Phase

- The potential effects on social and racial relations within the region of the construction workforce.

- Potential effects on Napranum residents' use of the region for hunting and fishing and other such subsistence and cultural activities, due to the increase in the regional population over the construction phase.

- The potential for significant levels of noise and dust pollution causing concern to Napranum residents.

- The socio-psychological effects of development including (but not limited to):

  (i) The damage caused to significant sites and to country.

  (ii) The effects of continuing development on, and in relation to aspirations for, life-style.

  (iii) The increased interaction with Europeans.

- The impact on local communities including job opportunities, community employment contracts and effect on the Napranum economy.

Operational Phase

- Impacts associated with workforce recreation including the use of Aboriginal hunting and foraging areas, and the environmental impact of recreational activities on marine and terrestrial resource important to Aboriginal economic systems.

- Impacts associated with the interaction of a large, largely single sex workforce and the Napranum community, including the potential for:

  (i) Increased alcohol availability and consumption.

  (ii) Impacts on social and racial relations.

- Impacts on Aboriginal use of the area for cultural purposes.

- Socio-psychological effects of damage to sites and landscape of cultural significance.

- Impacts on aboriginal life-styles and aspirations for life-style. Relate peoples' aspirations and values to the context of development in the region, including potential new development and new populations.

- Propensity for proposal to engender incremental demographic and infrastructural change and the cumulative social impact of these changes.

- Impact of development on the cultural and social viability of the Napranum community.

- Impact on the life-styles and aspirations of other Aboriginal groups and communities in the wider region.

- Impact of the development, including (but not limited to) the discharge of red mud, ash and other major waste emissions, on the use of fauna and flora in the region by Napranum residents, and on the safety of such use.

8.3 Economic Impact

The report shall present a balanced view of the project's impact on the regional, State and National economies in terms of direct and indirect effects on employment, income and production, and the extent to which Queensland services and goods might be utilised (estimates may be made of the taxes that the Company is expecting to pay, the effect of the project on net exports, and so on).

An assessment of industry opportunities which may arise in the region as a result of the establishment of the project is also required. As part of this assessment, the report should indicate any measures which could be taken to ensure that regional firms will be given opportunities to participate in the supply of goods and services to the project.

8.4 Workplace Health and Safety

Workplace health and safety aspects during the construction phase should be well documented at the planning stage. This program should be presented to the Division of Accident Prevention of the Department of Employment, Vocational Education, Training and Industrial Relations for perusal and consultation. The provisions of the legislation should be incorporated in this program.

A comprehensive workplace health and safety program for the future operation of the facility would need to be documented at the planning stage.

A health and safety program should include provisions for control of occupational exposure, storage and handling of hazardous substances and other matters which affect the health and safety of employees at the refinery.

8.5 Public Health and Safety

Certain matters concerning public health and safety may need to be considered at the planning stage. Potential does exist for atmospheric contamination by hazardous substances.

Items to be considered are:

- Safety of non-employees on the site; and
- Safety of the public who may be in the surrounding area.

8.6 The Greenhouse Effect

The EIS should include a budget for the emission of greenhouse gases. A greenhouse budget should include an estimation of the impact of the total operation, including mining, processing, transport of inputs and the finished product. The budget should include reductions in the emissions of greenhouse gases from other plants or through reductions in the tonnage being transported as a result of the proposal. The contribution to greenhouse gas emissions of in situ vegetation removed during construction should be included in budget calculations.

9. Environmental Safeguards, Monitoring Proposals, Risk Analysis and the Environmental Management Plan

This section should describe all measures proposed to minimise the adverse impacts of the proposal. This statement should draw together all relevant information from other parts of the study and contain a clear statement of specific commitments which the Weipa Alumina Plant Project will make to the provision of safeguards, monitoring and contingency plans for accidents that could result in damage to the environment. Any action by others to enable the Weipa Alumina Plant Project to meet these commitments must be identified. This includes hazard analysis, risk analysis, security measures, handling and transport risks and safety measures.

9.1 Socio-economic Environment

Impact Management

- The Environment Impact Statement must specify measures to mitigate the negative socio-economic impacts of the development together with measures designed to enhance the potential positive impacts. These measures should include:
- Staff behavioural guidelines to:
  - (i) Reduce the social impacts associated with the influx of a large workforce.
  - (ii) Reduce potential site desecration and damage to landscapes.
  - (iii) Reduce the impact on marine and terrestrial resources and areas important to indigenous economic and social systems.

(iv) Establish inter-group and inter-race relations on the basis of mutual knowledge and respect.

- Induction programs for the incoming European workforce to develop an understanding and respect for Napranum residents and their cultures.

- Employment and training programs for Napranum residents, in particular focusing on Aboriginal people and developed in close consultation with them.

- Optimal safety and precautionary measures to reduce risk to the Napranum community, including (but not limited to) those residents who use terrestrial and marine resources potentially affected by the development.

- Environmental safety standards to reduce the risk of damage to environmental resources important to Aboriginal people.

Monitoring Program

Given the scope and duration of the project, the Environmental Impact Statement should provide a detailed proposal for monitoring social impact. The monitoring proposal should consist of both research and implementation arms and be conducted continuously for a minimum of 10 years from the start of construction.

A comprehensive social impact monitoring program is required to:

(i) Monitor differences between predicted and actual impacts.

(ii) Evaluate the effectiveness of impact management strategies.

(iii) Develop and implement measures to effectively mitigate unexpected impacts and modify existing mitigatory measures.

(iv) Evaluate the effectiveness of safeguards.

9.2 Water Pollution Issues

The implementation of the necessary commitment to embark on an effective impact minimising program for water pollution should be detailed.

A contingency plan is needed to account for each possibility of accidental pollution release.

9.3 Flora and Fauna

Fauna corridors should be part of the mining operations strategy for maximising the conservation of fauna in the area.

The study should detail how the site will be integrated with fauna management throughout the peninsula. Also methods of minimising barriers where infrastructure crosses existing corridors such as Beening Creek, need to be outlined.

A vegetation monitoring program needs to be established for areas where it is predicted that emissions will come in contact with vegetation, and where their concentrations may be detrimental to vegetation growth.

9.4 Air Quality

The report should describe continuous monitoring programs to be used for measuring the concentrations of pollutants at points of discharge to the atmosphere during the operation of the plant. The requirements of the Division of Environment, Department of Environment and Heritage regarding ambient air monitoring will be decided at the time of approval of licence and will depend on the conclusions of the report and assessment by the Division of the significance of expected impacts on the atmospheric environment.

10. Information Sources, Public Involvement and Consultation

Describe consultations and studies undertaken in the course of proposal formulation and preparation of the draft EIS, and sources of information and technical data.

Describe negotiations/discussions with relevant Commonwealth, Queensland and local authorities. Any further or ongoing consultations or studies should be outlined.

Discuss the outcomes of social surveys, public meetings, discussions with interest groups, including the local Aboriginal communities and traditional custodians of the region. Discuss provisions for continued access by user groups.

APPENDIX A

GUIDE TO PREPARING PROCESS FLOWSHEETS AND MATERIAL BALANCES

Before starting on the flowsheet, decide how to group the process equipment [in concept] into "systems". Each system will have its own area within the flowsheet; it will also have its own material balance. Keep the number of systems small (one is enough in many cases). At the same time, do not crowd a system with many plants that can be treated as separate entities.

For example, if a process reagent such as lime or sulphuric acid is needed, and is likely to be made on site, but could possibly be purchased instead, the plant used to make it could be treated as a separate system.

1. On the flowsheet, show the following:-

   - all items of plant, equipment, facilities which are included within each system. If you wish to exclude any items that would normally be regarded as part of a system, mention this specifically and say why;
   - all significant material flows *into* and *out of* each system (flows "external to" the system);
   - all significant material flows *between* the equipment and facilities inside each system (flows "internal" to the system);
   - quantities of materials (for example, tonnes per day or tonnes per year). For staged development, a single flowsheet showing first stage is probably adequate;
   - the boundary of each system, and of the overall system. A system boundary can be indicated by a line which crosses every flow line representing an "external" flow of material. Boundary lines should be different in some way from flow lines, and from outlines representing equipment.

2. For each stream of material shown on the flowsheet, give the following details - either within a Material Balance table itself, or in a separate table:

   - description of source and general nature;
   - expected quantities;
   - composition and (where appropriate) temperature; describe composition in terms of:
     - characteristics relevant to production aspects; and
     - characteristics relevant to effects on the natural environment.

3. Compile a Material Balance table for the system(s), to show how the constituents of the input streams can be accounted for by the constituents of the output streams - within practical limits. The aim of this is to show that important and difficult waste streams have been taken into account in planning the project, so that the operating organisation will not have large quantities of unexpected material to dispose of.

   An example of a Material Balance Table is given below (with some quantities omitted). It is meant as a guide, and you should not assume that the level of detail shown there is necessary for your project, or that it is sufficient. You should use your own judgement about how much detail you give; you may be asked for more later, if thought necessary.

MATERIAL BALANCE TABLE

BASIS FOR MATERIAL BALANCE:

1. Definition of "System" around which the balance is made: Alumina Refinery and Plant Services (excludes red mud and ash disposal systems)
. Basis for Stated Quantities: One year
. Operating Conditions to which the balance applies: 120% of design throughput; dry weather (no hydrological gains/losses)

Description of Stream of Material	Mass of Material passing											
	Components according to Physical Form			TOTAL MASS (t)	Major Chemical Elements (x 1000 tonnes)							
	Solid	Liquid	Gaseous		Al	O	e	H	Ca	C	F	& so on	Others
INPUTS TO SYSTEM												
Raw Materials:												
Bauxite, 13% moisture	1 305 000	195 000	0	1 500 000	290	620			104		39		47
Process Reagents:												
50% Caustic soda solution	75 000	75 000	0	150 000		97	43	10					
Limestone				21 000		:0			8	3			
Starch													
Flocculants													
Sulphuric Acid													
Fuels:													
Coal	14 500	500		15 000									
Fuel oil													
Air:													
Combustion air													
Process air													
Water:													
Fresh water													
Sea water													
Water Treatment Chemicals:													
Alum													
Soda Ash													
OUTPUTS FROM SYSTEM													
Products:													
Alumina													
By-products:													
Slaked Lime													
Solid Wastes													
Bauxite residue (red mud)													
Ash from:													
Boiler													
Lime Kiln													
Sludges from:													
Water Treatment													
Caustic cleaning													
Liquor Causticising													
Oxalate removal													
Gaseous Wastes:													
Stack gas from:													
Lime Kiln													
Calcination													
Moisture Losses at:													
Evaporator vents													
Cooling Towers													
Precipitation tanks													
Mud clarifiers													
Liquid Wastes:													
Demineraliser wastes													
Plant washings													
STORAGE WIT													
Residues stored:													
(None)													
TOTALS													

No.				Operation	maximum expected		ground (m)	(m)	(m/s)	(°C)	ground (m)		

* These include stockpiles, building openings, conveyors and so on.

** Provide concentrations and mass rates of emission

MELBOURNE "AGE"

27th August 1992

Alcoa plans $35m expansion in WA

By BARRY FitzGERALD, Perth

Alcoa is to take advantage of a market opening in the weak alumina market to underpin a $35 million expansion at its Wagerup refinery in Western Australia.

The company will also spend $77 million next year on a plant to burn organic debris in the liquor stream at the refinery, boosting its overall efficiency.

The 16-month expansion project comes as the group — the world's biggest alumina producer — works towards the January 1993 commissioning of the second production unit at Wagerup at a cost of $316 million.

The second unit takes Wagerup from 900,000 tonnes to 1.5 million tonnes a year, cementing its position as one of the world's biggest and lowest-cost producers.

In the $35 million expansion plan, Alcoa will take annual capacity at Wagerup up by 250,000 tonnes to 1.75 million tonnes.

Although not big in overall tonnage terms, the incremental expansion represents a low-cost source of additional capacity.

Typically, expansion of existing operations costs between $300 and $500 per annual tonne of additional production, while for greenfield developments the figure blows out to $1000 a tonne.

On that basis, the 250,000 tonnes of additional annual capacity would cost between $75 million and $125 million.

Alcoa's ability to do it for $35 million is explained by its representing a case of de-bottlenecking rather than expansion. The larger scale of operations will also bring with it a cut in production costs.

Mr W Moyle
27 Rangeview Grove
NORTH BALWYN
VICTORIA 3104

Your ref:
Our ref: 189/76
Enquiries: Mr D Betts

Dear Sir

ENVIRONMENTAL ASSESSMENTS OF THE ALUMINA INDUSTRY

In response to your query regarding environmental impact assessments of the alumina industry I have enclosed some documents which should clarify the Authority's process and relate it specifically to an assessment of the Wagerup (Alcoa) refinery.

Unfortunately I do not have a spare copy of the environmental review document written by Alcoa as part of the formal assessment process; only the subsequent report prepared by the Environmental Protection Authority. However I have included the guidelines which were prepared for Alcoa to follow in the compilation of their Consultative Environmental Review.

I hope that this literature will be of use to you. Please accept my apologies for the delay in dealing with your request. The Authority has recently moved offices and much of the documentation I have included was packed.

Yours sincerely

R A D Sippe
DIRECTOR
EVALUATION DIVISION

18th February 1992

enc

aluminaQ180292DBe

Environmental
Protection Authority

1 Mount Street Perth
Western Australia 6000
Telephone (09) 222 7000
Facsimile (09) 322 1598

l summarise the issues,
oblems and recommend
the proposal
lly acceptable.

appeal against the
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near wetlands.

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interest in the proposal.

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onds and revegetation.

Appeals

Environmental assessment is not only about analysing the ecological impact of a project.

It's also about people.

That's why the EPA's assessment process allows people to appeal to the Minister for Environment against matters which will affect them as well as the environment.

Under the Environmental Protection Act, the public can appeal over:

- Whether a project is assessed formally or informally
- The level of formal assessment (it might be too low)
- The EPA's assessment report and recommendations

The developer also can appeal against conditions that are set on a project.

Appeals must be accompanied by $10 and you have 14 days in which to lodge them.

Separate appeals cover works approvals and licences.

For more information, please contact:

The Environmental Protection Authority
1 Mount Street
PERTH WA 6000

Ph: (09) 222 7000
Fax: (09) 322 1598

Environmental Protection Authority

Environmental impact assessment

Western Australia - an environment worth protection

it works

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nor subdivision, for example,
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details of the proposal and
g advice to the developer,
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to manage any problems.

vice is publicly available at the
formation Centre.

But a majc w industry that is likely to have a s.. ..ficant environmental impact would be assessed "formally", in which case the company would be asked to do an environmental impact statement.

Formal assessment

The EPA's assessment of projects is aimed at determining whether they are environmentally acceptable.

To that end, the EPA will provide advice on what developers should do to ensure the environment is protected.

The Minister for Environment sets legally binding conditions on projects and, very occasionally, these conditions may say a project is environmentally unacceptable.

In Western Australia, the three levels of formal assessment are:

- Consultative Environmental Review
- Public Environmental Review
- Environmental Review and Management Programme.

The CER is the lowest level of formal assessment and the ERMP is the highest.

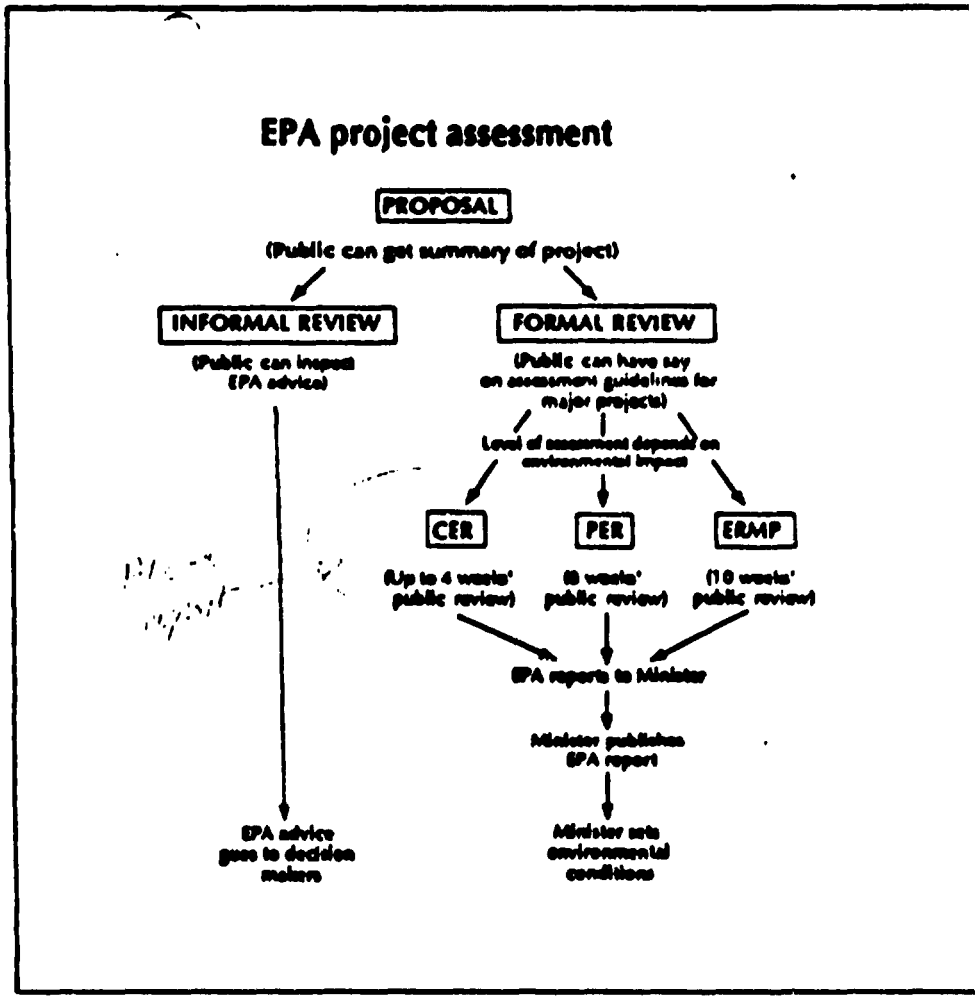
By appeal, anybody can ask for the level of assessment to be upgraded.

With "formal" assessments, the EPA will ask the developer - known as the proponent - to provide detailed information about the project.

The Authority will also provide the developer with guidelines for preparing the CER, PER or ERMP document.

The public can comment on guidelines for high-level assessments, or ERMPs.

For this assessment document, the developer must explain the project and outline its environmental impact and how that impact will be managed.



Public submissions

Reports by developers are made public for up to 10 weeks during which submissions can be made.

For some projects, the EPA may arrange public meetings to discuss the issues and provide greater opportunity for public debate.

After the public has had a say, the EPA then considers the proposal, including the public submissions.

Submissions are confidential though the proponent will be asked to comment on the issues they raise.

The EPA also seeks advice from independent experts, including office from Government departments and private consultants.

When the assessment is finished, the EPA prepares a report which will say whether the project is environmentall acceptable.

ENVIRONMENTAL PROTECTION AUTHORITY'S GUIDELINES FOR

CONSULTATIVE ENVIRONMENTAL REVIEW

Review of the Expansion to Wagerup Alumina Refinery and Compliance with Approved Conditions

PREAMBLE

The purpose of this environmental review is for the proponent to compare details of the current expansion with the details of the original project given in 1978, with reference to:

- changes in the proposal;
- any changes in predicted impacts;
- any consequential amendments to the environmental management programme; and
- any appropriate changes to commitments .

As well, a comparison of environmental management performance to the proponent's commitments made in the original ERMP (1978) should be given.

SUMMARY

This section should contain a clear and concise summary of the salient features of the proposal, site location, existing environment, magnitude and extent of potential environmental impacts and environmental safeguards and management. Reference should be made to the 1978 ERMP and Supplementary document.

1. INTRODUCTION

This section should include:

- existing facilities and how the proposal relates to them;
- background, objectives, and scope of proposal;
- relative legislative requirements and approval processes including relationship to the Environmental Protection Act 1986;
- explanation of the purpose of PER; and
- environmental interaction with other developments present and future.

2. NEED FOR PROPOSAL

This section presents an opportunity for the proponent to describe in general the broad costs and benefits of the project to the proponents and the community. These should be described at local and State levels.

3. THE PROPOSAL

The document should provide a description of the important elements of the development including alternatives examined, transport of material to site and final disposal of material. It should cover location, layout, anticipated life of the project, timing of the project, possible future expansion and utility services required. All the above should be kept brief and related back to the existing facilities, so that a comparison can be readily made.

A brief description of the refinery operations including supplies of raw materials, water and energy should be given. Details of emissions to the environment including nitrogen oxides, carbon dioxide

dust levels should be provided. The impact of increased processing rates on residue management uld be discussed in particular. Workforce numbers and composition should also be detailed.

4 EXISTING ENVIRONMENT

This section can refer to the appropriate chapters in the 1978 ERMP and needs to only briefly describe the environment and an appraisal of physical and ecological systems likely to be incrementally affected by the proposal.

5 ENVIRONMENTAL IMPACTS

This part of the document should describe the overall and incremental potential impacts of the proposal on the environment. Consideration should be given to both long and short-term effects of the proposal, and reference should be made to relevant sections of the 1978 ERMP documents in the light of advances in knowledge and technology in the intervening 11 years. Actual impacts to date, and incremental potential effects should be discussed.

Aspects which should be addressed include:

- Location of proposed refinery expansion and any likely impacts arising from clearing and construction activities:

- New circuit facilities:

  - increase in energy requirements;
  - increase in solid wastes and gaseous emissions; and
  - increase in ambient noise levels.

- Impacts of accelerated mining rates:

  - on rehabilitation approach, rate and effectiveness;
  - will areas be cleared for mining and associated facilities which were not referred to in 1978 ERMP;
  - requirement for additional equipment, opportunities for improvement in environmental standards;
  - on the spread and management of dieback disease; and
  - on water quality.

- Waste disposal impacts of:

  - additional red mud;
  - other additional liquid and gaseous emissions including an analysis of any increased contributions of Greenhouse gases.

- Social Impacts

  The overall and incremental impacts of the proposed expansion on the local communities should be examined and described. The section should also detail impacts to date from the development and operation of the existing plant and include:

  - impacts of increased workforce for construction and operational phases on the local community;
  - construction camps for contractors/Alcoa, including broad short term/long term costs; benefits to the Shire;
  - housing requirements including supply to the township of Waroona;
  - impacts on existing services in affected communities; and
  - public consultation mechanisms to identify and monitor impacts of the development and operation of the proposed expansion.

ENVIRONMENTAL MANAGEMENT AND MONITORING

This section should outline the updated programme of controls and safeguards proposed to minimise adverse environmental impacts. The objectives, scope and details of the programme should be described, with reference to the appropriate section in the 1978 ERMP proposals for the management of leachate and dust from red mud residues should be described.

The groundwater monitoring programme should be modified as necessary to monitor the extra red mud waste generated to ensure the environmental management programme is constraining the impacts to an acceptable level. Emphasis should be given as to how the environmental management programme will be adapted to rectify any shortcomings shown by the monitoring programme. Commitment to environmental management should be given. Long term management of red mud disposal should be canvassed.

The procedures for reporting results of the monitoring programme to the appropriate authorities should be outlined.

7 CONCLUSIONS

Conclusions of the overall impact of the proposal (including role of ameliorative measure) should be stated, together with an assessment of the environmental acceptability of the project.

This section should also include a concise summary of all environmental management commitments made in this document, and those which remain current from the 1978 ERMP.

8. COMMITMENTS

A summary of all environmental management commitments should be given. These should be numbered.

10. REFERENCES (Bibliography/Abbreviation)

- Glossary

Provides definition of technical terms used. Also define and explain units of measurements which may not normally be understood by the interested layman.

- These Guidelines should be appended.

Wagerup Alumina Refinery Expansion

Alcoa of Australia Ltd

Report and Recommendations of the Environmental Protection Authority

Environmental Protection Authority
Perth, Western Australia
Bulletin 423 December 1989

Contents

Appendices

Map

Summary and Recommendations

Alcoa of Australia mines bauxite from the Darling Range, and refines it into alumina at refineries at Kwinana, Pinjarra and Wagerup. In Western Australia Alcoa is covered by the Special Agreement Act ML1SA, 1961, and is thereby excluded from the environmental control of the Environmental Protection Act, 1986. In this report the EPA has recommended that Alcoa be required to be covered by the same environmental law as other companies.

Alcoa has been highly successful at mining and rehabilitation in the Darling Range. There is, however, considerable uncertainty as to the long term environmental acceptability of extensive residual areas on the Swan Coastal Plain. In this report there is a recommendation that Alcoa provide a "walk-away" solution to residue disposal for all of its operations in Western Australia.

Alcoa proposes to raise the production of alumina at its Wagerup refinery from 840,000 tonnes to 1.5 million tonnes annually.

The 1978 environmental review and Agreement Act ratified production of up to 2 million tonnes per year. Alcoa then constructed only one out of a proposed four units, with a then nominal capacity of 500,000 tonnes. The Environmental Protection Authority required the present expansion to undergo a formal assessment at the level of Consultative Environmental Review.

The capacity of the refinery will be increased by integrating a second production unit with the first one.

Bauxite for the refinery is mined from the Willowdale mine, 10 km east, and transported to the Wagerup processing facility by conveyor. While there are no new constructed facilities required at the mine about 50% more water will be needed, mainly to suppress dust on mine haul roads. Extra bauxite production will be achieved by the working of extra shifts and will require 35 more miners and an increase in earth-moving and support vehicles.

At the refinery most existing facilities will require upgrading or duplication, but there is no new clearing required.

Bauxite residue disposal will report to the existing impoundments. Alcoa will continue with "wet" disposal methods, at least for the present. As the disposal lakes continue to grow in size their ongoing management may become a more significant factor, with their attendant problems of dust, and potential to pollute groundwater.

Construction at the refinery will take place over 30 months and will require a peak workforce of about 850, most of whom are expected to commute.

The refinery will require an increase of personnel of about 90, bringing the expanded, combined mine-refinery workforce to about 609. There is the possibility for social impact to the town of Waroona nearby, which can be minimised by close liaison between Alcoa and the Shire of Waroona.

The accelerated mining regime will enable areas to be mined and rehabilitated more quickly but will require a re-scheduling of forestry management and production in order to minimise the potential for conflict

With the evolution of the technology of alumina refining since 1978, savings in the amounts of requirements (such as energy, water and sodium hydroxide) per tonne of alumina are expected. The Wagerup plant uses natural gas as its energy source, and the increased power requirements may be sourced from a co-generating unit, which would efficiently deliver power in excess of requirements, to be fed back into the State Energy Commission of Western Australia grid system. Extra water will come partly from the Samson South Diversion Drain, but increasingly from rainwater channelled off the residue ponds as these grow in size. Requirements for the mine area will be met either via an upgraded pipeline from the refinery or by building a reservoir nearer to Willowdale. The latter option has the potential for significant environmental impact and would require a careful review of the proposal to minimise effects on stream valleys and on fish migration routes.

The Environmental Protection Authority concludes that this proposal is acceptable subject to the following.

Recommendation 1

The Environmental Protection Authority concludes that the Wagerup Refinery Expansion Proposal is environmentally acceptable and recommends that it could proceed provided that commitments given in the proponent's 1978 ERMP, 1978 ERMP Supplement and 1989 CER are followed, and subject to the following:

Recommendation 2

The Environmental Protection Authority recommends that Alcoa liaises closely with the Department of Conservation and Land Management throughout the project's life to ensure that mining schedules are integrated with that of forest management.

Recommendation 3

The Environmental Protection Authority recommends that all Alcoa's operations in Western Australia come under the jurisdiction of the Environmental Protection Act 1986.

Recommendation 4

The Environmental Protection Authority recommends that the proponent be required to set up a programme to develop a walk-away solution for the bauxite residue disposal across all three refineries, to the satisfaction of the Minister for Environment, within 12

months of the commissioning of this expansion.

Recommendation 5

The Environmental Protection Authority recommends that minimising of greenhouse gas emissions should be a major factor in the proponent's selection of energy generation options.

Recommendation 6

The Environmental Protection Authority recommends that Alcoa establishes formal liaison and monitoring processes with the Shire of Waroona to the satisfaction of the Environmental Protection Authority, upon advice from the Social Impacts Unit, to minimise social disruption to the Waroona district.

Recommendation 7

The Environmental Protection Authority recommends that the proponent should be responsible for decommissioning the plant and rehabilitating the site and environs of the expanded facility, to the satisfaction of the Environmental Protection Authority. At least six months prior to decommissioning, the proponent shall prepare, for the expanded facility and its site, a decommissioning and rehabilitation plan to the satisfaction of the Environmental Protection Authority.

1. Introduction

Alcoa of Australia Pty Ltd has been operating the Wagerup Refinery (Stage 1) near Waroona (100 km south of Perth) since 1984, under the Alumina Refinery (Wagerup) Agreement and Acts Amendment No 15 of 1978. This agreement covers a production capacity up to 2 mtpa (million tonnes per annum).

Initially the refinery produced about 670,000 tpa, but fine tuning of the plant (currently under way) is expected to lift its capacity to 840,000 tpa of alumina.

The expansion proposal referred to in this report is to increase the production of the refinery to a capacity of 1.5 mtpa by the construction and operation of a new process line.

Although the original 1978 Environmental Review and Management Programme and Environmental Protection Authority Assessment (DCE Bulletin Number 50) planned and gave approval for a capacity of up to 2 mtpa a formal review was nevertheless sought. It was considered necessary because of the considerable elapsed time (nearly 12 years) since the original assessment, during which period earlier concepts and values have changed. The level of assessment set was formal Consultative Environmental Review. (CER).

The purpose of the CER prepared by Alcoa is to outline the significant changes in the scope of the project in relation to predicted impacts and changes to environmental management programmes and to compare Alcoa's performance against the commitments made in the 1978 Environmental Management and Review Programme.

2. Project description

The capacity of the refinery will be raised from 840,000 tpa to 1.5 mtpa by building a second production unit. Stage 2 will be integrated with Stage 1.

2.1. Alternatives

Alcoa considered further expansion at its Kwinana and Pinjarra refineries as alternatives to Wagerup but concluded that the latter was most suited because:

- Wagerup has the most up to date technology;
- it is the most energy efficient of the three plants;
- has the greatest potential for achieving economies of scale; and
- the bauxite resource for Wagerup at the Willowdale mine is the least constrained by other land uses.

2.2 Willowdale mine

In order to feed the expansion additional bauxite from the Willowdale mine (10 km east) will be transported via the existing conveyor to the refinery. There will be no major works required at the mine, but 50% more water will be required, most of which will be used for dust suppression on haul roads. A decision by Alcoa needs to be made on whether to upgrade the capacity of the existing pipeline from the refinery to the mine or to construct a new reservoir closer to it.

The number of 50 tonne haul trucks will initially be increased from 11 to 14, but as these fall due for replacement, the fleet will be progressively converted to a lesser number of more fuel efficient 85 tonne trucks. As well, two bulldozers, a scraper and service vehicles will be required. Extra production will be achieved mainly by working additional shifts.

2.3. Wagerup refinery

At the refinery most existing facilities will require upgrading, or duplication, but as the existing plant site was cleared at the outset to accommodate the Stage 2 expansion, there is no new clearing required.

2.4. Residue lakes

Residue disposal will continue to be to the existing underdrained impoundments ,the first of which was filled in July 1989. The composition of the sodium hydroxide liquor will remain the same at 12g/l total alkali. Alcoa has not yet made a decision on whether to change to "dry" disposal methods, such as are already employed at Kwinana and Pinjarra refineries.

2.5. Raw materials, water and energy requirements

Compared with the 1978 proposal there are expected to be significant savings on requirements per tonne of alumina produced. These are shown in the table below, taken from Alcoa's Consultative Environmental Review (Table 1) and have arisen as a result of design improvements which have evolved in the interim.

Table 1: Raw Materials Usage (per tonne of alumina produced)

Material	Unit 1 1988-90	Units 1 and 2 1992	Original Proposal
Bauxite (t)	3.4	3.4	3.4
NaOH (kg)	53-61	50-58	62
Water (kl)	1.8	1.5	2.3
Energy (Gj)	10.0-10.7	9.7-10.2	10.0-12.5

Make-up water requirements will rise from 1,470 to 2,170 megalitres initially, and will continue to be obtained from the facilities on Yalup Brook, supplemented if necessary by winter runoff from the Samson South diversion drain. However, as the size of the residue area increases and more rainfall run-off from it can be collected and recycled, the make-up water requirement will decrease.

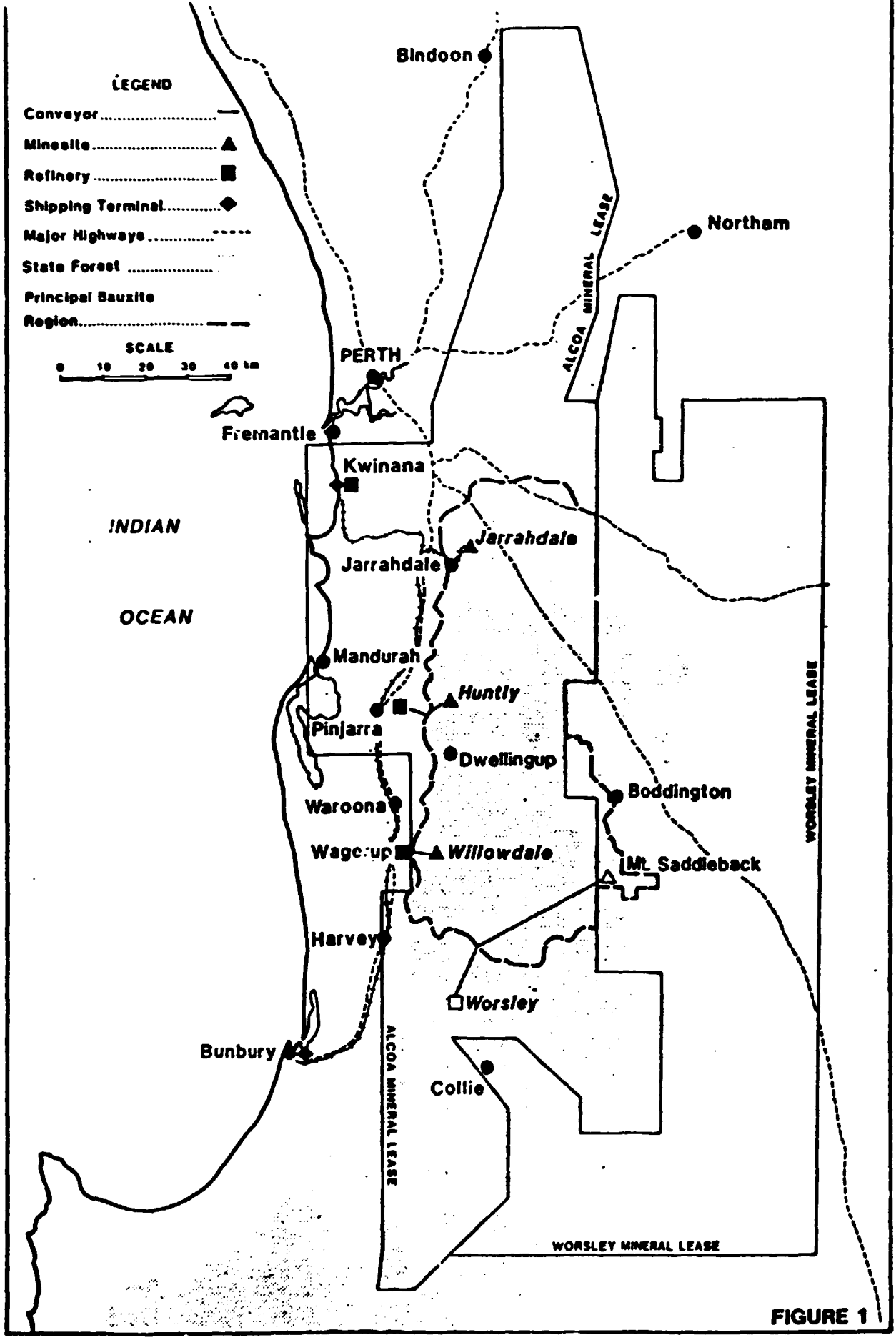


Figure 1 : Location

Power requirements will increase Alcoa will choose between another turbo-alternator, or a co-generation power unit, which would be far more efficient and would have the capacity to feed surplus power back into the SECWA grid.

2.6. Workforce

The construction workforce will peak at 850 over the 30 month period of construction, and the permanent workforce at the refinery is expected to increase by 88. Alcoa believes that, on past experience, most of the construction workers will, aided by a travel allowance, commute to the site, and that about 45-50 of the permanent workforce may settle in Waroona.

The expanded combined Willowdale - Wagerup production workforce will total 609 personnel.

3. Existing environment

While the Willowdale minesite lies within State forest, the refinery is at the foot of the Darling Scarp in cleared agricultural land. No further clearing at the refinery site is envisaged for Stage 2 and, while the rate of mining at Willowdale will increase, the overall area to be mined and rehabilitated remains the same as described and approved in the original ERMP. Similarly the residue ponds will be more quickly filled as a result of the proposed expansion, but the total volume to be disposed of is the same as originally proposed.

4. Submissions relating to Alcoa's Consultative Environmental Review

1. Five submissions were received; two from conservation bodies and three from government agencies. More detail on the points raised, and
2. Alcoa's responses, are compiled in Appendix II of this report.

Concerns raised centred around:

- the unquestioned assumption that a refinery expansion was good for Western Australia;
- aluminium recycling - lack of consideration of this issue;
- incremental impacts on greenhouse effect,
- dieback in the jarrah forest;
- residue pond rehabilitation;
- unclear procedures with regard to construction camps;
- likely impacts of the construction workforce;
- unclear direction with regard to supplementary water supplies; and
- forest management implications arising from the increased mining rate.

The Environmental Protection Authority has taken these points into account in its assessment and recommendations which follow.

5. Environmental impacts and management

Alcoa's operations in Western Australia are covered by a special agreement act from 1961.

A difficulty peculiar to projects which are subject to early State Agreement Acts is that they do not fall directly under the control of the Environmental Protection Act 1986. In order to remove this inconsistency Alcoa should come under the direct powers of the Environmental Protection Act, in the same way as other developers in Western Australia.

Expansion of refinery throughput means that the bauxite resource will be depleted sooner, although there are still reserves at the proposed 1.5 mtpa rate to ensure that the operation has a life of at least 50 years. The impacts though are expected to be less than were anticipated in 1978's ERMP because of design and technology improvements in the interim.

The proposed increase will require an additional 6,100 terajoules of natural gas each year, the consumption of which would create approximately 286,000 tonnes of carbon dioxide, or 1.3% of the total generated annually by the combustion of fossil and wood fuels in Western Australia. However the amount of carbon dioxide will be substantially lower than was envisaged in the 1978 ERMP (see Table 1) when three units were proposed for the refinery.

With regard to greenhouse gas emissions, the Wagerup plant is cleaner than most others because it is relatively modern and uses natural gas as its energy source. If expansion to meet projected world demands for alumina is considered acceptable, then the development of Wagerup Stage 2 with the capacity to co-generate power should be encouraged as an environmentally preferable technology.

A potential problem with the accelerated mining regime proposed is the implications for long-term forest management in the Samson, Driver, Hoffman and Waterous forest blocks. The fast-changing mining plans for these areas are not integrated with long-term fire protection and logging plans, and changes to scheduling of logging, mining and fire protection (buffer) zones may be required in order to avoid conflict. Increased mining rates will require forest dieback mapping in advance of clearing for exploration of mining, as well as actual logging of areas to be mined, and the sale of these products. Some of these activities may stretch the present resources of the Department of Conservation and Land Management.

The 50% increase in water requirements at the mine will be met by either upgrading the existing pipeline from Wagerup, or by constructing a new reservoir nearer to the mine. If the latter option is chosen there is the potential for environmental impacts, such as the blocking of a fish migration route, and the drowning of portion of a forested catchment, and the

proposal should be referred to the Mining and Management Planning and Liaison Group* for review.

Bauxite residue is generated from the refining process. Two tonnes (dry weight) are created for each tonne produced of alumina. This residue contains caustic liquor (sodium hydroxide) at a concentration of about 12 g/l. This alkali cannot be fully recycled and the storage and confinement of the residue presents a growing management problem at all of Alcoa's refineries. The uses to which these dumps can be put are restricted, even after stabilisation and revegetating. At Wagerup it is proposed to rehabilitate to pasture for stock grazing. The sealed ponds may become waterlogged with alkaline solution unless liquor is regularly pumped away to a refinery.The scale of bauxite mining and refinery projects and their long-lasting effects require that high priority be given to finding permanent solutions to the alkaline residue disposal lakes so that, upon cessation of mining and refining operations, there will be no requirement for ongoing management. This is similar to the requirements placed upon other mining operations.

6. Social impacts

The possible social impacts on the Waroona community from up to 850 construction workers and an extra 130 production employees have been based on the preferences shown by the workforce for Stage 1 of the refinery. Only about 38% of Alcoa's workforce currently lives in Waroona, with the remainder split mainly between Mandurah (32%), Harvey (11%), Pinjarra and Bunbury (14%).This data is taken from Alcoa's CER, Section 5.4. Using the 38% figure an extra 46 new employees might be expected to take up residence in the Waroona area, the current population of which is around 1,960. No estimates are given in Alcoa's CER of where the large construction force will be based, although again it is expected that most will commute to the Wagerup site from areas further afield. The company has indicated that it will seek to minimise any traffic disruptions during the construction phase.

In order to pre-empt potential problems Alcoa plans to undertake a community survey in conjunction with the Social Impacts Unit**. It is seen by the Authority to be important for Alcoa to maintain its good lines of communication with the community via the Shire of Waroona, through the construction phase and into production.

- The MMPLG consists of representatives from the Environmental Protection Authority, Water Authority of Western Australia and Departments of Conservation and Land Management. Its function is to rehabilitate and integrate them with other uses to minimise conflicts.

** This unit is directly responsible to the Deputy Premier and works closely with affected communities, developers and government agencies to identify and ameliorate the social impact of developments.

7. Conclusions and recommendations

The proposal is considered to be environmentally acceptable with the following recommendations.

Recommendation 1

The Environmental Protection Authority concludes that the Wagerup Refinery Expansion Proposal is environmentally acceptable and recommends that it could proceed provided that commitments given in the proponent's 1978 ERMP, 1978 ERMP Supplement and 1989 CER are followed, and subject to the following.

Recommendation 2

The Environmental Protection Authority recommends that Alcoa liaises closely with the Department of Conservation and Land Management throughout the project's life to ensure that mining schedules are integrated with that of forest management.

Recommendation 3

The Environmental Protection Authority recommends that all Alcoa's operations in Western Australia come under the jurisdiction of the Environmental Protection Act 1986.

Recommendation 4

The Environmental Protection Authority recommends that the proponent be required to set up a programme to develop a walk-away solution for the bauxite residue disposal across all three refineries, to the satisfaction of the Minister for Environment, within 12 months of the commissioning of this expansion.

Recommendation 5

The Environmental Protection Authority recommends that minimising of greenhouse gas emissions should be a major factor in the proponent's selection of energy generation options.

Recommendation 6

The Environmental Protection Authority recommends that Alcoa establishes formal liaison and monitoring processes with the Shire of Waroona to the satisfaction of the Environmental Protection Authority, upon advice from the Social Impacts Unit, to minimise social disruption to the Waroona district.

Recommendation 7

The Environmental Protection Authority recommends that the proponent should be responsible for decommissioning the plant and rehabilitating the site and environs of the expanded facility, to the satisfaction of the Environmental Protection Authority. At least six months prior to decommissioning, the proponent shall prepare, for the expanded facility and its site, a decommissioning and rehabilitation plan to the satisfaction of the Environmental Protection Authority.

Appendix 2

Submissions to CER and Proponent's Responses

Scope of Consultative Environmental Review

Question

The stated purposes of the CER "to outline any significant changes in the scope of the project in relation to the predicted impacts and changes in environmental management programmes, and to compare Alcoa's actual environmental management performance against the commitments made in the 1978 ERMP" (p2, CER) ignores many of the changes that have occurred in the last ten years. The mammoth changes in public attitudes and awareness of the environment, the emergence of information relating to the extremely serious nature of the greenhouse effect and the continuing decline of the jarrah forest from a variety of causes, put the current environmental review in a totally different context from the 1978 document.

Alcoa's response

Although there have been considerable changes in community attitudes towards the environment in recent years, the potential impacts of the mining and refining operations have not changed significantly. Indeed the magnitude of those impacts in most cases is expected to be substantially less than predicted in 1978 because of improvements in knowledge and/or management procedures since that time.

The only major issue not addressed in the original ERMP was the potential impact of Greenhouse gas emissions. This topic was discussed at some length in the CER and in earlier sections of this response to public submissions.

Alumina demand and recycling

Question 1

Aside from some subjective statements on the benefits to the community (and an absence of any mention of disbenefits) and a perceived inevitability of increased world demand and production of alumina, nothing is said of the need for the proposal. There is no mention as to where this demand arises from (ie what end uses the alumina has) nor of the possibility of reducing this demand with alternative (more environmentally benign) products and recycling. If the WA Government's statements on its commitment to sustainable development are true such questions should be addressed in the assessment of a "major development project" (p3, CER).

Question 2

Alcoa state that world demand for alumina is rising but they are not doing enough in WA to reduce this demand. Aluminium smelting is a very energy intensive process and it is also environmentally destructive because of the fluoride emissions produced by the smelter.

All forms of aluminium should be recycled to limit the destructive effects of bauxite mining and smelting. As the world's largest bauxite miners, Alcoa has a responsibility to set up an aluminium recycling plant in WA. Alcoa should take a lead in this area and this could be a requirement for the approval of the Wagerup expansion.

Alcoa's response

Demand for alumina is established by world markets over which Alcoa has little control. More than 80% of the alumina produced by Alcoa in Western Australia is smelted overseas. Most of the metal produced at Alcoa's smelters in Victoria is also exported. Although it is correct to say that the amount of energy required to produce primary aluminium is relatively high, the main uses of the metal are such that substantial net energy savings often occur over the life of the products involved. For example, the amount of aluminium in the average US passenger vehicle at the time of the 1973 oil embargo was about 37 kg. It is now 71 kg (American Metal Markets, October 6, 1989). Aluminium displaced up to 3.2 kg of ferrous metals in vehicles. The energy savings through reduced fuel consumption over the life of the vehicle is many times greater than the energy cost in producing the aluminium.

One of the major advantages of aluminium is its recycling properties. It is highly durable and can be recycled many times for applications such as beverage cans without loss of quality. The total energy requirement to recycle aluminium is less than 5% of that required to produce the primary metal. Approximately 27% of aluminium used in short life products in Australia is derived from recycling sources (Aluminium Development Council, Australia, 1989). More than half of the aluminium cans sold each year in Australia are recycled. This is a higher rate of recycling than for any other beverage container and is the highest recycling rate achieved by any voluntary system worldwide. About 1.3 million cans were returned in 1988 through Alcoa, Comalco and other voluntary recycling schemes. It is reasonable to expect that the proportion of recycled material will increase substantially as longer life products such as building materials and car parts become available as scrap.

Greenhouse impacts

Question 1

The proposed expansion will consume a considerable quantity of fossil fuel and will increase the State's output of carbon dioxide by 1.3% (286 000 tonnes of carbon dioxide per annum). In addition there will be further impacts due to the clearing of the forest, the energy inputs into the construction of the new plant and the additional mining activity. All of these should have been included in the greenhouse gas assessment of the project.

We are pleased however that Alcoa have done a Greenhouse impact assessment. Their attempt

suffers from many deficiencies such as those listed above. The EPA should require them to rework their analysis to include all sources of greenhouse emissions and commitments from Alcoa about how they plan to mitigate these effects. This should be a standard requirement in the assessment of all major industrial projects in future.

Alcoa themselves estimate that 6 million trees covering 12 000 hectares will be required to consume the additional carbon dioxide produced by this project. We believe that this is a substantial underestimate for the reasons stated above.

We request that Alcoa be required to supply at least 6 million additional trees to Greening Australia and other community tree planting groups if this project is approved. These trees should be in addition to those they already supply to compensate for carbon dioxide emissions at their other sites.

Question 2

It is recognised that some alternatives have been assessed in an attempt to limit greenhouse emissions. Commitments to energy efficiency and the use of gas rather than coal or oil are commended. However, there is no tandem assessment of the effect of carbon dioxide production and forest clearance (with the resultant decrease in CO_2 absorption) on the greenhouse effect. In fact there is no mention of forest clearance at all in this section; an omission that is unacceptable considering the significant clearing (100-110 hectares per year) that would occur.

Yet the CER states in length the many trees Alcoa have been responsible for planting. This results in a lack of the complete picture. How many of those trees are just replacing ones they previously removed?

Whilst we commend Alcoa's commitments to the Land Care project, it is disturbing to see the project used as a justification for environmentally damaging acts. Undertaking one environmentally responsible act does not constitute licence to destroy with the other hand.

Regardless of the comparative context in which greenhouse gas emission figures are presented, the fact remains that the expansion of the Wagerup refinery would be a significant contributor to greenhouse gas emissions in WA, and should be assessed as such.

Alcoa's response

The additional natural gas required for the operation of the expanded refinery dominates the energy consumption figures and hence Greenhouse gas emissions. Carbon dioxide emissions from additional mobile equipment at the Willowdale Mine are almost inconsequential by comparison (<4000 tonnes per annum, or approximately 1.4% of the total emissions).

Before clearing, merchantable timber and minor forest produce is removed from the site and utilized as building materials, fence posts, etc. Only the residual material is burnt. All mined areas are rehabilitated as soon as possible after mining, and usually within three years of initial clearing. Carbon accretion by the dense stands of regrowth in rehabilitated areas is expected to at least offset and probably exceed the amount of carbon released as CO_2 in the burning of waste material during clearing for mining. Alcoa has initiated a joint study with CALM to improve the utilization of wood material on areas scheduled for mining. A large-scale field trial is planned for January 1990. Longer-term clearing associated with conveyor alignments and other ancillary works is more than compensated by landscape, shelterbelt and commercial tree plantings on Alcoa farmlands.

Alcoa's approach to mitigating the effects of CO_2 emissions resulting from its use of fossil fuels is consistent with the recommendations of the Western Australia Greenhouse Coordination Council's discussion paper of November 1989: "Addressing the Greenhouse Effect" (refer Recommendation 10, page 19). In particular, Alcoa will:

1. continue to give close attention to energy efficiency in the design of the additional power station facilities, and to energy conservation throughout the plant;
2. jointly with SECWA, evaluate the viability of a cogeneration power facility;
3. continue to ensure that any land disturbed by the mining operations is fully revegetated, unless agreed otherwise with the relevant State agencies (eg to better suit recreational needs at a particular site);
4. minimize the amount of wood wasted in the clearing operations which precede mining;
5. increase the existing tree cover on Alcoa farmlands by establishing commercial plantations and large landscape/shelterbelt plantings where appropriate;
6. continue to support community-based tree planting and other land restoration projects through the Alcoa Landcare Project; and
7. continue to encourage the development of a conservation ethos within its workforce.

One submission suggested that Alcoa should be required to supply at least 6 million additional trees to Greening Australia. Alcoa believes this coercive approach is inappropriate, for the following reasons:

1. The Company has been the major sponsor of Greening Australia in Western Australia since 1983, and had a major involvement in community tree planting projects before then. Introducing a coercive element into what is already a successful community-based tree planting and land conservation programme is likely to discourage other potential sponsors from becoming involved, and dissuade Alcoa from further extending its own involvement in similar activities.
2. Alcoa has already committed itself to a major extension of its support for community-based tree planting and land conservation projects through the Alcoa Landcare Project announced in October this year. The project will establish at least 2.5 million trees over the next 5 years. The tree planting component of the project is

expected to continue well beyond 5 years.

One submission expressed concern that the Alcoa Landcare Project was being used as justification for the refinery expansion. The Alcoa Landcare Project is an extension of the Company's ongoing support for community-based tree planting projects. Tree planting is the primary objective of only one of the seven projects encompassed by the Alcoa Landcare Project. However, it also will be one of the desirable outcomes from five of the other six projects. None of the projects was planned with the objective of justifying the Wagerup expansion. The same submission questioned the number of trees planted as a result of Alcoa's community support and farming activities. The numbers quoted on pages 41 and 42 of the CER do not include trees established by Alcoa in the rehabilitation of land disturbed by its mining operations.

Rehabilitation of residue ponds

Question 1

The red mud ponds which Alcoa have produced at Kwinana, Pinjarra and Wagerup are ugly and hazardous. There have been extensive leaks from the Kwinana red mud ponds and these have polluted the local groundwater. The situation at Wagerup seems to be somewhat more satisfactory.

However, there is still no firm evidence available that these red mud ponds can be rehabilitated back to forest and farmland. The red mud is also radioactive and the radon and radiation levels over such areas could be too high for human habitation. The EPA should request Alcoa to undertake a major project, as a matter of urgency, to demonstrate that they can rehabilitate these red mud lakes. Radiation levels on the rehabilitated land should be carefully monitored.

Alcoa's response

Alcoa has a commitment to rehabilitate residue areas to productive land uses after decommissioning. Successful surface revegetation has been demonstrated at Kwinana on areas A,B and C (total area 90 ha) where grazing and vegetable growing have been successfully established. A 10 ha area at Pinjarra has also been successfully rehabilitated to pasture. The commitment for Wagerup is to rehabilitate residue areas back to productive farming use.

Since all residue areas are located on agricultural or industrial land, establishment of forest is not seen as an important objective of rehabilitation. Tree growing trials are in progress at Kwinana and Pinjarra and while early results are promising it is not expected that trees and shrubs growing on residue areas will serve more than an aesthetic or windbreak function.

Intensive studies were conducted in 1981 and 1989 on the background radiation levels associated with Alcoa's operations including residue disposal. These studies indicate that while small increases in radiation levels occur due to the presence of naturally occurring radioactive minerals in Darling Range bauxite, these increases are within acceptable public limits. Radiation levels are similar to those in existing urban areas along the Darling Scarp.

Ongoing monitoring of radiation levels within Alcoa's operations including rehabilitated residue areas is a part of the Company's extensive environmental monitoring program.

In line with the ALARA principle, Alcoa would not advocate re-use of residue areas for residential development while an alternative range of more appropriate land use options is available.

Impact on the jarrah forest

Question 1

To be able to operate in dieback infected areas is a privilege, not a right, and in many ways comprises the better interest of the public and the environment. It is therefore essential that this commitment be upheld.

Note: This statement refers to a commitment by Alcoa listed in their CER and reprinted below:

> 8.6 Alcoa will implement a comprehensive dieback management programme designed specifically for its mine operations in the jarrah forest. This will include the rehabilitation of dieback-affected areas adjacent to its mine operating areas, in accordance with procedures agreed with State agencies, and irrespective of the cause of introduction of the disease.

Question 2

Dieback is a major environmental problem in WA and bauxite mining is a major cause of this problem. Alcoa themselves admit this on page 15 of the CER. It is not sufficient to monitor the spread of dieback. They must make a major effort to control and reverse it. Alcoa should be required to make a substantial contribution to programmes to develop procedures for dieback control and prevention.

Alcoa's response

Alcoa does implement dieback management procedures in all forest areas in which it operates. The intensity of the measures taken varies according to the existing level of disease impact and the amount of uninfected or lightly-infected forest at risk. It is not practicable to implement stringent dieback management procedures in areas where the existing disease impact is high, especially where access to the area prior to mining has not been restricted. In these circumstances it is generally not possible to establish disease boundaries with any degree of reliability. However, basic disease management measures are still undertaken.

Alcoa has actively pursued research into dieback disease and the development of control and rehabilitation procedures for the last 11 years. During that time, more than $2.5 million has been

expended on research and development, $1.4 million in the funding of research by other organizations. As the major sponsor of the Foundation for Jarrah Dieback Research, Alcoa has made a substantial contribution to knowledge on dieback and the developments of methods for controlling the disease (refer Landscope, Spring 1989, 38-44). In addition, Alcoa funds the rehabilitation of all dieback affected areas in the vicinity of its operations, regardless of the cause or introduction of the disease. The bulk of the areas rehabilitated were infected prior to the commencement of any mining activity.

Conservation areas

Question 1

The phrase "for as long as their conservation values remain" causes considerable concern. A representative example of an ecosystem has an increasing conservation value as surrounding areas of that ecosystem are destroyed unless the conservation values are compromised by an outside influence, be it a direct disturbance or the destruction of a connecting corridor. This qualifier should be removed from the commitment.

Question 2

We would like to use this opportunity to express our dissatisfaction that the Lane-Poole Reserve is still not a national park. We do not believe that this proposal should be approved until Alcoa is prepared to allow the creation of the Lane-Poole National Park. The northern jarrah forest is an important ecosystem which should be protected in a national park and the Conservation Council has long maintained that the Lane-Poole Reserve should be given national park status.

Alcoa's response

The qualification refers to the unlikely possibility of a major deterioration of conservation values within the reserves, not outside them. The conditions under which bauxite mining might be considered (after a major deterioration in conservation values) were defined by the State's Reserves Review Committee, and ratified in the Alumina Refinery Agreement Amendment Act No.99 of 1986. Any decision to allow mining to proceed would be made jointly by the Ministers for Resource Development and Conservation and Land Management, based on the recommendations of an environmental review committee which would include representatives of the National Parks and Nature Conservation Authority, the voluntary conservation movement and Alcoa.

Alcoa has worked cooperatively with State agencies, other forest users and representatives of the conservation movement to facilitate the establishment of a comprehensive network of A Class conservation reserves within its mineral lease (refer Figure 5 of CER). After several years of areas recommended for conservation by the EPA in its System 6 duty report of 1983. Any decision to change the current status of Lane-Poole Reserve is the prerogative of the State Government. Expansion of the Wagerup refinery in no way affects that decision.

Lane-Poole is the largest of the reserves in Alcoa's mineral lease. Excluding recently agreed additions such as the Stene conservation area, Lane-Poole comprises approximately 54,400 ha of which 80% is zoned for conservation and 20% is zoned for recreation. The recreation zone contains about 80 million tonnes of bauxite on the lateritic upland flanking the Murray River Valley. As indicated in the CER, Alcoa has agreed not to extend its bauxite mining operations into the conservation areas of Lane-Poole Reserve, but has retained the right to mine in the recreation zone, subject to agreement on appropriate management plans to minimize impacts on recreational values. Alcoa has no objection to the main body of the conservation zone of Lane-Poole Reserve being declared a national park, but believes that inclusion of the whole recreation zone would be inconsistent with the Company's right to access the bauxite in that zone.

Mining in the salt risk zone

Question

In relation to the commitments and changes thereto, I would like to raise the following points:

8.2 The insertion of the word "bauxite" into this commitment considerably changes its nature. With the absence of "bauxite" from the original commitment, Alcoa's gold mining operations (Hedges Gold Mine) in the low rainfall area contravene it. I find it difficult to comprehend the difference in the impacts on salinity dependent upon whether the forest is cleared for bauxite or gold mining. Given that the original commitment was in relation to "mining", why has gold mining been permitted?

Alcoa's response

The word bauxite was added to reflect the reality of the existing situation, whereby a range of different mining operations already exist in the eastern part of the jarrah forest (eg coal mining east of Collie, gold mining near Boddington and Worsley Alumina's bauxite mining at Mt Saddleback).

Addition of the word bauxite is relevant in a legal sense, in that the Alumina Refinery Agreement (Alcoa) Amendment Act No.86 of 1987 effectively restricts Alcoa's rights in Mineral Lease 1SA to the mining of bauxite. Alcoa does not have the right to mine other minerals unless the area of interest is first excised from Mineral Lease 1SA and a separate lease is granted. Any proposal to mine in the separate lease would be subject to the environmental assessment provisions of the Environmental Protection Act 1986.

The original commitment in the Wagerup ERMP of 1978 was made in the context of a proposal involving relatively extensive bauxite mining operations. Alcoa believes that small localized operations such as the gold mining operations near Boddington, or more

extensive operations located outside existing or potential water supply catchments, should be assessed individually. They should not be considered in the same context as Alcoa's bauxite operations. This was the case with the Boddington and Hedges Gold projects, which were assessed under separate ERMPs in 1985 and 1987 respectively.

Management of rehabilitated areas

Question

Who decides when the time has come for CALM to assume full management responsibility? Do the public get a say?

Alcoa's response

The current proposal is that a set of criteria will be developed by CALM with input from Alcoa's consultants. CALM will decide which of the areas nominated by Alcoa meet the agreed criteria.

Water supply

Question

The Water Authority of Western Australia considers that Section 3.5 of the "Review of the Expansion to Wagerup Alumina Refinery, and Compliance with Approved Conditions" is inadequate.

Under the Act, the Company is "entitled to a first call on surface water from sources situated within the Wagerup Refinery Site".

The source of the extra water requirements for the proposed extensions to the refinery is Samson South Drain, which traverses the refinery site. Winter flows will be diverted to make up any shortfall from existing sources. There is no specified quantity range for this diversion, nor the percentage of annual total flow volume for the drain in question. The report also does not address the method of handling the additional wastewater which will result from the refinery extension.

Similar comment relates to the discussion of mine site water requirements where no mention is made of source or disposal of wastewater.

Alcoa's response

The Alumina Refinery (Wagerup) Agreement and Acts Amendment No.15 of 1978 gave approval for a 2 million tpa refinery. The purposes of the CER were to compare Alcoa's actual environmental management performance against the commitments made in the 1978 ERMP and to outline any significant changes in the scope of the project in relation to predicted impacts and consequent changes in the environmental programmes put forward in that document. The additional water supply requirements outlined in the CER are substantially less than projected in the 1978 ERMP.

At its current rated capacity of 0.84 million tpa the Wagerup Refinery utilises 2900 ML of fresh makeup water annually. With the expansion of the refinery to 1.5 million tpa this will increase to 4500 ML/A.

At present, makeup water is sourced from stormwater runoff from the plantsite and residue areas and surface runoff from the local catchments of North and South Yalup Brooks. All of the flow from South Yalup Brook is captured and stored in two dams across its valley within the plant boundary. Part of the flow of North Yalup Brook is also diverted into the dams by a small diversion dam and pipeline. The proportion of the winter flow from North Yalup which is utilised depends upon the amount required to top up the dams and the flow which is available, but for average weather conditions is around 60%. This withdrawal does not affect any downstream users as the stream is located on Alcoa property until it joins the Samson South Diversion Drain which itself traverses Alcoa property prior to discharging into the much larger Harvey Main Drain on its way to the Harvey Inlet.

To meet the water requirements of the expanded refinery it is planned to utilize excess winter runoff from the Samson South Diversion Drain. A detention pond already exists on the drain, adjacent to the residue disposal areas. It has a storage capacity of around 1000 ML. A pump station will be constructed on this pond to enable transfer of water to the refinery.

During average runoff years only around 250 ML of Samson South water will be required, representing about 10% of the winter flow. During multiple drought years as occurred during 1978-79, up to 60% of the winter flow could be required. The water utilized from Samson South Diversion Drain will be winter rainfall runoff which would otherwise flow into the Harvey Main Drain and is not used by others. It should be noted that a large amount of additional surplus winter runoff could be diverted into Samson South Diversion Drain from McKnoes or Drakes Brooks if required.

A projected water balance for the refinery is given in the attached table. The water balance accounts for a future conversion to dry residue disposal.

As indicated in the CER, all wastewater from the refinery will be collected and recirculated to minimize make-up water requirements. There will be no discharges of wastewater to natural streams or the drainage network associated with the local irrigation scheme.

One submission referred to the lack of a firm proposal to meet the water requirements for the expanded Willowdale Mine. These water requirements are substantially lower than projected in the 1978 ERMP. The original proposal was for a number of small water holes on streams close to the mining operations (as currently exist at the Jarrahdale Mine). This was subsequently discarded in favour of a pumping scheme from the refinery water supply reservoir. Two options are currently under consideration to meet the long-term requirements for the expanded mine:

- upgrade the existing pumping system from the refinery; or
- construct a small weir on a stream closer to the centre of the mining operations (as currently exists at the Huntly mine).

The second option requires consideration by the State's Mining and Management Program Liaison Group before it can be further evaluated.

Review of environmental research and management programs

Question

8.10 Will the documents referred to in this commitment be publicly available?

Note: The commitment referred to is re-printed below.

Alcoa will submit a brief review of its environmental research and management programme to the Department of Resources Development on an annual basis. Copies will be made available to relevant State agencies and the Shire of Waroona. A more detailed review will be prepared on a triennial basis.

Alcoa's response

One submission questioned the availability of the annual and triennial reviews of environmental research and management programs. These reviews are circulated to relevant State agencies by the Department of Resources Development. The more detailed triennial reviews are available for perusal by the public in the EPA library.

Social impacts of the construction workforce

Question

The Social Impacts Unit has reviewed the consultative Environmental Review document prepared by Alcoa of Australia and offers the following comment. The Company has generally covered the social impact requirements of the guidelines originally issued.

The benefits to the State and local area are well recorded and satisfactory analysis of demographic data and impacts relating to housing requirements and services has been undertaken.

However, the document does not give clear plans or procedures relating to the construction phase especially in relation to the operation of construction camps by sub-contractors and the impact of up to 800 workers.

For this reason, the Unit strongly believes that Alcoa's commitment to the establishment of liaison and monitoring processes with the Shire of Waroona be formalised as a condition relating to approval, if forthcoming.

It is important that the Company and Council liaise closely during the construction phase to enable the issues relating to the impact of construction camps and workers to be resolved <u>before</u> any problems arise. The Unit will assist in this regard.

Alcoa's response

As indicated in the CER, Alcoa's experience has been that the majority of construction workers will prefer to commute rather than live in a construction camp. Alcoa has a well established liaison process with the Shire of Waroona and will ensure that potential issues related to the impact of construction camps and workers are addressed before significant problems arise.

Dismantling of facilities

Question

Who decides on what is a "reasonable restoration measure"?

Alcoa's response

The State agency responsible for the administration of the Alumina Refinery (Wagerup) Agreement is the Department of Resources Development. It is envisaged that the Department would coordinate the planning of the dismantling and restoration measures, taking due account of land-use priorities identified in regional management plans and the views of the landowner (Alcoa) and relevant State and local authorities. Both Alcoa and the Department are cognisant of the environmental protection responsibilities outlined in Clause 17 of the Agreement.

WAGERUP REFINERY - WATER BALANCE

1) USES :

	Present Capacity (2300 tpd) (ML/A)	Unit 2 Capacity (4000 tpd) (ML/A)
Plant Evaporation	367	639
With Residues	1147	1994
Mine Use	60	90
Cooling Evaporation	400	700
Natural Evaporation from Residue Areas	904	904
Drying Area Dust Control	- -	120
TOTAL :	2878	4447

2. SOURCES :

a) Internal

Bauxite Moisture	252	438
Caustic Water	55	96
Plantsite Runoff	425	425
Rainfall Runoff Residue Areas	620	1230
SUB TOTAL	1352	2189
Net External Requirement	1526	2258

b) External Sources

		Av. Year	Dry Year 1:10
Yalup Brook	1526	2000	1300
Samson South Drain	-	258	942

1) Assumes "Average" weather conditions except as otherwise noted.

2) All figures are approximations only.

WAGERUP ALUMINA REFINERY EXPANSION - COMMITMENTS

All but one of the major environmental management commitments made in the supplementary Environmental Review and Management Programme of 1978 are still considered relevant. Alcoa believes its commitment to dieback research is adequately covered in Item 6.4, repeated below as 9. There is no continuing justification for dieback research to be considered separately. Additional or modified commitments are proposed in the areas of residue disposal, dieback management and forest conservation. A restatement of the major environmental management commitments is given below. The proposed changes (printed in heavy type) mainly reflect the importance placed on these issues in Alcoa's current environmental management programme.

(1) In addition to the 10-year mining plans to be submitted to the State under Clause 5 of the Wagerup Agreement, Alcoa will also prepare and submit to the State mining and management programmes which will specify such matters as the areas which it is proposed to mine, the method of mining, and the proposed methods of rehabilitation in accordance with procedures to be agreed between Alcoa and the State. Alcoa undertakes to consult closely with the State on the preparation of these programmes and not to implement these programmesuntil agreement to them has been reached with the State or they have been determined by arbitration.

(2) Bauxite mining will not take place in the eastern, lower rainfall portion of Alcoa's lease, until research shows that mining operations can be conducted without significantly increasing the salinity of water resources.

(3) Alcoa undertakes to formulate its detailed rehabilitation proposals to best suit the land use priorities established by the State for the particular mining area concerned.

(4) Alcoa will monitor the success of all its rehabilitated mined areas in co-operation with the Department of Conservation and Land Management and, if necessary, is prepared to carry out further treatments up to the time when it is agreed that CALM should resume full management responsibility.

(5) **Alcoa will forego the bauxite resources in the Jarrah forest conservation areas agreed in consultation with the State's Reserves Review Committee and specified in the Alumina Refinery Agreement Amendment Act, No 99 of 1986, for as long as their conservation values remain. Mining adjacent to the conservation areas will utilise site-specific environmental management procedures agreed in consultation with the Mining and Management Programme Liaison Group. These will include particular consideration of dieback management and mine rehabilitation requirements.**

(6) **Alcoa will implement a comprehensive dieback management programme designed specifically for its mine operations in the Jarrah forest.** This will include the rehabilitation of dieback-affected areas adjacent to its mine operating areas, in accordance with procedures agreed with State agencies, and irrespective of the cause of introduction of the disease.

(7) **Alcoa will prepare detailed design reports on future residue disposal areas and submit them to the Water Authority of Western Australia for approval. The design reports will include consideration of slope stability, seepage control, groundwater monitoring and construction and operating procedures. Results from monitoring programmes will be reported to the Water Authority at intervals determined by agreement with the Authority.**

(8) **Alcoa will develop long-term management plans for the residue deposits including consideration of surface drainage, seepage control, groundwater management, slope stability, surface rehabilitation, aesthetic impact and future land use. Such plans will be formulated in consultation with relevant State agencies and will include agreement with the State on responsibilities for any ongoing management requirements after decommissioning of the refinery. Concept plans will be formulated by 1994 and reviewed periodically**

thereafter. Alcoa will recover and treat or reuse alkaline solutions in the residue disposal areas until such times as it is demonstrated that such solutions do not pose an environmental hazard.

(9) Alcoa is committed to an ongoing research programme into all aspects of its operations that have the potential to adversely affect the environment, and into those environmental characteristics that could be adversely affected by its operations.

(10) **Alcoa will submit a brief review of its environmental research and management programme to the Department of Resources Development on an annual basis. Copies will be made available to relevant State agencies and the Shire of Waroona. A more detailed review will be prepared on a triennial basis.**

(11) Alcoa will co-operate in a joint community services monitoring programme in conjunction with the State and the Shire of Waroona to monitor socio-economic effects of the project and provide input for community services planning.

(12) Alcoa will dismantle its facilities at the termination of mining and refinery operations and carry out reasonable restoration measures at the sites of those operations providing such facilities are not required for other purposes.

BULDOBWAGERUP:clb

BAUXITE/ALUMINA/ALUMINIUM PRODUCTS TONNES AND REVENUES - CURRENT & POTENTIAL

VOLUME

(million tpa for all except semis etc which are 10,000 tpa)

	TRANSFER FOR PROCESS	EXPORTED	IMPORT REPLACEMENT	LOCAL CONSUMPTION
BAUXITE				
current	7.06	3.87	0	0
proposed	7.766	3.87	0	0
ALUMINA				
current	0	2.87	0	0
proposed	0	3.157	0	0
ALUMINIUM				
current	0	0	0	0
proposed	0	0	0	0
SEMI & FINISHED PRODUCTS				
current	0	0	0	0.1
proposed	0	0	0.13	0.1

REVENUE

(US$million pa except semis etc which are US$10,000 pa)

	ASSUMED UNIT RATES (US$/tonne)	EXPORTED	IMPORT REPLACEMENT	LOCAL CONSUMPTION
BAUXITE				
current	11.9	46	0	0
proposed	11.9	46	0	0
ALUMINA				
current	200	574	0	0
proposed	200	631.4	0	0
ALUMINIUM				
current		0	0	0
proposed		0	0	0
SEMI & FINISHED PRODUCTS				
current	2500	0	0	250
proposed	2500	0	325	250

FIGURE 1

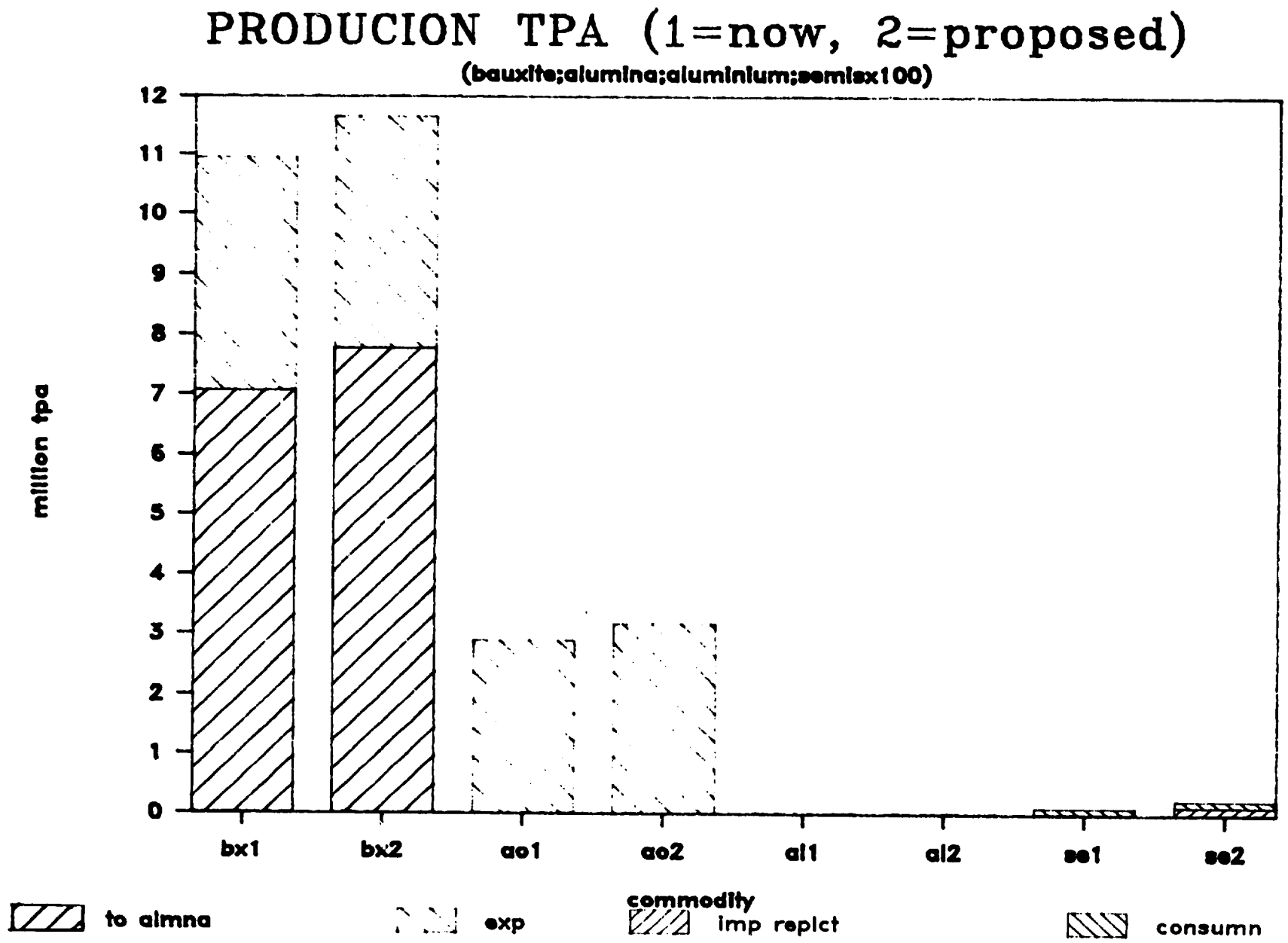
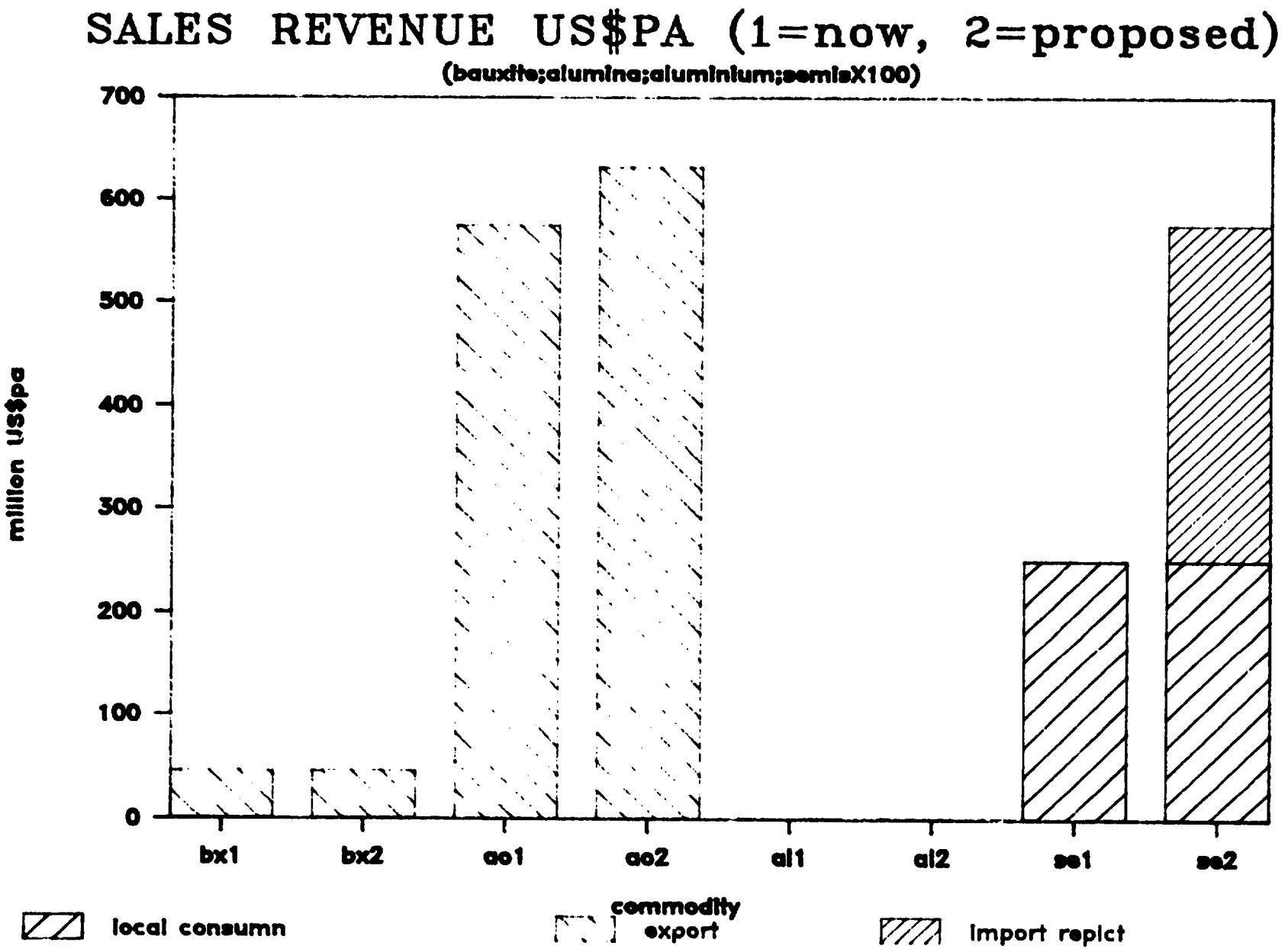

PRODUCION TPA (1=now, 2=proposed)
(bauxite;alumina;aluminium;semisx100)
million tpa
12
11
10
9
8
7
6
5
4
3
2
1
0
bx1
bx2
ao1
ao2
al1
al2
se1
se2
commodity
to almna
exp
imp replct
consumn

FIGURE 2


SALES REVENUE US$PA (1=now, 2=proposed)
(bauxite;alumina;aluminium;semisX100)
700
600
500
400
300
200
100
0
million US$pa
bx1
bx2
ao1
ao2
al1
al2
se1
se2
local consumn
commodity export
import replct