Environmental Impact Assessment of the Phase 2 Expansion of the Matola Port Terminal and Mozal Aluminium Smelter

VOLUME 1: DRAFT EXECUTIVE SUMMARY

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Table of Contents

Table of Figures

This Draft Executive Summary (CSIR Report No. ENV-S-C 2000-092D) was prepared for the International Finance Corporation (IFC) and the World Bank. The report contains the same technical information as the report titled Draft Summary Report (CSIR Report No. ENV-S-C 2000-092A). Additional explanatory text has been added and the document has been formatted according to the IFC requirements.

Summary of conclusions and recommended management actions

Mozal, the Mozambican Aluminium Company, is presently developing the first phase of a two-phase aluminium smelter project at the Beluluane Industrial site, 21 km west of Maputo. Mozal is now undertaking a feasibility study of the Phase 2 expansion. The Phase 2 expansion involves the construction of a second pot-line at the smelter which will result in the doubling of capacity from 253 000 tonnes of aluminium per annum to 506 000 tonnes per annum. The port terminal expansion will include the construction of one additional ship unloader, one additional 45 000 tonne alumina storage silo and two to four new 3000 tonne heated storage tanks for storing imported liquid pitch. All expansions at the smelter will take place within the existing Mozal boundaries and no additional land is required. Some additional land at the port terminal will be required for the construction of the liquid pitch tanks.

This report has been prepared to achieve three main objectives with respect to the assessment of the Phase 2 expansion, namely:

1. A summary of the description, assessment, recommended and actual mitigation actions for the two previous environmental impact assessments that were undertaken for Phase 1 and 2 of the Mozal smelter (1996) and Phase 1 of the Matola port terminal (1998);
2. An update of four specialist studies undertaken for the environmental impact assessment of Phase 1 and 2 of the Mozal smelter;
3. An environmental impact assessment of the impacts associated with the construction and operation of Phase 2 of the Matola port terminal to support the Phase 2 development of the Mozal smelter.

Summary of previous EIA's

The detailed summary of the previous two environmental impact assessments undertaken in 1996 and 1998 for the Mozal smelter and Matola port terminal respectively is contained in Appendix 2 of the Main Report (Volume 2) for the Phase 2 expansion. These assessments addressed in detail alternative sites for both the smelter and port locations. The impact description, assessment and recommended and actual mitigatory actions are summarized for each issue that was investigated. This summary allows the reader to obtain an overall perspective of the environmental assessments and actual management actions undertaken for the Mozal project.

Updated studies

Eleven specialist studies for the environmental impact assessment of the smelter in 1996. Seven of these studies comprehensively addressed all relevant environmental aspects of Phase 1 and 2. Four of these studies have been updated for this report. These are:

- Mass Balance and Materials Handling Study (Geyer and Butler, 1996);
- Storm Water Management Study (van Ballegooyen, Luger and Monteiro, 2000);
- Socio-economic study (Berns, 1996);
- Social Impact Assessment (Wamukoya et al, 1996, ACER Africa, 1998 and Berns, 1996).

Mass balance and materials handling study:

The 1996 solid waste volumes for the Mozal smelter were based on empirical estimates. Actual waste management data from the Hillside smelter in South Africa was used to update these estimates. These data were not available for the 1996 assessment as the Hillside smelter was only commissioned in 1996. Using these data, the review of waste management on the smelter site indicated that approximately double the amount of solid waste would be produced than initially predicted. Although the predicted solid waste has doubled, waste generated per ton of product (0.055 tonnes of waste per ton of aluminium) is relatively low when compared to other metallurgical processes (e.g. steel manufacturing and chrome smelting).

All waste streams have been identified, quantified and classified according to the relevant legislation. Discussion between Mozal, the Mozambican Government, a waste management contractor and their consultant were held and temporary and permanent waste disposal solutions were developed.

Storm water management study:

The review of storm water management indicates that a specific management strategy must be implemented to ensure that the World Bank guideline for fluoride levels in storm water will be adhered to, and no significant impacts will result in the receiving water of the Matola River.

Economic study:

The review of the economic assessment indicates that the 1996 predictions were generally accurate, with actual employment levels during Phase 1 construction being higher than predicted, actual employment levels during Phase 1 operations being less than predicted, tax revenues lower and contribution to the Gross National Product slightly higher.

Social impact assessment:

The review of the 1996 social assessment indicates that the recommended mitigation actions for the predicted social impacts were generally well implemented. The 1996 assessment identified that compensation for loss of grazing and crop production would have to be provided and that no involuntary resettlement was required on the Mozal site. Subsequent to the approval of Mozal, the Government of Mozambique proclaimed the area surrounding Mozal as an industrial park (Beluluane Industrial Park). As a result, resettlement of residents within the boundaries of the industrial park became necessary. Mozal as the project sponsor provided US$ 1 million to assist the Mozambican Government who is responsible for resettlement, with the resettlement process. The review concluded that resettlement has been undertaken efficiently and in accordance with the World Bank procedures on involuntary resettlement.

Phase 2 EIA

Finally the environmental and social impacts associated with the construction and operation of Phase 2 of the Matola port terminal are assessed. The specialist studies included the following assessments:

- Traffic Assessment
- Noise Assessment
- Economic Assessment
- Vehicle emissions Assessment
- Socio-economic Assessment

No significant impacts are predicted and appropriate mitigation actions are recommended for negative impacts and enhancement measures for positive impacts.

It is concluded that with the implementation of the management actions as discussed below the fully implemented Mozal project (Phase 1 and 2) will comply with or exceed local regulations and World Bank/IFC policies, guidelines and standards.

Environmental Management Programme

Recommended management and monitoring actions are contained in the following table. The recommendations originate from the updated reviews of the four specialist studies undertaken for the initial assessment of the smelter in 1996, and the assessment of the Phase 2 expansion. Each environmental aspect is briefly described, after which an appropriate management and monitoring action is recommended.

Mozal will ensure that the recommended management and monitoring actions contained in the following table are included as part of the existing environmental management programme that has been compiled for the construction and operation of Phase 1 of the smelter and port terminal development. The present on-site environmental officer will be responsible for integrating these management actions into the existing management programme and will be responsible for ensuring that the required actions are implemented. Mozal will appoint a third party to undertake periodic audits of the environmental management programme.

The purpose of the environmental management programme is to make sure that, in implementing the phase 2 developments, negative environmental impacts are managed and monitored, positive impacts are maximised and affected areas are rehabilitated. Furthermore, the environmental management programme ensures that:

- Recommendations contained in the environmental impact assessments are effected during the implementation of the project;
- Outstanding issues from the environmental impact assessments are addressed;
- Assumptions contained in the environmental impact assessments are tested and verified;
- Provision is made for the evolving nature of the project without compromising on the environmental management requirements of changes in project scope.

The effectiveness of the environmental management programme is principally a function of the degree of implementation of the environmental management actions described in the following table.

Ongoing public participation will continue throughout the phase 2 construction and feedback meetings will be held to communicate the progress of the implementation of the recommended management and monitoring actions.

Environmental Management Programme: Management and monitoring actions

Environmental aspect	Management and monitoring actions
Fluoride contaminated solid waste disposal.	The composition of all fluoride-containing wastes will be analysed to confirm relevant classification and appropriate disposal method.
Hazardous waste disposal.	Dispose of class G and H:h wastes in mono-cells at the temporary land fill in Matola once the Mozambican Government has permitted the site and on condition that the waste is treated according to the South African Minimum Requirements for the Handling, Classification and Disposal of Hazardous Waste. Continue discussions with the Mozambique Government with respect to the establishment of a permanent waste disposal site for class H:H and H:h waste. Spent potliners (SPLs) to be stored in special purpose buildings until recycling methods are determined. The Hillside aluminium smelter in South Africa is at an advance stage with respect to recycling of SPLs via the cement industry. Mozal may be able to use this as a model for recycling of SPL in Mozambique.
Fluoride and sulphur dioxide emissions.	Mozal will monitor fluoride emission as recommended in the initial environmental impact assessment and will initially monitor SO_2 emissions to verify the dispersion modelling results and obtain baseline data.
Fluoride contaminated storm water management.	Implement the 3-step storm water management strategies as recommended. Monitoring programme to include: • Model verification monitoring • Operational phase compliance monitoring • On-site monitoring Controlled mixing of fluoride contaminated storm water with waste process water if concentration is above standard due to unforeseen operational circumstances such as an accidental spillage during a first flush rain event, or after a prolonged dry period.
Congestion as a result of increased traffic.	Traffic authorities to monitor road intersections. If in the longer term delays at the right turn from the Mozal access road into the EN4 (N-S) become excessive, the introduction of traffic signals should be considered to alleviate the situation.
Decrease in traffic safety as a result of increased traffic.	The measures yielding the greatest benefits for the reduction of road accidents are speed control, improved visibility, lane demarcation and forewarning. Enforcement of traffic rules and roadworthiness will also improve traffic safety. Mozal has provided radar speed control equipment, while traffic authorities need to implement speed control and other measures. All Mozal drivers will attend a safe driving programme.

Environmental aspect	Management and monitoring actions
Increase in noise as a result of the operation of construction equipment during construction of additional port facilities.	Mozal will: • Keep all equipment in good working order, • Operate equipment within its specification and capacity. • Operate equipment with appropriate noise abatement accessories. • Operate equipment in as diversified manner as possible. • Turn equipment off when not in use. • Position equipment in sheltered locations. • Utilize partly finished buildings to accommodate equipment. • Carefully select times when the environment is least sensitive to noise impact.
Increase in noise due to Mozal haulage operations along the Matola port access road and related nuisance effects on local residents.	Mozal will initiate discussions with CFM (Mozambican Ports and Rail Authority) with respect to the possible measures to mitigate the noise impact. Two options exist: 1. A technical solution (noise barrier etc) and/or 2. Voluntary resettlement/compensation of the residents located adjacent to the port terminal access road in the Matola port industrial area, If voluntary resettlement is agreed it will be the responsibility of CFM to ensure that a resettlement action plan is drafted and implemented according to World Bank procedures. Mozal will closely monitor the process to ensure that full compliance with the World Bank directive is adhered to. Noise level monitoring along the Mozal and Matola access roads during the operational phase should be implemented to verify predicted noise levels. If necessary additional technical mitigatory measures may be investigated.
Cumulative noise as a result of all traffic on the Maputo Corridor.	Mozambican Government to investigate the need to monitor noise levels along the Maputo Corridor. Mozal will: • Mozal will permanently disable all exhaust brakes on trucks. The operational functions and safety of the vehicles will not be affected by this, however, wear of brake shoes and brake drums will increase. • Mozal will ensure that vehicles are maintained to ensure that noise abatement devices like exhaust mufflers, engine hoods and motor brakes etc. are in good condition and working order. • Mozal will provide education for truck drivers about the characteristics of diesel engines, i.e. that the flat torque characteristic allows the truck to climb an incline in a higher gear, which generates less noise.
Vehicle emissions from Mozal haulage operations.	Mozal will ensure that fleet vehicles are well maintained, thereby keeping emissions to a minimum.
Cumulative vehicle emissions as a result of all traffic on the Maputo Corridor.	Mozal will encourage the Mozambican authorities to enforce stricter roadworthiness control of vehicles. The authorities should also ensure that motor vehicle emission legislation be strengthened and enforced. Mozal, together with the Mozambican Government should investigate the possibility of conducting a monitoring programme of CO and NO_x. Such a monitoring programme should be co-ordinated with the Trans African Concessions (TRAC), operators of the Maputo Development Corridor.

Environmental aspect	Management and monitoring actions
Mozal phase 2 construction and operation will provide job opportunities, improvement in skills base, and business opportunities for local Mozambican companies.	Mozal will continue to give preference to local Mozambican workers. Training will be provided for workers and SMME development will be encouraged through the existing structures of the Mozal Community Development Trust. Monitoring to include levels of local employment, training programmes and SMME involvement.
Increase in HIV/AIDS and sexually transmitted diseases and malaria.	Mozal will continue to implement malaria eradication programme and HIV/AIDS awareness on site and within the surrounding communities through the structures of the Mozal Community Development Trust.
Mozal Phase 2 construction will result in secondary impacts such as an ongoing process of land alienation and an increase in conflict in households and a reduction in the level of poverty.	Mozal will work with the Mozambican Government toensure that the Boane District Planning Framework is communicated and implemented to ensure that secondary impacts are mitigated. Mozal will initiate a programme to support NGO's that can support vulnerable community groups through the Mozal Development Community Trust.
Resettlement for Beluluane Industrial Park.	Mozambican Government with support from the Mozal Community Development Trust to continue to implement agricultural development programme and village management programme. A 4 year monitoring and evaluation programme of the resettlement has been initiated and is set to continue.

1 Background

Mozal, the Mozambican Aluminium Company, is presently developing the first phase of a two-phase aluminium smelter project at the Beluluane Industrial site, 21 km west of Maputo (Figure 1) at a cost of US$ 1.18 billion. The development includes the construction and operation of the Matola port terminal and the Mozal aluminium smelter (Figure 2 and Figure 3).

Two environmental impact assessments of the smelter and the port terminal were previously conducted and approved by the Mozambican Environmental Authorities - Ministério Para A Coordenação Da Acção Ambiental (MICOA) and reviewed by the IFC in 1997 and 1998 respectively. These studies included the assessment of alternative sites for both the smelter and the port locations and are as follows:

- Environmental impact study of the Mozal aluminium smelter (CSIR Report No. ENV/P/C 97092). This study addressed both Phases 1 and 2 of the Mozal smelter development and was completed in 1996;
- Environmental impact study of the Mozal Matola port terminal (CSIR Report No. ENV/S/C 98058 C). This study addressed only Phase 1 of the port development and was completed in 1998.

An Environmental Management Programme (EMP) that includes the recommended management and monitoring actions provided by the above two assessments has also been compiled and implemented during the construction stages of both Phase 1 developments of the smelter and port terminal. An EMP for the operational phase has been compiled according to the ISO 14001 Environmental Management System standard.

Mozal now intends to develop the second phase of the aluminium smelter and port terminal at a cost of US$ 0.8 billion to allow for increased aluminium production. As a result Mozal is undertaking a study to assess the feasibility of the proposed second phase expansion. Mozal appointed the CSIR to undertake an environmental impact assessment of the second phase of the proposed port expansion and to review four of the specialist studies undertaken for the 1996 assessment of the Mozal smelter development. The environmental impact assessment forms an integral part of the feasibility study and has been undertaken in accordance with the Mozambican Environmental Regulations No. 76/98 and the World Bank Operational Procedures for Environmental Assessments (OP 4.01, 1999).

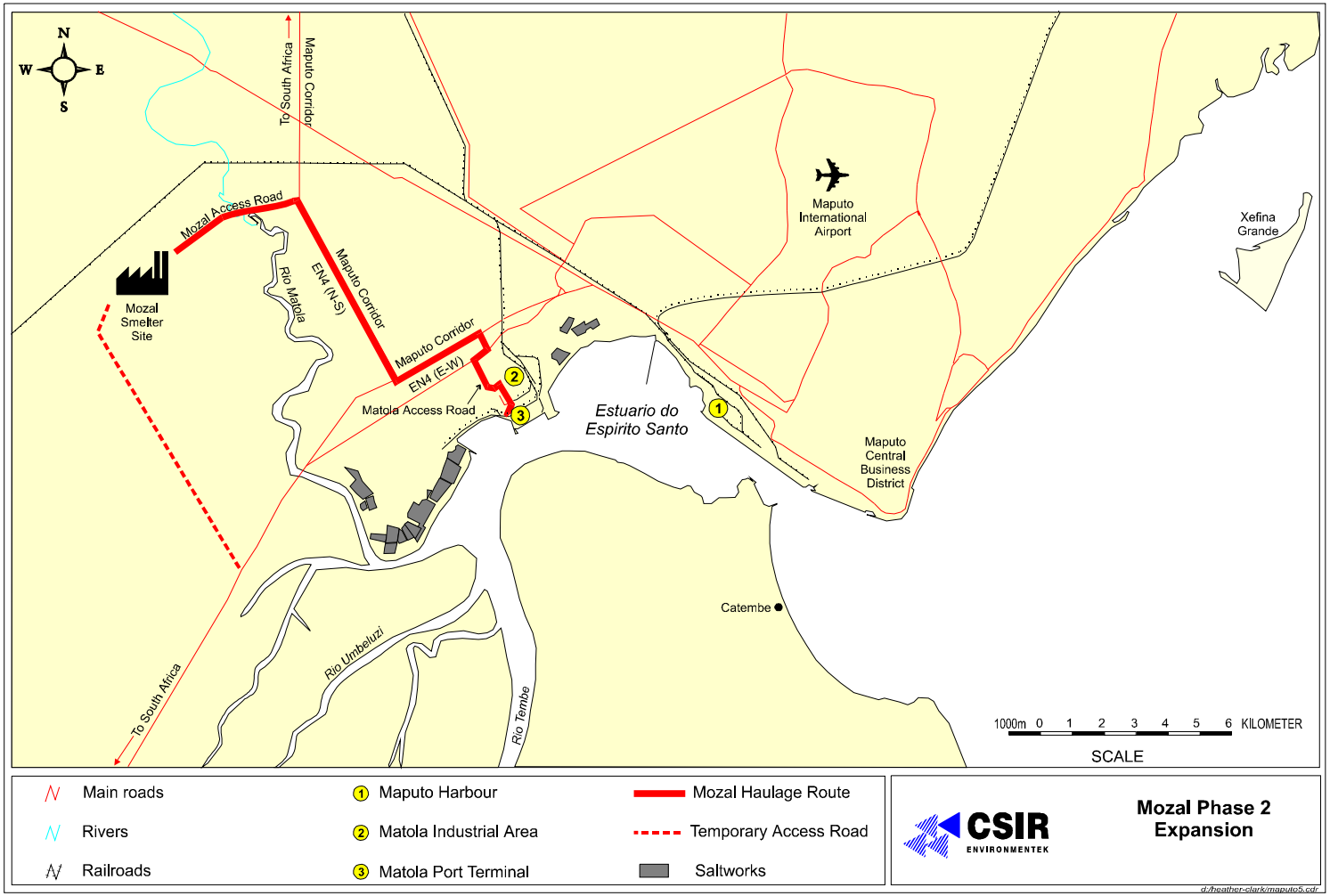

Figure 1: Map showing situation of the Mozal smelter and Matola port terminal

Figure 2: Matola port terminal: Phase 1

Figure 3: Mozal aluminium smelter: Phase 1

2 Structure of the report

This report has been structured to include the summary of conclusions and recommended management actions as the first section of the report. Thereafter, some background on the proposed project is provided in Section 1. The approach adopted for the environmental assessment is discusses in detail Section 3 while the project is described section 4. A description of the affected environment is presented in Section 5. Section 6 and 7 form the bulk of the report. A review of four of the specialist studies that were undertaken in 1996 for the environmental impacts assessment of the Mozal smelter (Phase 1 and 2) is presented in Section 6. Finally, an assessment of the phase 2 expansion of the port, where recommendations to mitigate negative impact and enhance positive effects are made, is presented in Section 7. The recommendations provided in Section 6 and 7 form the basis of the management and monitoring actions of the environmental management programme.

3 Approach to the environmental impact assessment

The study was conducted according to the Mozambican Environmental Regulations No. 76/98 and the World Bank Operational Procedures for Environmental Assessments (OP 4.01, 1999). This involved extensive scoping, which included one-on-one meetings, distribution of information sheets, advertising in local newspapers and conducting a scoping workshop. Detailed minutes of the various meetings and workshops are contained in Appendix 1 of the main environmental impact assessment report for the Phase 2 expansion. The public participation process is summarised in the following table.

Key issues identified during scoping were summarised in a draft scoping report, which was distributed in Maputo for public comment for a period of six weeks. These issues included aspects related to traffic, noise, economics, dredging and social impacts. The issue of dredging was later dropped as Mozal decided that smaller ships would be used to import raw materials resulting in no need for additional dredging. The issue of vehicle emissions was introduced by MICOA after the scoping report was finalised and was thus not recorded in the report. On completion of the public comment period specialists were appointed to undertake more detailed investigations of the key issues.

Finally a draft integrated Environmental Impact Assessment Report was compiled. This report has been made available for public comments in Mozambique for a period of 21 calendar days (according to Mozambican legislation) and in Washington for a period of at least 60 calendar

days (according World Bank operational procedures). The report was translated into Portuguese posted to all the key stakeholders. The document was also made available to the Mozambican public at various public libraries and community centres. A notice was placed in the local newspapers and letters were posted to all interested and affected parties informing them that the document is available for comment. The document will also be made available for comment at the World Bank InfoShop. A final public meeting was held during the comment period to present the findings of the assessment to the public. On conclusion of the public comment period a Comments Report will be drafted and appended to the draft Environmental Impact Assessment before being submitted to Mozambican Environmental Authority (MICOA) for approval and the International Finance Corporation (IFC) for consideration.

Public participation during the environmental impact assessment process.

Method of communication	Date
Meeting with Mozal to discuss process	March 2000
Publishing and distribution of Background Information Document (BID) to all the people that were involved in Mozal 1.	March 2000
Advertisement of Scoping Workshop: advertisement of the public meeting was made in the BID and one month before the public meeting in local newspapers (Notícias, Domingo).	March 2000
Meeting with key stakeholders: Dr Max Clark met with various Interested and Affected Parties (I&Aps) including members from the following organisations: MICOA, World Bank, CFM, IFC and ARA-Sul.	March to May 2000
Public Meeting of I&APs held in Maputo; over 50 people attended the meeting.	3 May 2000
Draft Scoping Report, with the minutes of all meetings, sent to key I&APs, everyone who attended the public meeting, the National Library and World Bank Library in Maputo and the office of the Administrator of Beluluane	May 2000
Advertisement of Draft Scoping Report in local newspaper to inform I&APs that the Scoping Report is available for comment.	June 2000
Comment Period (6 Weeks). A comments report was compiled and submitted to MICOA. This marked the end of Scoping.	1 June to 4 July 2000
Meeting with MICOA to discuss Scoping Report	8 June 2000
The date and venue of the feedback meeting, together with the location of the summary and main reports for review were advertised in local newspapers.	27/8 Sept 2000
Invitations to the public feedback meeting were posted to over 80 stakeholders.	27 Sept 2000
15 copies of the summary (Portuguese), main and specialist study reports were delivered to MICOA for distribution to the appropriate government departments. The Summary Report (Portuguese translation) was distributed to over 80 key stakeholders and was place in local libraries.	9 October 2000
A public feedback meeting was held at Mozal.	17 October 2000
According to Mozambican legislation, a public comment period of 3 weeks was allowed.	9 to 28 Oct 2000

4 Project description - Phase 2

The Phase 2 expansion involves the construction of a second pot-line at the smelter which will result in the doubling of capacity from 253 000 tonnes of aluminium per annum to 506 000 tonnes per annum (Figure 4). The capital cost of this phase is estimated to be US$ 0.8 billion.

The port terminal expansion will include the construction of one additional ship unloader, one additional 45 000 tonne alumina storage silo and two to four new 3000 tonne heated storage tanks for storing imported liquid pitch. The strip of land where the liquid pitch tanks are planned to be situated (Figure 5) will need to be acquired from the Mozambican Ports and Railway Authority, who own the land.

After the expansion, the total number of ships importing raw materials is expected to be 68 ships per annum, while the number of ships exporting the aluminium ingots is expected to be 60 per annum. This will equate to approximately 5 to 6 inbound ships per month and approximately 5 outbound ships per month.

The total number of trucks that will be required to haul the raw material from the port to the smelter equate to 110 round trips per day. A total of 58 round trips per day will be required to haul the aluminium ingots from the smelter to the port for export. The trucks exporting the aluminium ingots will operate 24 hours per day for 7 days a week along the haulage route shown in Figure 1. Trucks importing raw materials to the site from the port terminal are also likely to operate for 24 hours a day 7 days a week.

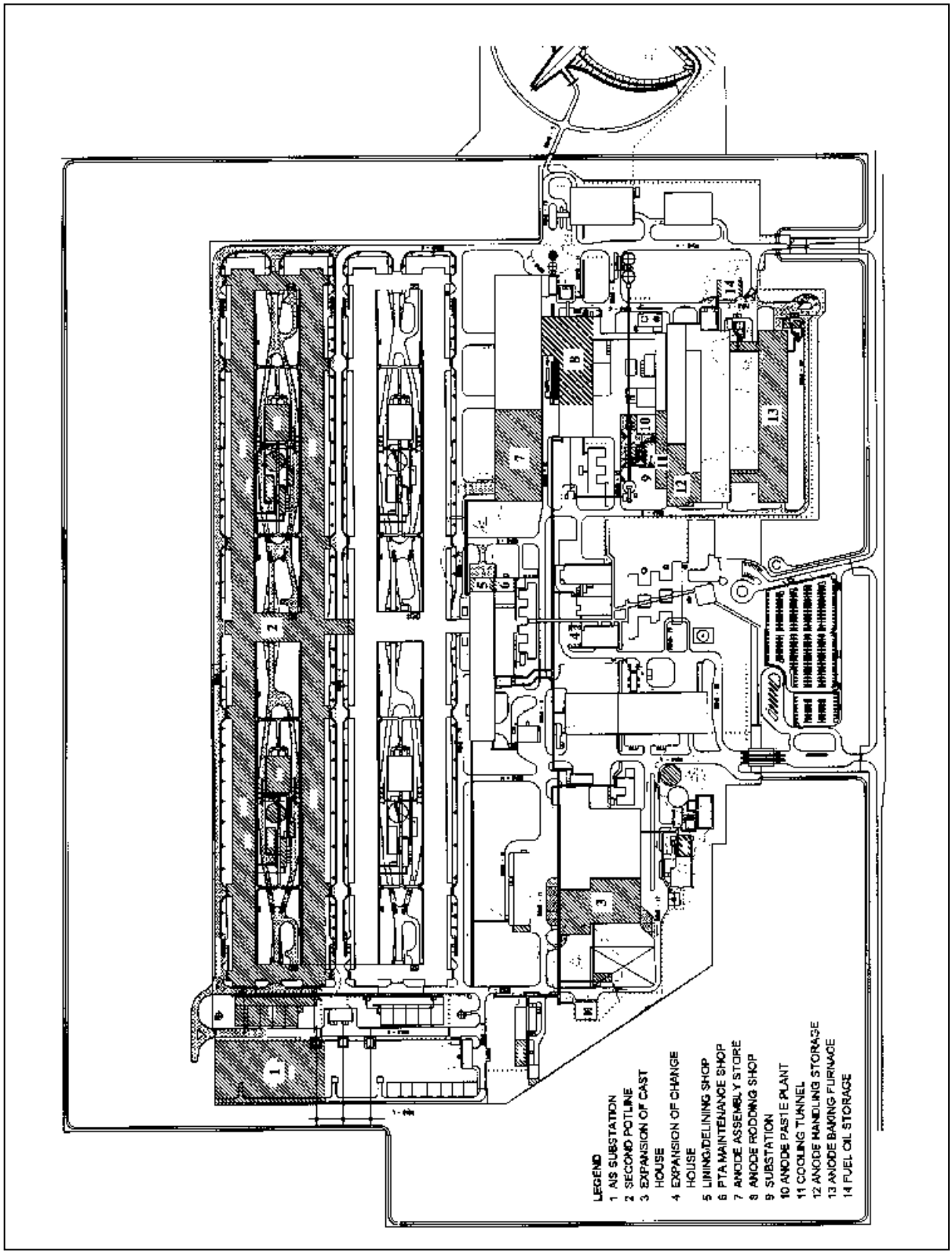

Figure 4: Mozal aluminium smelter, Phase 2 expansion

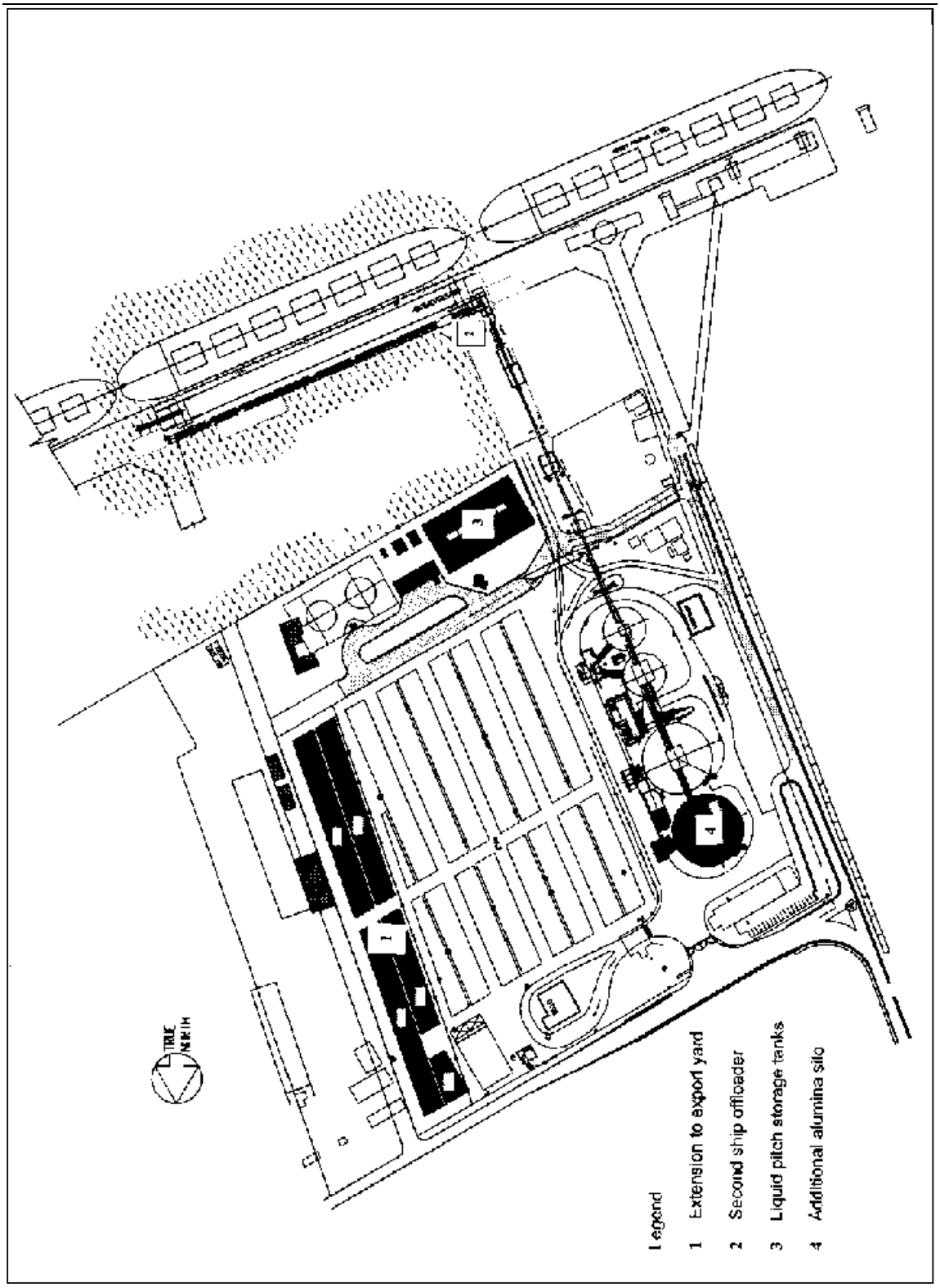

Figure 5: Matola port terminal, Phase 2 expansion

5 Description of environment

The reforms embarked upon by the Mozambique government have had a notable impact on macroeconomic parameters. Economic growth rose from an average of 6.7 percent per annum during 1987-95 to 10 percent per annum during 1996-98. Inflation declined from about 50 percent in 1995 to less than one percent in 1998.

The population of Mozambique is approximately 18.5 million and per capita Gross National Product (GNP) is US$ 90. The economically active population in Maputo Province (excluding Maputo city) was estimated to be 280,000 in 1997, which is approximately 35 % of the total population of the province. Recent unemployment figures for the province are not available, but estimates for the period 1989-1994 indicate an unemployment rate of 46 % for the country.

The Government of Mozambique approved the development of the Beluluane Industrial Park in 1998. This, together with the development of Mozal has had a major overall impact on the area. Further development of the industrial park may act as a catalyst for the gradual unbanization of the area with its consequential impact on the predominantly rural-based livelihoods population of the surrounding areas.

Several roads in the Matola area have been upgraded for the Mozal project. The section of the Maputo Corridor (EN4(N-S) and EN4 (E-W): Figure 1) that passed through the Matola industrial area is in the process of being upgrade to a four-lane highway. Other infrastructure that has been developed as a result of Mozal include: national electricity supply grid; telecommunications station; storm water drainage; new Beluluane School, as well as infrastructure directly associated with the Mozal developments.

6 Summary and update of previous environmental impact assessment of the Mozal smelter and Matola Port Terminal

6.1 Summary of previous EIA's

A summary of the two previous environmental impact assessments undertaken for Phase 1 and 2 of the Mozal smelter and Phase 1 of the Matola port terminal is contained in Appendix 2 of the Main Report (Volume 2) for the Phase 2 expansion. This summary allows decision-makers to have an overall perspective of the previous environmental assessments and actual management actions undertaken for the Mozal project. Recommendations contained in these reports were used to compile an environmental management programme (EMP) for the construction and operational phases of the smelter and port terminal.

6.2 Analysis of alternatives

Both of the abovementioned assessments considered various alternatives for the proposed developments. The smelter assessment considered 3 alternative sites and specialists assessed the impacts for each of the sites. A comparison of the relative impacts was undertaken and the present site was selected mainly due to the absence of rural dwellings on the site with no resultant involuntary resettlement requirements. For the port terminal assessment, two alternatives were considered. The first alternative included the use of existing facilities at the Port of Maputo. The second alternative included the construction of a new quay at the Port of Matola. The Matola port terminal was the selected as the preferred option for, amongst other reasons, its closer proximity to the smelter site.

6.3 Update of specialist studies

The following four specialist studies that were undertaken as part of the initial environmental impact assessment for Phase 1 and 2 of the smelter were reviewed and updated:

- Mass Balance and Materials Handling Study (Geyer and Butler, 1996);
- Storm Water Management Study (van Ballegooyen, Luger and Monteiro, 2000).
- Socio-economic study (Berns, 1996);
- Social Impact Assessment (Wamukoya et al, 1996, ACER Africa, 1998 and Berns, 1996);

The other specialist studies undertaken in 1996 for the smelter development included studies on air pollution assessment, fauna and flora, water resources, noise and visual aspects, cultural

resources and infrastructure. These studies comprehensively addressed all aspects of the development and predictions that were made are still valid for the Phase 2 expansion of the smelter. These studies were therefore not reviewed.

The objectives of the updated studies were to:

- Where appropriate, compare the predicted impacts to actual impacts and establish the relative success of the mitigation actions carried out during the implementation of Phase 1.
- Update information and provide recommendations to deal with issues that arise as a result of the updated information.

The construction of the smelter has only recently been completed and is not in full operation. It was thus only possible to achieve the above objectives for the socio-economic and economic studies. Only the second objective was met with respect to waste management and storm water management. The up-to-date reviews are summarised in the following sections.

6.3.1 Mass balance and materials handling study update

Mozal requested that the mass balance and materials handling study that was undertaken in 1996 be reviewed as more detailed information on the waste streams became available. The objective of the study was to update information and provide recommendations to deal with issues that arose as a result of the updated information.

The main finding of this study was that the 1996 empirical prediction of solid waste generated by the smelter was underestimated by approximately half. Actual waste management data from the Hillside Smelter in Richards Bay, South Africa that was not available in 1996 was used to update this information. Although the predicted solid waste has doubled, waste generated per ton of product (0.055 tonnes of waste per ton of aluminium) is relatively low when compared to other metallurgical processes (e.g. steel manufacturing and chrome smelting). Various meetings were held between the CSIR specialists, Mozal, MICOA and a waste management contractor and their consultants to discuss the options available for solid waste minimisation, recycling, storage, treatment and disposal. Possible temporary and permanent waste disposal sites have been identified and the Mozambican Government is in the process of investigating these options.

The updated information of the above issue together with others issues that were investigated and the proposed recommendations are summarised in the following table.

Mass balance and materials handling study update

Review issue	Review comment	Recommended management action
Solid waste emanating from smelter.	Actual waste management data from the Hillside smelter in South Africa was used to update the 1996 empirical estimates of solid waste for the Mozal smelter. These data were not available for the 1996 assessment, as the Hillside smelter was only commissioned in 1996. Using the actual waste data from Hillside, it was established that there would be substantially more solid waste emanating from the smelter site than initially predicted (approximately double). Updated estimated volumes of solid waste generated per annum are as follows; Class G waste: 5451 tons per annum Class H:h waste: 4436 tons per annum Class H:H waste: 11 540 tons per annum 6574 tons per annum of solid waste can be externally re-cycled. The Class H:h and H:H waste would have to be disposed of at a hazardous waste disposal site, with the exception of 11500 tons per annum, under steady state conditions, of SPL which is included in the Class H:H volume. The treatment of SPLs is dealt with in the following section. As an indicator, the waste generated per ton of product is 0.055 tonnes of waste per ton of aluminium. This value is relatively low when compared to other metallurgical processes (e.g. steel manufacturing and chrome smelting). The Mozambican Government, Mozal and a waste management contractor and their consultant are in the process of identifying possible temporary and permanent waste disposal sites.	The existing temporary landfill will be upgraded by MICOA to handle class G and H:h waste. It is therefore required that the temporary landfill site adhere to the South African Minimum Requirements for the disposal of hazardous waste. This means that the landfill would require an appropriate lining, a leachate management system (includes leachate collection and treatment) and proper management. MICOA will close the temporary landfill site once the permanent site is permitted. The leachate of the closed site will need to be monitored by the operator of the site for a maximum of thirty year according to the South African Minimum Requirements for Waste Disposal. The disposed waste will remain at the site after closure, however if needed it could be moved to the permanent site.

Review issue	Review comment	Recommended management action
Treatment/disposal of Spent Pot Liners (SPLs) and other class H:H waste.	The Spent Pot Liners (SPLs) will be stored at the Mozal site until recycling options become available. The recycling of Spent Pot Liners (SPLs) in cement and lime-kilns is currently being evaluated by Hillside Aluminium at various cement and lime-kilns in South African. If this method proves successful the cement plant situated at the Matola Port may be the ideal partner to Mozal for such a process. Other hazardous waste (class H:H) will be stored on the Mozal site until a permanent hazardous waste disposal site is established in Maputo.	Mozal will investigate the feasibility of recycling of Spent Pot Liners (SPLs) in cement and lime-kilns. Mozal will initiate discussion with the cement plant at the Matola port in this regard. However, the cement plant has various operating problems and will need to operate efficiently if it is to recycle the SPLs. An audit of the cement plant and preliminary testing of recycling the SPLs at the cement kiln will have to be undertaken before SPLs are recycled there on a large scale.
Fluoride mass balance showed some discrepancies in the 1996 assessment.	The fluoride input to the process is approximately 4240 t/a. The fluoride leaving the process is calculated to be approximately 4057 t/a. The remaining difference between the input and output fluoride amounts (182 t/a) is approximately 4.3% of the total input fluoride amount. This difference is small in view of the uncertainties in the fluoride content of the various waste streams. These uncertainties pertain to the solid waste such as spent potliners, bath, dross and other fluoride contaminated solid wastes. No additional gaseous or particulate fluoride will be emitted than initially assessed.	Once the plant is in full operation, the composition of all fluoride-containing solid waste should be analysed to confirm the relevant classification and appropriate waste disposal option in accordance with the relevant waste disposal regulations and guidelines.
Concerns that the SO_2 Mozal atmospheric emissions of 26kg/tonne of aluminium are high when compared to some smelters reported in the literature to have SO_2 atmospheric emissions as low as 1kg SO_2 /tonne aluminium.	The main reason for the difference in performance of SO_2 emissions is the different scrubbing process used. Mozal uses a dry scrubber, which is more efficient in scrubbing fluoride than the wet system, but does not scrub SO_2 . Smelters that use wet scrubbers achieve lower SO_2 outputs, however this is in exchanged for an increase in liquid effluent and solid waste. The choice of a technology (Aluminium Pechiney) with best efficiency towards fluoride removal is deliberate, as there is	In view of the SO_2 air dispersion results that indicated that no ambient international guideline values would be exceeded, it is not recommended that an additional wet scrubber be installed to reduce SO_2 emissions. No action is required unless other SO_2 emitters establish in the industrial park. The best options for Mozal to reduce SO_2 emissions would then be to purchase raw materials (petroleum coke and pitch) with lower sulphur content. However, market

Review issue	Review comment	Recommended management action
	no ambient SO_2 problem in the project area. Fluoride scrubbing will ensure that no damage to the surrounding environment will occur as a result of the fluoride emissions. This technology is at present regarded as the "benchmark" in the aluminium industry. Internationally, the most recently built smelters use this technology. It must also be noted that the inclusion of wet scrubbing for sulphur dioxide removal is not included in the list of BAT (best available techniques) (Oslo and Paris Commission, 1994), and is not recommended or included in the list of key issues of the World Bank published Pollution Prevention and Abatement Handbook (World Bank PPAH, 1998) for aluminium manufacturing. As more industries establish in the area SO_2 may become an issue of greater importance and this will have to be managed by the developers of the industrial park.	availability of such raw materials is currently limited. The likelihood of Mozal being able to purchase such materials is limited. The use of natural gas may also be an alternative. There are local plans for the development of the Mozambican natural gas fields. However, the likelihood of these plans being implemented in the near future is unsure.
Assessment methodology for SO_2 and fluoride emissions is not stipulated by the World Bank.	Atmospheric dispersion modelling was used to assess the impact of SO_2 and fluoride emissions on the surrounding environment. The sulphur in the raw materials can be measured. The emissions can then be calculated and an atmospheric model used to calculate the dispersion of the SO_2. The Air Pollution Assessment specialist study of the 1996 environmental impact assessment demonstrated that the level of SO_2 and fluoride would be well within the recommended World Bank guideline (World Bank PPAH, 1996), and within levels where no negative effect of fluoride on even sensitive vegetation will be expected.	It is recommended that the measured and modelled approach be accepted as an assessment technique for SO_2. Mozal will monitor fluoride emission as recommended in the initial environmental impact assessment and will initially monitor SO_2 emissions to verify the dispersion modelling results and obtain baseline data.

6.3.2 Storm water management study update

Two issues were reviewed in detail as part of this study. The first relating to the relationship between the World Bank guideline and the South African receiving water quality guideline for fluoride concentrations in storm water. The second relating to the mixing of waste process water with fluoride contaminated storm water to meet the required World Bank guideline under certain circumstances.

The main findings of this study was that if Mozal were to comply with only the World Bank discharge standard of 20 mg/l for fluoride contaminated storm water, there may be an impact on the Matola River. As a result a three-step water management plan has been recommended to ensure that no significant impacts will result in the receiving water of the Matola River even during prolonged dry periods.

These issues are summarised in the following table.

Storm water management study update

Review issue	Review comment	Recommended management action
Fluoride standards: World Bank standard versus the South African Receiving Water Quality Guideline	A specific management strategy must be implemented to ensure that if the World Bank guideline for fluoride levels in storm water (20 mg/l) is adhered to, no significant impacts will result in the receiving water of the Matola River even during prolonged dry periods. The standard used to assess the impact of fluoride contaminated effluent on a receiving water body is the South African receiving water quality standard of fluoride concentration of 5 mg/l.	In order to insure that the storm water discharge from Mozal complies with both the World Bank and South African water quality guidelines a **three-step** water management plan is being utilized. **STEP 1**: Trapping of the first flush in retention dams: *Objective*: to insure that there is no uncontrolled discharge of non-compliant storm water into the Matola River. **STEP 2**: Controlled mixing with cooling process water during prolonged dry periods: *Objective*: to allow trapped storm water with fluoride concentrations above the threshold 20mg/l to be discharged in compliance with this standard. **STEP 3**: Managed discharge strategy: *Objective*: to insure that when releasing storm water that complies with the World Bank standard, the South African water quality guideline for fluoride in the marine environment is also complied with. Monitoring programme to include: • Model verification monitoring • Operational phase compliance monitoring • On-site monitoring
Controlled mixing of waste process water with fluoride contaminated storm water to achieve World Bank standards under certain circumstance.	If due to unforeseen operational circumstances such as an accidental spillage during a first flush rain event, or after a prolonged dry period, the fluoride concentration in the retention dams is found to be above the World Bank Guidelines of 20mg/l, controlled mixing with the continuous bleed from the waste process water will assist in reducing the concentration of fluoride to the correct level. Mixing specifically to allow regular discharge of storm water with a concentration above 20 mg/l should not be the norm.	The controlled mixing of fluoride contaminated storm water with waste process water will assist in achieving the World Bank guideline of 20 mg/l after prolonged dry periods or after unforeseen operational circumstances such as an accidental spillage during a first flush rain event. It is recommended that the process water be monitored on a weekly basis over the first month of full Phase 1 operation to verify the assumption that it complies with the appropriate receiving water guidelines and World Bank Standards.

6.3.3 Economic study update

In this study, the Phase 1 economic impacts as predicted in the Socio-economic study (Berns, 1996), of the initial environmental impact assessment, are reviewed and compared with the actual impacts.

Substantially more employment was generated during the construction of Phase 1 than initially expected, however, less permanent jobs have been created. A major difference between the 1996 and 2000 assessments is firstly the multiplier that was used for calculating the total tax revenue and contribution to the GDP. A four sector Keynesian model was used to calculate the present multipliers where as a three-sector model was used for the 1996 calculations. A four sector framework was deemed more appropriate than a three sector framework, because the former included the impacts of the external sector, and more specifically the expenditure leakages resulting from the importation of goods and services during construction and operations. Secondly, the wage benefits during the operational phase is substantially higher that initially predicted as Mozal is paying higher than average wages to its workers and the expatriate local allowances have been included in the total. However, the substantial increase in wage benefits has not resulted in a major change to the contribution to the GDP as the four-sector multiplier is in the order of three times lower than the three-sector multiplier that was used for the initial assessment.

The comparison of the 1996 and 2000 assessments are contained in the following table.

	Initial 1996 Assessment	Present 2000 Assessment	Comments
Employment contribution:			
Construction			
Direct employment	5300	9000	-
Percentage local	50 %	74 %	
Operations			
Direct employment	873	747	-
Percentage local	91%	87%	
Wage income/benefits:			
Construction			
NPV Wage income	$6.4 million	$6.6 million	Current assessment includes expatriate local allowances
Multiplier	1.22	1.88	
NPV Wage income with multiplier	$7.8 million	$12.4 million	
Operation			
NPV wage benefits	$21.8 million	$101.9 million	Current assessment includes expatriate local allowances. The increase in shown for the 2000 Assessment is due to the substantially higher wages to Mozambican employees that will be paid by Mozal than initially predicted.
Multiplier	1.28	1.82	
NPV Wage benefits with multiplier	$27.9 million	$185.5 million	
Tax revenue:			
NPV Tax	$35.4 million.	$33.2 million	The previous assessment uses a three-sector framework for deter-mining economic multipliers for tax income. The current assessment uses a multiplier based on a four-sector framework.
Multiplier	4.8	1.77	
Total NPV Tax with multiplier	$170.4 million	$58.8 million	
Contribution to GDP:			
NPV	$57.2 million	$155.9 million	The higher contribution in the current assessment is largely due to the higher wage bill, as well as the inclusion of the local component of profits (not included in the initial assessment). The initial multiplier was based on a three-sector framework. The current assessment uses a multiplier based on a four-sector framework.
Multiplier	3.5	1.31	
Total NPV with multiplier	$198.3 million	$204.2 million	

6.3.4 Social impact assessment update

This section critically reviews the impact assessments of the Social Impact Assessment (Wamukoya et al, 1996, ACER Africa, 1998 and Berns, 1996) undertaken for the initial environmental impact assessment for Phase 1 and 2 of the smelter. Specifically, the success of the mitigation measures recommended by the specialists and other mitigation measures implemented by Mozal are reviewed.

The main findings of this review indicate that the recommended mitigation actions for the predicted social impacts were generally well implemented. From a resettlement perspective, the 1996 assessment identified that compensation for loss of grazing and crop production would have to be provided and that no involuntary resettlement was required on the Mozal site. Subsequent to the approval of Mozal, the Government of Mozambique proclaimed the area surrounding Mozal as an industrial park (Beluluane Industrial Park). As a result, resettlement of residents within the boundaries of the industrial park became necessary. Mozal as the project sponsor provided US$ 1 million to assist the Mozambican Government who is responsible for resettlement, with the resettlement process. The review concluded that resettlement has been undertaken efficiently and in accordance with the World Bank procedures on involuntary resettlement. Mozal have invested an initial amount of US$ 1.7 million in the formation of the Mozal Community Development Trust which is in the process of implementing the 5 major strategies: HIV/AIDS awareness, malaria control, technical college in Beluluane Industrial Park, small and micro enterprises development, and support for the resettlement and agriculture development programmes.

The review of the above issues together with other related social issues are summarised in the following table.

Summary of review of social impacts of Phase 1 excluding resettlement

Category	Predicted impact	Mitigation/enhancement	Effectiveness of mitigation
Employment and capacity enhancement.	(+) Creation of 5300 jobs. (+) Target: percentage local = 50%.	Give preference to the employment of local people. Training programme for local labour Establish a recruitment office.	9000 jobs (at peak construction period) were created. Actual: percentage local = 74%. Recruitment strategies were developed and implemented. Local workers were trained in basic construction skills as part of the project and were then made available from a pool to be employed by the various contractors on the project. A central recruitment office was established to ensure that local residents received priority when allocating jobs. A total training budget of $5 million was allocated for training staff during the operational phase. Focus to date has been on providing training for commissioning by the end of 2000. Thereafter, training needs will shift towards training in managerial and supervisory skills, with the ultimate goal of promoting local Mozambicans into more senior positions.
Construction village and housing.	(-) Possible conflict between foreign expatriate labour force and resident villagers; health impacts on the local resident community.	Quality housing and good entertainment facilities to be provided in the construction village; restricted entry to the construction village.	Excellent facilities were provided in the construction village; no conflicts between residents of the construction village and the local residents were reported. Mozal constructed approximately 100 residential dwellings in 4 cluster locations for permanent expatriate employees to alleviate housing shortage.
Influx of work seekers	(-) Influx of work seekers into Boane District	Improved planning processes	Ongoing influx of work seekers into Boane District was experienced; Boane District Planning Framework has not been implemented by the relevant local authority.

Category	Predicted impact	Mitigation/enhancement	Effectiveness of mitigation
Health	(-) Increased incidence of STDs, HIV/AIDS and unwanted pregnancies; reduced productivity form malaria. HIV/AIDS etc.	Education and awareness programme addressing HIV/AIDS; provision of free condoms (Mozal); malaria vector control programme	Mozal is involved in STD/HIV/AIDS awareness creation through the Mozal Community Development Trust, on the Mozal site and with the broader community. Looking at developing partnerships with a Danish NGO – ADPP. Mozal implemented extensive malaria spraying around the site and effectively created a mosquito free buffer zone. The Mozal clinic has been very effective in early identification and treatment of malaria amongst workers in order to minimise sickness and absenteeism. Mozal has also provided support for the tri-government malaria-spraying programme as part of the Lubombo Spatial Development Initiative.
Crime	(-) Increase in crime as a result of influx	Awareness programme; close cooperation between Mozal and local police and security agencies	The predicted increase in crime has materialised, which may be couple to the increase in affluence of some people and influx of jobless people into the Matola and Maputo area.
Infrastructure development	(+) Infrastructure development and improvement	Several infrastructure developments were seen as necessary, including the development and upgrading of access roads, electrical supply, water supply, sewage plant, harbour upgrade.	Mozal assisted with the following development of infrastructure: Development of the secondary access road to the smelter, upgrading of the access road to the Matola port terminal, construction of a telecommunications station, water pipelines and bridge over Matola River, development of a new quay at the Matola port, new Beluluane School (part of Corporate Social Investment). This investment total approximately $34 million.

Category	Predicted impact	Mitigation/enhancement	Effectiveness of mitigation
Traffic	(-) Increased traffic load and resulting congestion	Speed enforcement by traffic authorities	Limited effect due to local authority actions. Mozal effectively implemented traffic management on the Mozal secondary access road.
Local level planning	Uncontrolled settlement resulting from weakened planning processes in the area	Development of the Boane District Planning Framework.	Implementation of the planning framework has not been successful and has not yet been ratified by the relevant authorities.
Local development	(+) Improved development status and participation in cash economy (-) Possible alienation of peasants from the land; increased demand for land to build restaurants, modern homes and shops etc.		*No mitigation proposed* Actual impacts: New businesses have started in the area, but unauthorised sale of land and reduction in size of land holdings have been observed.
Corporate social responsibility – both an impact and a mitigation measure			Mozal Community Development Trust (MCDT) founded with an initial budget of US$ 1.7 million. US$ 2 million is budgeted for the second year. The MCDT has 5 major strategies: Malaria control, HIV/AIDS awareness, technical college in the Beluluane Industrial Park, SME development, Resettlement and agriculture.

Resettlement for Beluluane Industrial Park (Phase 1) update

Context of resettlement	Risk factors	Current situation
The impact of resettlement was not predicted in the initial assessment. This only became obvious after the Mozal project was approved and the Government of Mozambique declared the surrounding area as an industrial park. Hence no mitigation measures were recommended by the previous studies. As a consequence, resettlement was not addressed in the initial environmental management programme. Once Mozal and the Mozambique Government realised that resettlement would take place, a Resettlement Action Plan (RAP) was devised for Phases 1 and 2 of the Beluluane Industrial Park. Mozal on behalf of the Mozambique Government is managing resettlement.	(-) Alienation of people from agricultural land; decreased sustainability of livelihoods; other possible risks are landlessness, joblessness, homelessness, marginalization, increased morbidity and mortality, food insecurity, loss of access to common property and social disarticulation. (+) Potential greater ease of access to markets for production of cash crops; better housing provided as a result of the RAP.	Despite having started the resettlement action plan relatively late in the process, resettlement has been undertaken with efficiency and in accordance with the World Bank operational procedures on involuntary resettlement. Genuine commitment from all authorities and stakeholders and a notable lack of political conflict has been the key success factor for resettlement so far. The following has been done to date: • The resettlement has met the RAP requirement to ensure the same or improved standards of living in the new settlement area, although it is too early to indicate whether these standards will be sustained; • The relocation of affected families to new farming plots are complete and a four-year agriculture development programme is in place; • Grave relocations are complete and undertaken in compliance with traditional law, customs and rituals; • The housing construction is nearly complete and twenty families have already moved into their new homes; • All compensation payments have been made; • A four-year monitoring and assessment plan has been implemented using participatory methodologies, and is intended to indicate to the Mozambique Government risks and relative success of the resettlement. Mozal is supporting the first year of the Resettlement Implementation and Monitoring Programme through the Mozal Community Development Trust. Mozal expects the Government of Mozambique to play a more substantive role in this programme in subsequent years.

7 Assessment of Mozal Phase 2 expansion

The following specialist studies were undertaken as part of the environmental impact assessment to assess the impacts of the Phase 2 expansion of the Matola port terminal to support the Phase 2 expansion of the Mozal smelter:

- Traffic Assessment
- Noise Assessment
- Economic Assessment
- Vehicle emissions Assessment
- Socio-economic Assessment

These studies assessed the related impacts and made recommendations to mitigate negative impacts and enhance positive impacts. A brief description of the possible impacts together with an assessment and proposed mitigation action are summarised in the sections below.

The Phase 2 port expansion does not include activities expected to result in air pollution or solid waste and wastewater generation. Furthermore, all other impacts associated with Phase 2 of the smelter development were addressed in the previous environmental impact assessments.

7.1 Phase 2 traffic impacts

This section contains an assessment of the predicted traffic impacts resulting from the haulage of raw materials and finished products between the Matola port terminal and the Mozal smelter. The impact of traffic assessed by BCP Engineers (Pty) Ltd (BCP Engineers, 1998) for the Phase 1 Matola port terminal environmental impact assessment provided useful background information for this section. The key source of information for this section was, however, a traffic specialist study undertaken by BCP Engineers (Pty) Ltd as part of this environmental impact assessment (Walden, 2000). The traffic impact assessment was carried out in accordance with the recommended guidelines of the British Institution of Highways and Transportation, these guidelines being the accepted norm in Southern Africa.

Furthermore, the analysis procedures have been undertaken using the methods of the Highway Capacity Manual and the computer programme "SIDRA" developed by the Australian Road Research Board and which is recognised as one of the foremost traffic analysis tools in the world today. The road names referred to in this section are shown in Figure 6.

An impact statement is described for each impact after which an assessment in made and mitigatory actions proposed.

IMPACT STATEMENT 1

The increase in Mozal haulage operations will have an impact on the level of service of the intersections and road infrastructure i.e. congestion and delays.

Assessment

A low-medium negative impact is predicted at the intersection of the Mozal access road and the EN4 (N-S) (Maputo Corridor road) for traffic turning right (Figure 6). A low positive impact is predicted for some traffic directions at the intersection between the EN4 (N-S) and EN4 (E-W) as a result of changes signal settings.

Mitigation

If in the longer term the delay at the intersection of the Mozal access road and the EN4 (N-S) becomes excessive, the introduction of traffic signals should be considered to alleviate the situation.

IMPACT STATEMENT 2

The increase in Mozal haulage operations will have an impact on the road design life as a result of additional pavement loading.

Assessment

A low negative impact is predicted for this impact as additional pavement loadings resulting from the Phase 2 expansion are well within the load capacity of the various road components.

Mitigation

No mitigation is recommended.

IMPACT STATEMENT 3

The increase in Mozal haulage operations will have an impact on traffic safety along the haulage route.

Assessment

The decrease in traffic safety resulting from an increase in traffic is impossible to predict as this depends on a multiplicity of interacting factors.

Mitigation

All Mozal truck drivers will undertake a safe driving programme. The measures yielding the greatest benefits for the reduction of road accidents are speed control, improved visibility, lane demarcation and forewarning. Law enforcement by the Mozambican authorities with respect to vehicle roadworthiness and valid drivers licenses will also improve traffic safety.

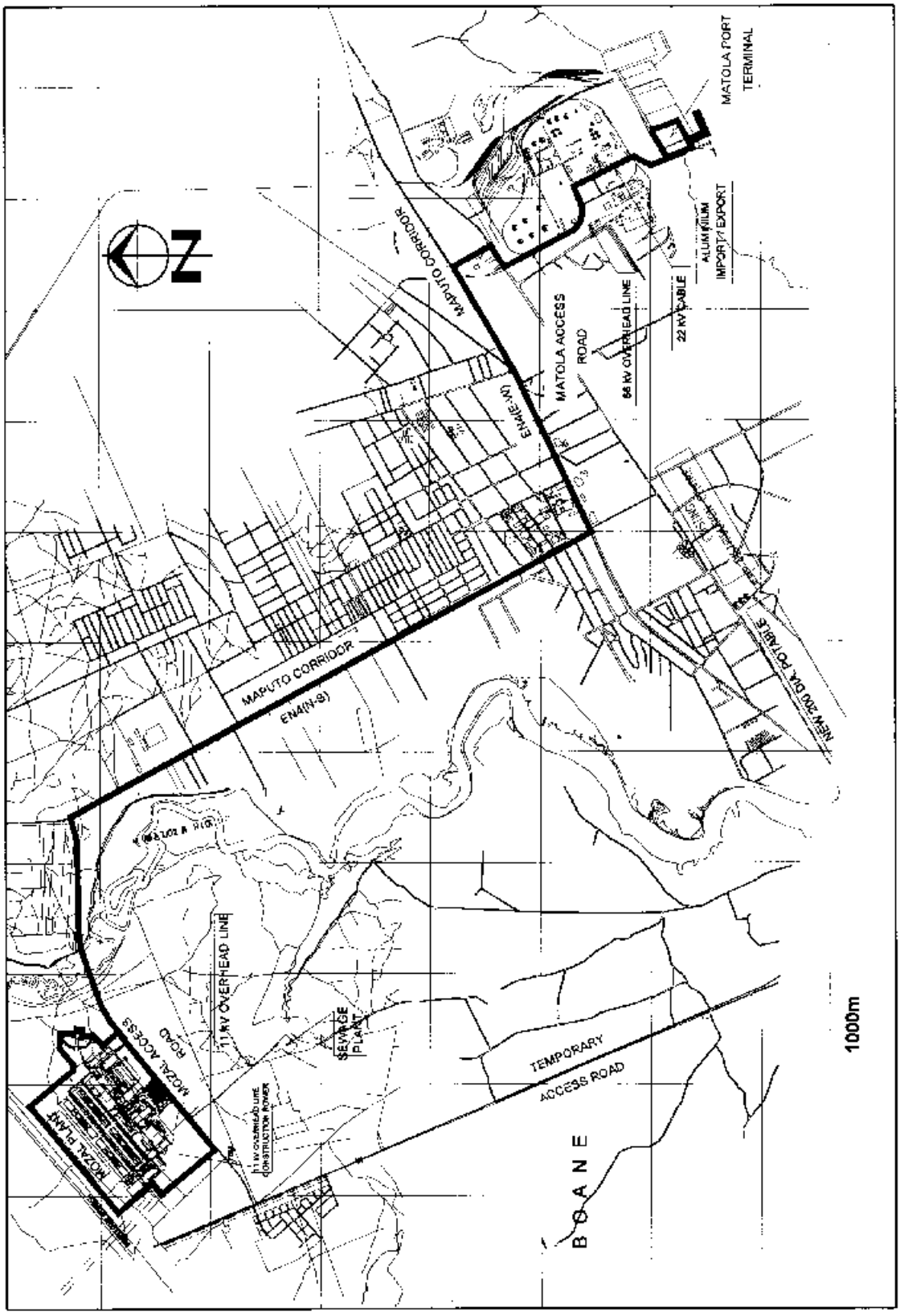

Figure 6: Mozal haulage route

7.2 Phase 2 noise impacts

This section contains an assessment of the predicted direct[1] and cumulative[2] noise impacts resulting from the construction and operation of the additional infrastructure at the Matola port terminal and the haulage operations between the port terminal and the smelter. The noise impact assessment for the Mozal smelter (Phase 1 and 2) (Rossouw, 1996) and the Matola port terminal (Phase 1) (Weber, 1998) provided useful background information. The key source of information for this section was the Class 1 Sound Impact Investigation undertaken by VibroAcoust International cc for this environmental impact assessment (Weber, 2000).

Standards used for this assessment include typical rating levels for ambient noise (Db(A)) in outdoor spaces (World Bank Pollution Prevention and Abatement Handbook, 1998) and the code of practice for the measurement and rating of noise with respect to annoyance and speech communication (SABS 0103, 1994).

An impact statement is described for each impact after which an assessment in made and mitigatory actions proposed.

IMPACT STATEMENT 1

The construction of the Phase 2 port terminal expansion will cause a direct noise impact.

Assessment

A medium to high negative direct impact is predicted as a result of the construction activities. It is however, noted that this is a temporary impact and will only last for the duration of the construction period.

Mitigation

The following mitigatory measures are proposed:

- Keep all equipment in good working order.
- Operate equipment within its specification and capacity. Don't overload machines. Apply regular maintenance particularly with regards to lubrication.
- Operate equipment with appropriate noise abatement accessories like sound hoods and maintain these accessories.
- Operate equipment in as diversified manner as possible, i.e. if possible, spread operation of equipment throughout working periods rather than operating several items simultaneously, turn equipment off when not in use. Position equipment in sheltered locations.

[1] Direct Impact -increase in noise from Mozal trucks. Applicable standard: SABS103 Standard for community response used to assess significance.

[2] Cumulative Impact - total noise level with all traffic including Mozal traffic. Applicable Guideline: World Bank Pollution Prevention and Abatement Handbook, 1998.

- Utilize partly finished buildings to accommodate equipment.
- Carefully select times when the environment is least sensitive to noise impact. Preferably during daytime hours during working days.

IMPACT STATEMENT 2

The operation of the port terminal will cause direct noise impacts.

Assessment

A low negative direct impact is predicted as a result of the additional noise from the second ship unloader.

Mitigation

The same mitigation measures as above apply.

IMPACT STATEMENT 3

Mozal's nighttime haulage operations along the Matola access road will cause direct noise impacts.

Assessment

A high negative direct nuisance impacts for residents adjacent to the Matola access road in the Matola Industrial Area is predicted as a result of additional noise from Mozal's nighttime haulage operations (Figure 7). The direct impact is associated with noise with respect to annoyance and speech communication according to SABS 0103. It should be noted that the additional noise generated by the Mozal trucks results in a cumulative noise level that is below the World Bank noise standard for industrial areas. Nevertheless, noise levels may have social consequences.

Mitigation

Two mitigatory measures are proposed:

1. A technical solution such as sound barriers or walls along the road to reduce the noise at the houses, or
2. Compensation and/or voluntary resettlement of the families living in the houses.

The possible compensation and/or voluntary resettlement are discussed in more detail in Section 7.5. Irrespective of the mitigatory action selected above, all mitigation recommended for the following impact statement is appropriate. Noise level monitoring along the Mozal and Matola access roads during the operational phase should be implemented to verify predicted noise levels. If necessary, additional technical mitigatory measures may be investigated.

IMPACT STATEMENT 4

Mozal haulage operations along the Mozal access road will result in a direct noise impact.

Assessment

A low to medium negative direct impact along the Mozal access road is predicted as a result of additional noise from Mozal haulage operations.

Mitigation

The following mitigatory measures are recommended:

- Mozal will permanently disable all exhaust brakes on trucks. The operational functions and safety of the vehicles will not be affected by this, however, wear of brake shoes and brake drums will increase.
- Mozal will ensure that vehicles are maintained to ensure that noise abatement devices like exhaust mufflers, engine hoods and motor brakes etc. are in good condition and working order.
- Mozal will provide education for truck drivers about the characteristics of diesel engines, i.e. that the flat torque characteristic allows the truck to climb an incline in a higher gear, which generates less noise.

IMPACT STATEMENT 5

All traffic, including Mozal's traffic, along the Maputo Corridor (EN4 (N-S) and EN4 (E-W)) will result in a cumulative noise impact.

Assessment

A high negative cumulative noise impact along the Maputo Corridor (EN4 (N-S and E-W)) is predicted as a result of cumulative noise from all predicted traffic.

Mitigation

It is important to recognise that the traffic without the Mozal trucks already constitutes an event of high significance in residential, institutional and educational districts along the EN4 (N-S and E-W). This is caused by the intended use of this road as a main international traffic artery and hauling route. The Mozambican Authorities should investigate this in more detail. The Mozambican Government should investigate the feasibility of monitoring the noise levels along this route. Mozal will implement mitigatory actions as recommended under impact statement 4.

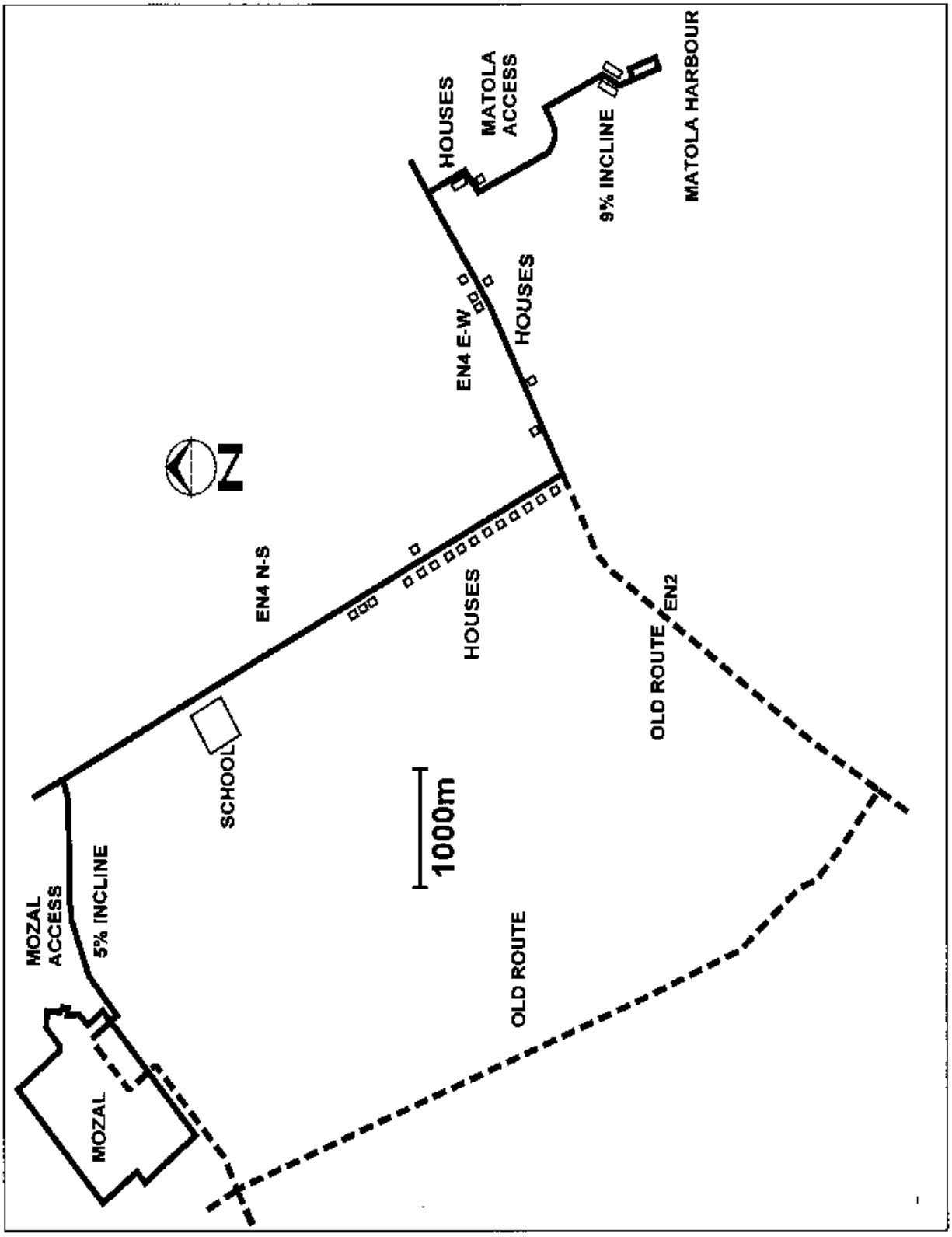

Figure 7: Sensitive sites with respect to noise impacts

7.3 Phase 2 economic impacts

This section contains an assessment of the predicted economic impacts resulting from the Phase 2 expansion of the Matola port terminal and Mozal smelter. The socio-economic study (Berns, 1996) undertaken for the initial environmental impact assessment provided useful background information for this section. The key source of information for this section, however, is the economic assessment undertaken by the CSIR for this environmental impact assessment (Crookes, 2000).

The total capital costs for the development of Phase 2 are expected to be $0.8 billion, which is approximately 32 percent less than for Phase 1 (see Table below). Direct costs include development of the reduction area, cast house, carbon plant, harbour materials handling, electrical systems and other general facilities. The total direct costs are $0.6 billion or 71% of the total costs. Indirect costs including the construction facilities and village, and other costs (such as owner's costs) are expected to be significantly less than for Phase 1 (approximately 46 % less). Estimates for Phase 2 are determined assuming a base of September 1997. An escalation factor has not been included for this Phase.

Comparison of capital costs ($ million) for Phase 1 and Phase 2

	Phase 1	Phase 2	% Difference
Direct costs	747.8	570.4	-23.7
Indirect costs	142.2	77.4	-45.6
Other costs	292.2	156.2	-46.5
Total	1182.2	804.0	-32.0

The following impacts were assessed in this section:

- Impacts on employment levels during the construction and operation;
- Economic impacts through wage income and multipliers (construction and operation);
- Economic impacts through tax revenues and multipliers (operation);
- Economic impacts through the contribution to the Gross Domestic Product (GDP) and multipliers (operation).

These are summarised in the table below.

Although there is a doubling in the output of aluminium as a result of the Phase 2 expansion, there will not be an associated doubling in the amount of infrastructure required, number of people employed (construction and operation), or in the wages that will be paid out. It is not expected that the Mozambican Government will have any shareholding in Phase 2 of the project as it has in Phase 1 (4 % shareholding). As a result of the total contribution to the GDP will not doubled as a result of the Phase 2 expansion.

Summary of economic impacts on the Phase 2 expansion

Economic Impact	Phase 2 Without multiplier	Phase 2 With multiplier	Phase 1 and 2 With multiplier
Employment contribution			
Construction			
Direct employment	5000	12000	-
Operations			
Direct employment	295	1211	-
Percentage local	98%	-	-
Wage income/benefits			
Construction			
NPV Wage income	$5.1 million	$9.5 million	21.9 million-
Operation			
NPV wage benefits	$29.8 million	$54.5 million	240.0 million-
Tax revenue			
NPV Tax Revenue	$31.6 million.	$55.9 million	114.7 million-
Contribution to GDP			
NPV GDP Contribution	$61.4 million	$80.4 million	284.6 million-

7.4 Phase 2 vehicle emission impacts

This section contains an assessment of the predicted impacts of vehicle emission resulting from the haulage operations of the Mozal trucks between the Matola port terminal and the Mozal smelter. This issue was raised by MICOA at a late stage during the environmental impact assessment process. As a result a screening study for this assessment was deemed appropriate.

The main source of information for this section is the Screening Study undertaken by the CSIR for this environmental impact assessment (D'Abreton, 2000). The analysis procedures were undertaken using the *CA*lifornia *LINE* Source Dispersion Model Version 4 (CALINE4 model) developed by the California Department of Transportation. It is specifically used to characterise CO dispersion along (and within 500m) of highways

IMPACT STATEMENT 1

The vehicle emissions from Mozal's trucks will impact on human health and on the surrounding vegetation.

Assessment

The screening modelling study indicated that no major air quality problems would result. However, further increased traffic may result in deteriorating air quality in the area, especially adjacent to major roads.

Mitigation

Mozal will ensure that fleet vehicles are well maintained, thereby keeping emissions to a minimum. It is also the responsibility of all polluters to reduce their vehicular emissions. The Mozambique authorities should ensure that motor vehicle emission legislation be strengthened and enforced.

It is also recommended that Mozal, together with the Mozambican government investigate the possibility of conducting a field-campaign type monitoring programme using, for example passive samplers to monitor CO and NO_x. Such a monitoring programme should be co-ordinated with the Trans African Concessions (TRAC) who is the developers and services of the new N4 toll road between Witbank and Maputo (The Maputo Corridor).

7.5 Phase 2 social impacts

This section contains an assessment of the predicted socio-economic impacts resulting from the Phase 2 expansion of the Matola port terminal and Mozal smelter. The Social Impact Assessment (Wamukoya *et al*, 1996), the Resettlement Action Plan (ACER Africa, 1998) provided useful background information. The key source of information for this section was the social impact assessment undertaken for this environmental impact assessment (Kapelus *et al*, 2000).

There are a number of positive and negative social impacts associated with the Phase 1 development of Mozal. In the event of Phase 2 being approved, many of these impacts (positive and negative) will again be evident. The impacts are associated with a number of key issues including:

- Employment;
- Local economic development;
- Poverty alleviation;
- Corporate and social responsibility by Mozal;
- Health;
- Voluntary resettlement
- Traffic

An impact statement is described for each impact after which an assessment in made and mitigatory actions proposed.

IMPACT STATEMENT 1

The Phase 2 construction and operation will provide employment opportunities at the local level.

Assessment

During the Phase 2 construction it is expected that 5000 people will employed. It is estimated that an additional 295 jobs will be created for the operational phase. A medium positive impact of short-term duration for the construction and long-term duration for the operation is predicted.

Mitigation/enhancement

Mozal will design an employment enhancement plan that ensures jobs are created at the local level during both the construction and operation of Phase 2.

IMPACT STATEMENT 2

The Phase 2 construction will improve the skills base in Mozambique.

Assessment

It is predicted that a high positive impact of medium to long term for the region will result from an improvement of the skills base.

Mitigation/enhancement

Replacement of previous expatriate jobs where appropriate must be seen as a guiding principle which will be further developed as part of the contractual aspects set out in tender documentation for Phase 2 contractors. Mozal will develop and implement a human resource development database which tracks and monitors training.

IMPACT STATEMENT 3

Phase 2 construction and operation will increase the number of opportunities for Mozambican companies to provide goods and services to Mozal.

Assessment

A positive impact of medium significance and medium term duration for the region will result from the increased opportunities for Mozambican companies to provide goods and services to Mozal.

Mitigation/enhancement

Contracts for sub-contractors will include guidelines on employing local residents where possible and local contractors with appropriate skills will be given preference. This will be supported through the initiatives started by the Mozal Community Development Trust. Mozal should monitor the number of local SMME's that will be involved in Phase 2 construction and operation.

IMPACT STATEMENT 4

Mozal's investment in the social investment programme the "Mozal Community Development Trust" will contribute to poverty alleviation in the local area.

Assessment

The Mozal Community Development Trust will have a medium positive impact of long-term duration for the local area in alleviating poverty

Mitigation/enhancement

Mozal has invested an initial sum of US$ 1.7 million in the formation of the Mozal Community Development Trust (MDCT). The MCDT has 5 major strategies: Malaria control, HIV/AIDS awareness, and technical college in the Beluluane Industrial Park, SME development, resettlement and agriculture.

IMPACT STATEMENT 5

Possible voluntary resettlement and or compensation of residents situated along the Matola port terminal access road due to the increase in nuisance noise.

Assessment

The Mozal nighttime haulage operations will result in a nuisance impact for residents situated along the port terminal access road in the Matola industrial area. There are 11 houses directly adjacent to the road with 9 houses further away, some of which are not residential units. It must be noted that the additional noise generated by the Mozal trucks results in a cumulative noise level that is below the World Bank noise standard for industrial areas.

Mitigation

Mozal will initiate discussions with CFM (Mozambican Ports and Rail Authority) with respect to the possible measures to mitigate against the noise impact.. Two options exist:

1. A technical solution (noise barrier etc) and/or
2. Voluntary resettlement/compensation of the residents located adjacent to the port terminal access road in the Matola port industrial area.

If voluntary resettlement/compensation is agreed upon Mozal will ensure that a comprehensive resettlement action plan is drafted and implemented according to World Bank Operational Directive 4.30. A more detailed discussion on this issue is contained in Appendix 5 of the main report.

IMPACT STATEMENT 6

Phase 2 will contribute to the prevalence of sexually transmitted diseases and HIV/AIDS.

Assessment

The Phase 2 construction could have a high negative impact of a long-term duration for the entire region as a result of HIV/AIDS spreading. However, as a result of a lack of data on the situation the confidence is low.

Mitigation

Mitigation measures relate to awareness campaigns, provision of condoms, and health care. Mozal will continue to support Government initiatives in this regard through the Mozal Community Development Trust.

IMPACT STATEMENT 7

The Phase 2 construction will result in a secondary impact of ongoing land alienation and increased conflict in households and settlements in the local environment.

Assessment

It is predicted that a high negative impact of long-term duration in the local area will result from the construction contributing to an on-going process of land alienation in the local environment. The change in the economy, influx of outsiders and competition for resources can have a medium negative impact on household and community cohesion through an increase in conflict in the medium term in the local area.

Mitigation

Mozal can support the government in creating awareness of the impacts of industrialisation as well as support to community organisations that can provide support to vulnerable groups. This should be undertaken as part of the Mozal Community Development Trust. The local authorities should communicate and implement the Boane District Planning Framework.

IMPACT STATEMENT 8

Malaria will continue to be a serious health risk to the Mozal employees and the surrounding communities.

Assessment

Malaria will continue to have a high negative impact of long-term duration in the whole of Mozambique. Malaria will continue to pose an impact risk of high negative status for a long-term duration for Mozal.

Mitigation

Mozal implemented extensive malaria spraying around the site and effectively created a mosquito free buffer zone. The Mozal clinic has been very effective in early identification and treatment of malaria amongst workers in order to minimise sickness and absenteeism. Mozal has also provided support for the tri-government malaria-spraying programme as part of the Lubombo Spatial Development Initiative. Mozal will continue malaria control measures on site.

IMPACT STATEMENT 9

Phase 2 construction and operation will contribute to a secondary impact of poverty alleviation.

Assessment

A medium positive impact of long-term duration in the local area will result from the Phase 2 contribution to job creation and poverty alleviation.

Mitigation/enhancement

The Mozal Community Development Trust (MCDT) can increase the opportunities for partnerships between civil society, business and government, promote the employment of women, promote technical careers and provide bursaries for such advancements. Although this can be facilitated through the MCDT, Mozal should ensure that it does not assume the sole responsibility for development and poverty alleviation in the local area. The MCDT should seek alternative funding from various NGOs and other industries that establish within the Beluluane Industrial Park.