ILMENITE Project

SOCIAL AND ENVIRONMENTAL IMPACT ASSESSMENT

ENVIRONMENTAL MANAGEMENT PLAN

Filed by QIT Madagascar Minerals S.A. (QMM S.A.) with
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1 Introduction

1.1 Objective of the Project Environmental Management Plan (PEMP)

The main objective of the Project Environmental Management Plan (the "PEMP") is to present the proposed monitoring and follow-up activities with regard to the implementation of the environmental measures recommended in the project's Social and Environmental Impact Assessment (SEIA), to validate the results of these activities and to assess their relevance. The term "environmental measures" refers to the measures for the elimination, mitigation or compensation as a result of the project's impacts on the social and natural environment.

This PEMP is in compliance with the laws of Madagascar in force, such as they apply to the Project, in accordance with the provisions of the Framework Agreement. We particularly relied on the applicable provisions of the MECIE, the Mining Code and Interdepartmental Order no. 12032/2000. This Order sets the elements that must be included in the Project Environmental Management Plan. It defines the PEMP as "a programme for implementing and monitoring the measures proposed by the environmental impact assessment in order to avoid, eliminate, reduce and eventually compensate for the project's damaging effects on the environment". The plan also sets forth the general principles and protocol that QIT Madagascar Minerals S.A. (QMM) plans to follow in order to implement and carry out its environmental management plan. Lastly, the management plan summarises the methods proposed for communicating the results of monitoring and follow-up programmes.

A certain number of QMM's activities within the scope of this management plan will require the commitment of public authorities. Certain actions taken by QMM, both of a social and environmental nature, will need be in line with the activities of the public administrations concerned, while taking the needs of the communities into consideration. The organisational framework will thus involve the commitment of partners representing these administrations and communities. It should be mentioned, however, that the company is not seeking to counter the administrative controls to which it is subjected, nor to avoid the legitimate recourse of people affected by the project.

The proposed management plan consists of two primary aspects, namely:

1. A monitoring programme, whose main objective is to monitor the implementation and to verify the application of the environmental measures proposed in the SEIA;

2. A follow-up programme, whose primary objective is to follow-up on the development of some of the components of the natural and human environments, by:

   - Assessing the efficiency and pertinence of the environmental measures implemented and/or in force;
   - Identifying and assessing those impacts that were simply not anticipated and/or whose scope may differ from what was expected.

In other respects, the PEMP also includes a non-exhaustive list of procedures and practices that support the execution of monitoring and follow-up programmes for the various project

phases. QMM agrees to establish and implement these procedures in a timely manner. Lastly, the document gives the PEMP implementation methods and, among others, the obligations concerning the communication and audit of results to which QMM agrees to adhere.

This PEMP has been prepared in support of the mining activities in the Mandena sector of the Fort-Dauphin deposit, which represents about one-third of the area covered by the permits granted to QMM S.A. Future mining activities in the sectors of Petriky and Ste-Luce, only slated to begin in fifteen years or more, will also involve issuance of environmental permits, based on an SEIA, as well as an assessment process whose guidelines will be identical to those of the environmental permit for the Mandena sector, the implementation of which is addressed in this PEMP.

1.2 Rio Tinto policies

Rio Tinto has set strict social and environmental standards for its activities involving exploration, operation and upgrading of the earth's mineral resources. The corporate policy and the standards to which all Rio Tinto subsidiaries must adhere are provided in a document on its management policy, entitled "The Way We Work – Our Statement of Business Practice" (included as Appendix 14 of the SEIA).

In more concrete terms, Rio Tinto is aware of the fact that excellence in the management of its responsibilities with regard to health, safety and the environment is critical to its long-term success. The Rio Tinto Group seeks, through efficient management practices, to ensure the health and safety of its employees, minimise all possible negative impacts from its activities on the environment and positively contribute to local communities.

To reach these objectives, some of the actions proposed by the Rio Tinto Group are presented hereinafter:

- Act in compliance with the applicable laws and regulations concerning health, safety and the environment, as well as its own voluntary commitments in this regard; and
- Strive for continuous improvement through the setting and reviewing objectives, evaluation and communication of performance in terms of health, safety and the environment, and by applying best practices, in the light of the local context.

1.3 QMM's commitments

In its operations, QMM will comply with the requirements of the applicable laws and regulations of Madagascar as well as with the conditions of its environmental permit.

With this in mind, and for such purpose, the Company's management undertakes the following specific commitments:

Compatibility of infrastructure feasibility studies with the PEMP

During the period proposed by the Framework Agreement for the execution of feasibility studies, QMM S.A. or one of its Affiliates agrees to ensure that all additional feasibility studies concerning project infrastructures remain compatible with the PEMP. QMM S.A. or its Affiliate will provide the ONE with feasibility studies and plans that are sufficiently complete to allow the latter to verify their compatibility with the commitments in the present PEMP.

Moreover, QMM S.A. or its Affiliate will provide the ONE with a schedule outlining when these studies and plans will be submitted.

Once these documents are received, the ONE will have a maximum of forty-five (45) calendar days to verify this compatibility. Should no notice be given within this time period, it will be deemed that there is compatibility between the studies and plans in question and the PEMP.

In the event of a justified notification requiring additional studies or plans, the ONE will have a further thirty (30) calendar days from receipt of these additional studies and plans to verify their compatibility with the PEMP and present any opinion.

These procedures will also apply in the event of any significant changes to the infrastructures described in the SEIA and that have been the object of an environmental assessment, as well as to the measures listed in the present PEMP.

Lastly, when justified by infrastructure feasibility studies, additional monitoring and follow-up measures could be included in the present PEMP.

The infrastructures covered include, but are not limited, to the followings:

- **hydraulic infrastructures**: weir (including a spillway/flood channel, dyke/dam) and a pumping station;
- **land transportation infrastructures**: roads, paved or not, trails, crossings, crossroads;
- **port infrastructures**: breakwater, wharf, technical facilities and related buildings, unloading and equipment and fuel storage areas and, access roads;
- **industrial infrastructures and energy production infrastructures:** power plants, fixed and mobile separation units, control and research laboratories;
- **technical buildings, housing and auxiliary infrastructures** and;
- **storage areas and conveyor units** for fuel, lubricants, chemical products (solids liquids and gases), intermediate products, end products and all waste.

In terms of the weir, in particular, the promoter will submit plans and specifications that are thorough enough to allow the competent authorities to verify the compatibility of its design with the following objectives outlined in the PEMP:

- Minimise the frequency of, and increases in high waters;
- Maximise the efficiency of the weir against saltwater intrusion so as to ensure a water supply of acceptable quality, for mining and rehabilitation activities;

- Minimise obstacles to watercraft traffic, especially those of a tourist nature, towards the Anony River, the mouth of the lake and the ocean.

Should weir design not sufficiently reduce these negative impacts, the promoter will propose mitigation and compensation measures.

The following social and environmental impacts associated with the weir's operations phase are taken into account in the PEMP, in terms of follow-up and mitigation measures:

- A potential increase in the sedimentation of the lake, which, if deemed to create a problem, could result in maintenance dredging being carried out as an eventual mitigation measure;
- Changes in halieutic resources being compensated for, in the short- and medium-term, by a fish-farming programme or other compensation measure;
- A possible increase in the prevalence of water-borne diseases such as schistosomiasis. A monitoring programme will be implemented in this regard.

Rehabilitation of the mining site

While the Mandena site has a few forest fragments and some wetland zones, it primarily consists of great numbers of bare zones, the result of several decades of continued deforestation. The residual forest cover on the Mandena site is actually in an advanced state of deterioration, and subject to intense anthropogenic pressures from continued deforestation activities.

The Framework Agreement includes a provision whereby QMM will rehabilitate the mined zones.

Should standing forested areas need to be felled (in 2000, only 203 hectares out of a total of 2,120 hectares of littoral forest were left standing, which leads us to believe that only very small surfaces could be felled for mining activities), a mitigation measure has been proposed that involves rehabilitating these surfaces by means of a programme for the planting of fast-growing species.

In order to protect the Mandena zone's remaining fragments of littoral forest, the promoter agrees, as part of the compensation measures, to support the creation of a conservation zone (230 hectares, 160 of which would be forest) in Mandena and to pursue its efforts regarding the ecological rehabilitation of the littoral forest over a zone of close to 200 hectares on the perimeter of the proposed conservation zone.

The wetland areas that will be disrupted by mining activities (of the 436 ha inventoried in the year 2000, of which it is proposed that 70 be maintained in the conservation zone) will be rehabilitated as part of a programme for the ecological rehabilitation of wetlands. This initiative will allow a supply of quality plants, the goal being to ensure a production of sufficient quality and quantity in the wetland areas targeted for rehabilitation.

In terms of the bare zones, which represent, according to inventories carried out in the year 2000, more than 1,400 hectares of the entire Mandena zone, QMM is prepared to go beyond its commitment to rehabilitate, as prescribed by the Framework Agreement. It proposes, as an

additional development and compensation measure, to rehabilitate these surfaces by planting fast-growing species that would serve as a sustainable source of wood.

More specifically, QMM SA or its Affiliate, as part of the programme for the plantation of fast-growing species, agrees to file triennial plans for the rehabilitation of mining sites with the Waters and Forest Department, as mining activities advances, that will identify the surfaces to be rehabilitated, the species chosen and the reforestation objectives. Bearing in mind that this rehabilitation will be carried out, as far as possible, two years after the replacement of the residual sands from mining, these plans propose a minimum reforestation density of 1,000 plants per hectare, and a 75% survival rate of the plants after 5 years. Rehabilitation plans will also propose a process for monitoring and follow-up of rehabilitation activities, as well as the conditions for the submittal, 5 years after the start of rehabilitation operations, a report stating that QMM has properly carried out its rehabilitation obligations. QMM also agrees to continue exploring the possibility of using topsoil under philippia and assess the pertinence of its use; if these evaluations yield positive results, that this topsoil be used for the planting programme.

QMM will take all the measures needed to promote the success of its rehabilitation programme, both with regard to the planting of fast-growing species and the restoration of wetlands and the littoral forest.

Should QMM not be able to meet its commitments in terms of rehabilitation, potential compensation for an eventual loss of supply of resources useful to villagers (wood, mahampy, etc.) will need to be determined, based on the contribution of the various conservation, planting, wetland restoration and ecological rehabilitation initiatives in all of the rehabilitated areas.

In the event where, despite all of QMM's efforts, the rehabilitation programme's objectives cannot be met (unless directly resulting from the villagers' own activities, which QMM was unable to bring a halt to by the means available to it), QMM agrees to compensate villagers according to an inventory of the territory uses and the income-generating or subsistence activities being carried out on such territory at the time of mining. This inventory will be carried out as mining operations progress, and will cover the areas targeted by each year's mining activities. It will be regularly updated and validated by the competent authorities.

Financing of the Port

Financing of the port will be carried out in compliance with the provisions of the Framework Agreement.

Approval and implementation of an environmental policy that meets ISO 14001 standards and which includes:

- A commitment to respect all applicable legal and other requirements;
- A commitment to continuous improvement in the protection of the environment, that is, to maintaining a continued process for the development of the environmental management system, and this so as to improve global environmental performance;
- A commitment to environmental protection and the prevention of pollution; and
- A commitment to communicate this policy to all personnel and the general public.

Making available the human, technical and financial resources necessary for meeting policy commitments and ensuring implementation of the ISO 14001 EMS.

The implementation by QMM of an environmental management system and policy in compliance with ISO 14001 standards and meeting RIO TINTO requirements with regard to the environment. This management system will be progressively implemented, based on an action plan and schedule that will be defined by QMM management as the project evolves.

2 Monitoring measures

The first objective of environmental monitoring is to ensure that all project activities and work are properly carried out, as pertains to the environmental commitments made by the Company and, more generally, the respect for and protection of the environment. The term "commitments" mainly refers to the environmental measures proposed in the SEIA as well as the laws, regulations, certificates of authorisation, government decrees and all other commitments made by the Company with respect to the project. This monitoring will also enable unexpected impacts, if any, to be identified and if necessary to eliminate or mitigate them. In summary, environmental monitoring seeks, in general, to ensure that safe environmental practices are followed throughout the work.

Work monitoring will be ongoing throughout the project, but more specifically from the drawing and specifications phase and until such time as mining of the Mandena sector is ended, the last zone mined is rehabilitated and the sites used are closed. Obviously, monitoring of work will be critical during necessary infrastructure construction phase

Phases in the Mandena mining project

In terms of project execution, the following four successive major phases are identified:

- preparation;
- construction and demobilisation;
- operations;
- closing of sites used.

To each of the phases, certain environmental activities correspond to project execution phases. These are presented in Table 1.

Table 1: Main environmental activities related to the phases of the Mandena mineral sands mining project.

Preliminary phase	**Construction phase**		**Operations phase**	
DESIGN	DETAILED ENGINEERING	CONSTRUCTION OF INFRASTRUCTURES AND CLOSING OF MINING SITES	MINING OF MINERAL SANDS	CLOSING OF THE MANDENA MINING SECTOR
Environment management integrated to project preliminary engineering	***Environment management integrated to project detailed engineering***	***Monitoring construction work for the various infrastructures and execution of environmental works***	***Environment management integrated to all mining activities.***	***Environment management integrated to the closing of the mining operations.***
Technical, social, environmental and economic studies. Impact studies prior to obtaining construction and mining permits.	Optimisation of certain works and/or of the methods for their execution. Verification of plans and specifications, as well as tender documents, with regard to environmental clauses. Optimisation and preparation of plans and specifications for all mitigation, development and compensation measures to be carried out during project construction phase. Execution of any additional environmental studies, if necessary. Monitoring of identified environmental components.	Daily monitoring of work on the job sites, of installations and of the work carried out by contractors. Implementation of mitigation, development and compensation measures. Monitoring workmanship and approval of environmental works. Monitoring of identified environmental components. Production of the operation manual containing environmental guidelines. .	Application of guidelines contained in the management guide. Design and execution of additional measures for reducing, mitigating or compensating for any unexpected impacts, if any. Monitoring the identified environmental components. Execution of the progressive closing of operations and the progressive return of territory to the State, etc.	Decommissioning and rehabilitation of the sites. Monitoring the identified environmental components.
The local, regional and national populations concerned will be regularly consulted and informed.				

2.1.1 The preliminary phase

2.1.1.1 Activities

The preliminary phase that began in 1986 will continue up to the time of investment decision. Until now, activities have primarily consisted of research work, studies and experiments. Recently, QMM has focused on conservation and planting activities, which are in keeping with the approach jointly promoted by QMM, the Fort-Dauphin Forests and Water District, the Mandromodromotra Rural Commune and the Ampasy-Nahampoana Rural Commune regarding the "enhancement and rehabilitation of renewable natural resources". In this regard, the parties have entered into an agreement aimed at implementing a method for the integrated management of renewable natural resources that is more viable and sustainable, called the "Mandena Management Committee".

Among some of the committee's most important activities, we note:

- **Studies, experiments and the social and environmental programme**

  - Conduct of scientific studies to acquire in-depth physical, biological and socio-economic knowledge about the region;
  - Conduct of an ongoing information and consultation programme targeting interested and affected parties at the local, regional and national levels (identification of concerns and social and environmental issues pertaining to the project);
  - Conduct of a project impact analysis on the social and natural environment, and the identification of appropriate environmental measures, particularly with regard to protection, mitigation, compensation or development measures regarding impacts;
  - Creation of an experimental nursery and of an ecological research centre;
  - Development and learning of techniques for growing plants in a nursery or plantation, so as to ensure effective rehabilitation of sites following mining activities;
  - Conduct of enhancement work with regard to freshwater and estuarine ecosystems;
  - Implementation of an experimental aquaculture programme with villagers;
  - Implementation of a sustainable programme for the support of community development initiatives in the project zone; and
  - Implementation of a social and environmental programme for mostly Malagasy specialists, hired on a full-time basis.

. **Establishment of conservation zones**

One of the main proposals from QMM during the project's preliminary phase involves setting aside an area within the Mandena mining zone for the specific purpose of conserving the characteristics of the sector's biodiversity. As such, the conservation of a 230-ha area, mostly covered with littoral forest (70 %), judged to be moderately degraded, and wetland forests (30 %), will preserve the characteristics of the zone's ecosystems. This measure, in fact, seeks to conserve all of the plant and wildlife species representative of Mandena's littoral forest. Conservation zones have also been proposed for the Ste-Luce and Petriky sectors (490 ha). These zones also seek to conserve plant and wildlife species that are considered endemic, rare or endangered.

The Mandena conservation zone will be managed by the Mandena Management Committee. It is part of the zone addressed by the DINA or Regulation respecting the use of Mandena's renewable natural resources.

- **The annual reforestation programme on the perimeter of Mandena**

In order to contribute to the supply of wood for the population of the project zone and to reduce the pressure on forest resources in the identified conservation zones, QMM has begun a programme, outside the deposit area, for the planting of fast-growing species. 30 ha were planted in 2001, and from 2002 to 2007, an area of 500 ha on the periphery of Mandena will be reforested. These plantings will consist of fast-growing species that villagers can use for energy or for commercial felling.

2.1.1.2 Future activities

- **Research and experimentation programme**

The research programme regarding conservation measures that began over the course of the last few years, will be pursued. It involves:

- The *in situ* and *ex situ* regeneration and propagation of endemic, vulnerable and endangered plant species;
- The long-term conservation of the seeds of native species;
- The relocation of certain wildlife populations;
- The breeding in captivity of certain rare populations to facilitate their reintroduction;
- The creation of a programme for the sustainable development of halieutic resources; and
- Research on aquaculture.

Further details on these research and experimentation programmes are presented in Appendix 11 of the SEIA ***"Description of QMM's environmental programme".

Moreover, over the coming months, QMM will carry out additional studies on port facilities, in order to obtain a more accurate model of the effects of wave activity on the beaches, in terms of sanding up, etc. These studies will enable optimisation of the works' final design.

- **Obtaining sectoral permits**

A number of the project activities and works will first require that permits and authorisations be obtained and that a number of agreements be finalized. These permits and authorisations will be granted by the various Departments concerned. Should prior studies be required, QMM will carry these out and prepare the documents required to obtain governmental authorisations.

QMM has drawn up a list, no doubt incomplete, of the permits required. This list includes the following permits and/or authorisations:

Roads

- Permit for the construction of roads;
- Permit for the installation of utility poles;
- Permit for the waterways.

Port

- Authorisation for the creation of a land bank for industrial use;
- Permit for construction of port facilities;
- Permit for private equipment in a port area;
- "Permanent" authorisation for foreign ships to enter Malagasy territorial waters.

Industries

- Building permits;
- Operating permits;
- Licenses to import fuel and lubricants;
- License for storing hydrocarbons;
- Etc.

Other buildings

- Building permits;
- Permits for land subdivision;
- Etc.

Land use

- Emphyteutic lease for private State domain;
- Emphyteutic lease for private land;
- Permit for temporary use;
- Concession (particularly with regard to the port);
- Public interest utilities and expropriation;
- Decommissioning or change in the use of the domain.

Health, safety, hygiene and environment

- Permit to establish and manage an infirmary;
- Permit to establish and manage a commissary;
- Authorisation for handling radioactive substances;
- Etc.

Finance

- Authorisation to establish an agreement.

2.1.2 The construction phase (detailed engineering, construction and implementation of the various infrastructures)

2.1.2.1 Programme of activities

- **Detailed engineering**

During the detailed engineering phase, the activities related to the environmental monitoring of the works will necessarily include:

- Integration of social and environmental measures proposed in the SEIA with an impact on the construction activities, to the plans and specifications as well as the calls for tender documents;
- Verification of plans and specifications as well as the calls for tender documents to ensure the compliance of the components covered in these documents, including any descriptions, requirements and performance conditions that may be included in various documents, such as:
  - The contractual procedure in force and the mediation processes with regard to traditional landed property as prescribed by the laws of Madagascar for the use of territory by the villagers;
  - The authorisation permits required for the project;
  - The State laws, standards and regulations applicable to the project and related to the protection of the environment. ***Note***: When there is no specific Madagascar law that addresses the management of particular activities or facilities for QMM's various operations, international standards will be used;
  - The mining code of good social and environmental practices; and
  - Rio Tinto's code of good social and environmental practices.
- Preparation of a detailed work monitoring plan for the construction period (monitoring sites and components, schedule and frequency of intervention and verification of the implementation of mitigation measures as well as QMM's respect of various commitments, etc.);
- Monitoring of complementary social and environmental studies required, as applicable, with regard to certain sectoral permits;
- Preparation of a guide of social and environmental practices, based on the problems identified in the impact study.

- **Construction of infrastructures**

The construction phase is a very critical step in the environmental management plan. Not only are the necessary operations numerous and of broad scope, but this is the step where the specific and general mitigation measures proposed in the SEIA will be implemented. QMM will be responsible for ensuring adherence to the laws, regulations, directives, codes and provisions of the agreement as regards health, safety and the environment on the work sites, and for environmental consideration in all construction activities during this three-year period. To this effect, QMM will set up a team for monitoring activities. This team will consist of competent persons with experience in the field of monitoring works for the purposes of health, safety and the environment.

The project for mining of the Mandena mineral sands will include the following construction sites:

Mining infrastructures:

- Construction of the ore separation plant;
- Construction of related infrastructures (power plant, pumping station, administrative offices, garages, etc.);
- Construction of the weir;
- Improvement of *Route Nationale* RN12A and of the trail south of Mandromodromotra (8 km);
- Construction and/or assembly of the prefabricated or modular housing units; and
- Digging of a basin for the installation of the dredge and floating separator.

Port infrastructures:

- Construction of the breakwater and wharf;
- Construction of related infrastructures (access roads, oil pipeline, conveyor);
- Construction of the storage area (ilmenite, zircon, hydrocarbons);
- Construction of a temporary camp in the Andriambe sector;
- Development and operation of a quarry in Andriambe;
- Construction of an access linking the quarry to the road that runs between the plant and the port;
- Construction of an unloading dock and a storage area at the Fort-Dauphin port.

Road infrastructures:

- Construction of a new stretch of road from the Mandena separation plant to the Ehoala port;
- Improvement of the stretch of road between the Fort-Dauphin unloading dock and the Andriambe quarry;
- Improvement of the stretch of road between the Fort-Dauphin unloading dock and the separation plant.

During the construction phase, it will be of prime importance that all construction work standards, directives and social and environmental measures contained in the plans and specifications (agreement provisions) be applied. In this regard, the contractor responsible for the construction work will be obligated to respect QMM's obligations (Cahier des charges) so as to ensure the quality of the work carried out. QMM's obligations (Cahier des charges) defines the respective rights and responsibilities of QMM and of the contractor mandated to carry out the work.

- **Implementation of infrastructures and closing of job sites**

At this stage, the environment management operation manual operating manual will have to be completed. This manual will be prepared concurrently with the project's detailed engineering and construction operations. This manual will serve as a reference for all social and environmental matters. Managers will find in it environmental elements to be integrated in the management of the mining site, the mining infrastructures, the port infrastructures and, the use of the new stretch of road linking the plant and the port. The manual's objective is to ensure that the mining of mineral sands is carried out in a manner so as to best protect the existing environment.

Training programmes for the staff responsible for the operation and maintenance of equipment will also need to be completed at this stage. All training programmes will need to address the health, safety and environmental issues as they relate to the equipment or tasks in question.

Furthermore, during this stage of the implementation of the project infrastructures, QMM will ensure that the following activities are carried out:

- Clean up and rehabilitation of the construction sites;
- Implementation of a management system for handling environmental complaints;
- Technical support, regarding the definition of environmental performance objectives, for the managers responsible for infrastructures;
- Ensuring that operations respect QMM's commitments, as defined in the SEIA;
- Ensuring that information on environmental issues is made available to the populations and stakeholders concerned;
- Raising managers' awareness with regard to the particularities of dealing with local populations as well as the importance of recognizing their needs, and this in order to ensure harmonious relations.

2.1.3 The operations phase

The operations phase of the mining of the Mandena mineral sands will include, among others, the following activities, at QMM installations:

At the mining site (dredge and floating separator operations):

- Management of the natural resources upstream of the mining operations (about one year prior to the date when mining of sands is scheduled to begin);
- Clearing and stripping (about three months before mining begins);
- Dredging of sands over a surface of around 0.15 to 0.30 ha a day (average width — 250 to 300 m);
- Piling and draining of light and heavy sands;
- Loading and transport of heavy sands to the separation plant;
- Return of residual sands from the separation plant to the site;
- Reprofiling of the light sands layer (one to two months after piling); and
- Rehabilitation activities in the mined zone (two to three months after piling).

At the mineral separation complex site:

- Movement of trucks (to and from the mining site and the port) and service vehicles;
- Operation of the separation plant, the dryer and the power plant;
- Ilmenite and zircon storage;
- Wastewater treatment;
- Handling and the return transport to the mining site of residual sands, including monazite; and
- Dismantling of the separation plant complex infrastructures, along with closing and rehabilitating the site.

In the lodging area:

- Water supply;
- Wastewater treatment;
- Management of household waste; and
- Maintenance of streets, water mains and power distribution lines.

At the weir and pumping station:

- The presence and operations of the weir;
- Pumping of water from Lake Ambavarano.

At the port site:

- Transport, storage and loading of ilmenite and zircon;
- Pumping of fuel from tankers to the storage tanks;
- Loading and unloading, as well as storing and transporting, material, equipment, containers, etc.;
- Management and maintenance of the ships that are present (waste, wastewater and used oil, cleaning of the bilges);
- Ship traffic in Fausse Baie des Galions;
- Periodic maintenance dredging (if needed).

Use of the road linking the plant to the port:

- Transport of ilmenite and zircon;
- Transport of fuel;
- Transport of material, equipment, spare parts, etc.;
- Regular road maintenance work (road surface, drainage, bridges and culverts).

2.1.3.1 Programme of activities

For the 25-year period where mining activities will be carried out in the Mandena mining sector, QMM proposes various activities that will ensure that environmental protection is sustained.

The purpose of these activities will be to provide those managing the infrastructures the directives, standards and codes of good practice related to management of the social and natural environment while mining activities are being carried out.

Given this, the primary environment management activities will be the following:

- The implementation of the environment management measures included in the operation manual;
- Maintenance of the environment management manual;
- Implementation of an environmental emergency plan tailored to the project requirements and to the risks as regards incidents of an environmental nature;
- Monitoring of the environmental measures highlighted in the SEIA, and eventually finalized in this document, with regard to QMM's commitments;
- Ensuring that the sites where mining activities have been carried out are thoroughly cleaned and rehabilitated;
- Development and conduct of a process for progressively returning to the State the land that has been mined and rehabilitated (see note below); and
- Preparation of an annual report on the state of the environment.

Note: During this period, QMM will progressively return to the State those parcels of land that have been mined and then rehabilitated. Given the nature of the mining process, which will only temporarily impact the zones being mined, the rehabilitation of these zones will be carried out progressively, in accordance with a complete programme carried out over set periods of time after mining activities have ended in a given zone. More details regarding the programme and the set periods will be provided in the triennial Rehabilitation Plans proposed previously, in Section 1.3. These plans will notably provide for preparing a report on the closing of operations for each zone, once the rehabilitation activities for the zone in question are completed. The duration of these activities, which may not exceed 5 years (except in the case where QMM and the competent authorities reach a specific agreement) is to be determined. The report will also address the transfer of the zone management to competent bodies or groups. It may also propose that QMM be responsible for providing advice and follow-up, tailored to legal requirements and to the needs of local communities, as part of tripartite agreements. Once this report is signed, QMM will be able to seek an environmental discharge for the zone in question, which it will receive as per the process provided for under the regulations in force.

2.1.4 The closing phase of the sites used

Mining of the Mandena sector will end in about 20 to 25 years, following a production plan that targets the mining of 750,000 tonnes per year. However, the mining of this sector will be followed by mining activities in the sectors of Petriky and Ste-Luce, for additional periods of 15 and 20 years respectively. Thus, the end of mining activities in the Mandena sector does not represent the closing of the mining project, which will only take place once all three sectors (Mandena, Petriky and Ste-Luce) have been mined, in sixty or so years.

At the end of mining operations in Mandena, with the exception of the mining sector zones (around 50 ha) where rehabilitation is underway or about to start, the infrastructures used, that is, the mineral separation plant (MSP), roads and weir, will be the only sites considered during the closing phase of the sites used. The port infrastructures are permanent, and most of

the mined territory will also have been first rehabilitated, and then progressively returned to the State.

According to the scenario actually being considered, whereby QMM would choose to relocate the OSP, this latter infrastructure would need to be dismantled and its site rehabilitated. In such a case, the 6 km stretch of road (north section) linking RN12A to the separation plant, along with those road sections providing access to the rehabilitation and conservation zones, could then be transferred to the authorities.

In terms of the weir, studies conducted by QMM suggest that the works should be left at the outflow of Lake Ambavarano once mining of the Mandena sector has ended. This recommendation takes into consideration the fact that the aquatic ecosystem upstream of the control structure will have been transformed into a freshwater ecosystem over the 20 to 25-year mining period. Dismantling of the structure subsequent to mining would modify the freshwater and estuarine environments and bring about new impacts. Furthermore, the presence of the weir will have helped ensure the integrity and quality of the Fort-Dauphin waterworks intake in Lake Lanirano. QMM believes that the city will also support the idea of maintaining the weir. It is proposed that studies be carried out during the project's final feasibility phase, in order to establish the details regarding construction of the weir, including the desired level of resistance to freak weather.

Five years before the closing of mining operations, generally speaking, QMM will need to conduct any additional studies that are required, and this so as to submit a closing plan to the State that will keep environmental impacts to a minimum while maximizing positive impacts.

3 Organizational framework and methods

3.1 Methods for monitoring the application of environmental measures

Environmental and social measures were developed while taking into consideration the laws and regulations of Madagascar, as regards the project and in compliance with the provisions of the Framework Agreement, the mining industry good practices standards and the accepted international standards for industrial and mining projects. The concerns voiced by the population in the Mandena sector, directly affected by the project, as well as those of various local, national and international stakeholders, were all taken into account.

Some of the measures in the SEIA are still being established; as a result, in a number of cases their exact parameters cannot be specified at the present time. Likewise, some of the actions proposed and techniques used will need to first be discussed with the appropriate external experts, representatives from the government of Madagascar and the populations concerned.

Moreover, the list of these measures is not comprehensive, and may be modified and improved, on the basis of the requirements of the governmental authorisations that have yet to be obtained. Other measures could also be added as a result of discussions and agreements with the involved communities and stakeholders.

As to the applicable methods for situations involving compensation or indemnification, it is important to specify that the recognized practices in this type of situation favour a settlement in kind as compensation for any disruption (e.g. loss of usufruct) rather than monetary

settlement. Should, however, the latter case apply, the amount of the damages, including interest, of any monetary settlement, in accordance with the laws of Madagascar, will cover all redress for prejudices incurred.

The tables in the following pages outline this programme. The measures proposed are listed according to the order in which the impact analyses are presented in the SEIA.

Physical components

Soil

- Profile and critical slope
- Soil surface and quality

Water

- Run-off and seepage
- Hydrology and hydrogeology
- Water quality

PROTECTION AND MITIGATION MEASURES - SOIL

Potential impacts	Location of the potential impact	Proposed measures	Methods for monitoring application of the measure
Modification of the local topography, creation of hillocks, ruts and ridges, compaction of loose surfaces, excavation.	**Construction phase:** - Construction and improvement of road sections; - Site of the temporary camp and the quarry, at Andriambe; - Separation plant construction site; - Pumping station; - Dredge and floating separator; - Weir – improvement of RN12A and of the trail south of the Mandromodromotra River; - Ehoala storage area; - Ehoala Port; - Fort-Dauphin unloading dock.	- Restoration of the profile; - Rehabilitation of the sites; - Start planting areas on the outskirts of the structures; - Drainage work; - Set up of all the devices necessary to ensure the safe movement of all vehicles, under proper conditions by, if applicable, paving: ✓ Either with an asphalt surface dressing (single or double layer) over a base layer of quarry pit run; ✓ Either in mass concrete over the laterite layer; ✓ Either by other means (macadam surface, treatment of the top soil); - Drainage of roads: ✓ Construction of a drainage system, along the road, with outflows at the low points; - For the granite and laterite quarries: ✓ Appropriate handling and storage of the burden: transport and evacuation, or grading at a location close by; ✓ Clean up and rehabilitation of the sites, access roads and approaches once mining activities have definitely ceased (entirely or in part); ✓ Definition of technical data for mining of the quarries.	- Preparation and monitoring of contractual terms; - Transmission of drawings and specifications; - Determination of work methods; - Monitoring of work for restoration of the profile and planting (regular visits of the sites involved) in order to ensure that the work is in compliance with the drawings and specifications; - Production of activity reports; - As regards drainage, research in conjunction with the populations or river communities residing near the routes deemed most appropriate for water disposal towards the evacuation zones; - Carrying out water disposal and evacuation on the basis of the soil type and landform configuration.

PROTECTION AND MITIGATION MEASURES - SOIL

Potential impacts	Location of the potential impact	Proposed measures	Methods for monitoring application of the measure
Disturbance of the stability of the dune protecting the Fort-Dauphin airport.	**Construction phase:** - New road between the quarry and the Ehoala port.	- Retaining wall; - Road surface; - Protection of the slope; - Implementation of mechanical devices (fascines) and biological means (windbreak, cover crops) to stabilise the dune.	- Preparation and monitoring of contractual terms; - Transmission of drawings and specifications; - Monitoring of the work; - Production of activity reports.
Erosion of the banks at the mouth of Lake Ambavarano.	**Construction phase:** - Weir.	- Stabilisation of banks near the weir.	- Preparation and monitoring of contractual terms; - Transmission of drawings and specifications; - Determination of material and crops to be used; - Monitoring of the work; - Production of activity reports.
Change in the volume of sands in the mined sectors and modification of the topography.	**Operations phase:** - Dredge and floating separator (mining of sands).	- Rehabilitation of the mined sectors; - Preparation of a topographical plan of the site prior to mining; - Preparation of an annual plan for restoration of the land (prior to each of the years in which mining will take place); - Preparation of a concept development plan for restoration of the landscape in the detailed engineering phase prior to mining.	- Preparation and monitoring of contractual terms; - Transmission of drawings and specifications; - Determination of material and crops to be used; - Monitoring of the work;
Erosion of the banks of Lakes Besaroy and Ambavarano and the first few kilometres of the Mandromodromotra River.	**Operations phase:** - Weir (presence and operation).	- Stabilisation of the banks by planting freshwater mangrove trees, *Typha angustifolia* and cyperaceae.	- Transmission of drawings and specifications; - Determination of work methods; - Crop production;

PROTECTION AND MITIGATION MEASURES - SOIL

Potential impacts	Location of the potential impact	Proposed measures	Methods for monitoring application of the measure
			- Production of activity reports.
Modification of the beach profile, along the shoreline of Fausse Baie des Galions.	**Construction phase:** - Access road linking the storage area and the breakwater.	- Stabilisation of the bank; - Planting; - Ensuring that plants are initially protected by windbreaks; - Replacement of dead plants.	- Transmission of plans and specifications; - Determination of work methods; - Ensuring the supply of quality plants; - Monitoring of the work; - Production of activity reports.
Possible dredging	**Construction and operations phases:** - Port.	- Respect for the accepted international standards and practices for this type of activity.	- Preparation and monitoring of contractual terms; - Transmission of plans and specifications; - Identification of the deposit site; - Monitoring of the work; - Production of activity reports.
Erosion of the foredune in the western sector of Fausse Baie des Galions and sanding up of the wharf area at the Ehoala promontory.	**Construction and operations phases:** - Breakwater.	- Construction of a structure to prevent sanding up; - Prior study carried out on a small-scale model; - Set up of fixed, markers to follow the evolution of the relief (horizontal and vertical planes).	- Preparation and monitoring of contractual terms; - Transmission of plans and specifications; - Monitoring of the work; - Monitoring of the follow-up programme with regard to modifications to the hydrodynamic features and water quality in Fausse Baie des Galions and Fort-Dauphin Bay; - Production of activity reports; - Periodic survey on the topography of the shoreline at the reference points (markers); - Monitoring of the markers set up.

PROTECTION AND MITIGATION MEASURES - SOIL

Potential impacts	Location of the potential impact	Proposed measures	Methods for monitoring application of the measure
Accidental hydrocarbon spills.	**Construction phase:** - Sections of road leading to the temporary camp and quarry at Andriambe; - Separation plant site; - Pumping station; - Dredge and floating separator; - Weir; - Stretch of RN12A and of the trail south of the Mandromodromotra River; - Ehoala storage area; - Ehoala port; - Fort-Dauphin unloading dock	- Maintaining trucks and site equipment in good working condition; - Containment of hydrocarbons and construction of tank farms, according to the applicable development standards, including, if necessary, of containment structure; - Demarcation of a specific area for refuelling and for vehicle maintenance; - Inspection and monitoring of hydrocarbons handling; - Development and application of an environmental emergency plan that includes the installation of the necessary protective and safety equipment (particularly at the Fort-Dauphin Port); - On-site availability of emergency equipment; - Recovery of contaminated sands and disposal at an authorized location; - Securement and guarding of the hydrocarbon storage area; - Protection of the oil pipeline (port operations phase); - Request for approval from the administration regarding the storage areas for contaminated products.	- Maintenance log for equipment and vehicles; - Purchase of emergency material and distribution to various work and mining sites; - Preparation of storage areas for wasted oil and contaminated sands; - Development and application of an environment management procedure; - Development and application of an inspection programme; - Monitoring of pumping activities (at the port, during the operations phase); - Production of incident reports; - Periodic verification of the effectiveness of the environmental emergency plan; - Writing of activity reports.
	Operations phase: - Dredge and floating separator sector; - Weir; - Access road linking the plant to the Ehoala port; - Ehoala storage area; - Ehoala port.		

PROTECTION AND MITIGATION MEASURES - SOIL

Potential impacts	Location of the potential impact	Proposed measures	Methods for monitoring application of the measure
Accidental heavy minerals spills.	**Operations phase:** - Mining site; - Road; - Port.	- Development of a decontamination plan.	- Production of incident reports.
Visual pollution (solid waste, old tires, scrap metal….).	**Construction and operations phases:** - Mining site; - Road; - Port.	- Storage of waste in an adequate location.	- Periodic inspection of the storage area.
Management of radioactive sands.	**Operations phase:** - Mining site.	- Effective homogeneisation of sand and monazite; - Implementation of programme for radioactivity monitoring.	- Follow-up of the homogeneity of the sand-monazite mixture.
Use of borrow material containing radioactive elements.	**Construction and operations phases:** - Mining site; - Road.	- Use of laterite in building installations needed to meet the applicable radiation protection standards.	- Measurement of uranium and thorium concentrations in installations containing laterites, in order to ensure that applicable radiation protection standards are met.

PROTECTION AND MITIGATION MEASURES - WATER (Run-off and seepage)

Potential impacts	Location of the potential impact	Proposed measures	Methods for monitoring application of the measure
Modification of drainage following development of various infrastructures (creation of ruts, hems and ridges…).	**Construction phase:** - Various construction sites (plant complex, excavation site of the basin for the floating separator, quarry, etc.).	- Restoration of the profile; - Drainage work; - Planting on the approaches of the work zones; - Development of an adequate drainage of the mined zones, including the evacuation of waters beyond sections being mined, especially the quarry; - Building, if necessary, of protective walls on the borders of cultivated areas; - Appropriate management of quarry sand: maximization of use or disposal.	- Preparation and monitoring of contractual terms; - Transmission of plans and specifications; - Monitoring of the work; - Determination of work methods; - Ensuring the supply of quality plants; - Production of activity reports; - Monitoring of sanding due to wind or run-off from neighbouring zones.

PROTECTION AND MITIGATION MEASURES - WATER (Hydrology and hydrogeology)

Potential impacts	Location of the potential impact	Proposed measures	Methods for monitoring application of the measure
Modification of water flows and levels.	**Construction and operations phases:** - Flow of the Mandromodromotra and Anony Rivers; - Level of Lake Ambavarano, during the construction of the weir.	- Plans and specifications in compliance with flow control conditions, according to the types of works.	- Monitoring follow-ups as regards the inflow of freshwater in the Mandena mining sector. Continuation of the programme actually underway; - Record-keeping; - Production of activity reports; - Transmission of plans and specifications for the weir.
Modification of the watercourse beds and flow.	**Construction phase:** - Crossings of the watercourses along the trail south of the village of Mandromodromotra; - Along the access road linking the separation plant and the Ehoala port.	- Rehabilitation of the watercourse banks and beds; - Clean up of the watercourses; - Development of culverts and construction of bridges that take into account the watercourses' hydrological features; - Design of the works for the occurrence of a 50 year flood recurrence.	- Preparation and monitoring of contractual terms; - Transmission of plans and specifications; - Monitoring of the work; - Preparation of a guide of sound environmental practices; - Production of activity reports.
Beginning of modifications to the hydrodynamic features of Fausse Baie des Galions.	**Construction phase:** - Breakwater at the Ehoala peninsula.	- Optimisation of the structure's concept, during detailed engineering phase of plans and specifications for the breakwater, as regards the works orientation and length, and this so as to minimise the impacts on hydrodynamic characteristics.	- Preparation and monitoring of contractual terms; - Transmission of plans and specifications; - Submittal of report of complementary study on modelling of wave action; - Monitoring of the work; - Instructions regarding the creation of wildlife habitats; - Production of activity reports.

PROTECTION AND MITIGATION MEASURES - WATER (Hydrology and hydrogeology)

Potential impacts	Location of the potential impact	Proposed measures	Methods for monitoring application of the measure
Modifications of the hydrodynamic characteristics of Fort-Dauphin Bay.	**Construction phase:** - Fort-Dauphin unloading dock.	- No measures.	- Preparation and monitoring of contractual terms; - Transmission of plans and specifications; - Monitoring of the work; - Production of activity reports.
Modification of the water-table level.	**Operations phase:** - Mining site operations sector.	- Rehabilitation of the mined sectors; - Choice of sites for the rehabilitation of wetlands based on expected lowering of the water-table.	- Reinstallation of the piezometers destroyed during dredging; calibration of the devices, and correlation with the ones they replace; - Continuation of piezometric monitoring, once environmental permit is obtained; - Densification of the monitoring network, if necessary (to be assessed in the final feasibility phase); - Continuation of actual monitoring of the water-table probes, using the existing network of wells (monthly reports); - Monitoring of the follow-up programme for freshwater inflow in the Mandena mining sector; - Record-keeping; - Ensuring the supply of quality plants; - Monitoring of the rehabilitation work; - Production of activity reports.
Modification of the water flow in the Anandrano River, when diverted.	**Operations phase:** - Operations sector northwest of the mining sector.	- Restoration of the river bed and course; - Biophysical inventory of the river, in order to identify sensitive zones (wildlife habitat, erosion, etc); - Installation of sediment barriers in any identified sensitive zones.	- Development of the sampling programme; - Determination of work methods; - Monitoring of the work; - Production of activity reports.

PROTECTION AND MITIGATION MEASURES - WATER (Hydrology and hydrogeology)

Potential impacts	Location of the potential impact	Proposed measures	Methods for monitoring application of the measure
Modification of the water balance characteristics and sedimentary balance of the freshwater and estuarine aquatic ecosystems.	**Construction and operations phases:** - Mandromodromotra River, Lake Ambavarano, upstream of the weir, and Anony River, downstream of the works.	- Weir ensuring a flow similar to that under natural conditions; - Definition of technical data with regard to the weir, and the spillways, in agreement with the populations; - Design of the weir for voluntary evacuation of a portion of the sediments, if deemed necessary subsequent to the work carried out during the detailed engineering phase (e.g., sedimentary balance and detailed modelling); - Maintenance dredging, in the event sedimentation deemed to cause a problem occurred during the operation of the weir.	- Preparation and monitoring of contractual terms; - Transmission of plans and specifications; - Monitoring of the follow-up programmes concerning freshwater inflow and sedimentation rate in Mandena's internal waters; - Record-keeping; - Production of activity reports.
Modification of the hydrodynamic characteristics of the western section of Fausse Baie des Galions.	**Construction and operations phases:** - At the Ehoala port site.	- No measures.	- Follow-up of the programme, as regards modifications to the hydrodynamic characteristics and water quality of Fausse Baie des Galions and Fort-Dauphin Bay; - Record-keeping; - Production of activity reports.

PROTECTION AND MITIGATION MEASURES - WATER (Water quality)

Potential impacts	Location of the potential impact	Proposed measures	Methods for monitoring application of the measure
Modification of the freshwater and estuarine aquatic environments' water quality.	**Construction phase:** - Anony River and Lake Ambavarano, during the construction of the weir. **Construction phase:** - Watercourses along the trail south of Mandromodromotra, as a result of a crossing; - Watercourses along the access roads to be built or improved.	- Execution of the work during periods other than the rainy season; - Stabilisation of the flood channel's banks prior to its opening. - Execution of the work during periods other than the heavy rain season; - Rehabilitation of the banks; - Rehabilitation of the watercourse beds; - Construction of sediment barriers; - Clean up of watercourses.	- Preparation and monitoring of contractual terms; - Transmission of plans and specifications; - Monitoring of the follow-up programme with regard to the water quality for aquatic life; - Preparation of a guide of sound environmental practices; - Monitoring of the work; - Production of activity reports.
	Operations phase: - Maintenance of the road linking the separation plant and the Ehoala port.	- Frequent maintenance; - Use of the appropriate work methods; - Use of rational pesticides and fertilizers.	- Verification of methods and of the work carried out; - Production of activity reports.
Increase in the turbidity in Fausse Baie des Galions and Fort-Dauphin Bay.	**Construction phase:** - Breakwater; - Development of the unloading dock at the Fort-Dauphin Port.	- No measures.	- Follow-up of the programme with regard to modifications in the hydrodynamic characteristics and water quality in Fausse Baie des Galions and Fort-Dauphin Bay; - Transmission of plans and specifications; - Monitoring of the work; - Activity reports.

PROTECTION AND MITIGATION MEASURES - WATER (Water quality)

Potential impacts	Location of the potential impact	Proposed measures	Methods for monitoring application of the measure
Increase in the turbidity of bodies of water during the dredging of mineral sands.	**Operations phase:** - Mandena mining sector, Lakes Ambavarano and Lanirano and, the Lanirano, Anandrano and Mandromodromotra Rivers.	- Maintenance of adequate drainage; - Maintenance of a green strip, 50 m in width, along the lakes and rivers; - Development of a retention basin, whenever necessary; - Rehabilitation of the bed and course of the Anandrano River, if river crossings are built.	- Follow-up of the programme with regard to the water quality for aquatic life as well as the sedimentation rate in Mandena's internal waters; - Transmission of plans and specifications; - Delineation of the green strip on the periphery of aquatic environments; - Determination of work methods; - Monitoring of the work; - Activity reports.

Biological components

Flora

- Littoral forest
- Wetland environment
- Open environment
- Freshwater environment
- Estuarine environment
- Marine environment

Fauna

- Littoral forest
- Wetland environment
- Open environment
- Freshwater environment
- Estuarine environment
- Marine environment

PROTECTION AND MITIGATION MEASURES - FLORA

Potential impacts	Location of the potential impact	Proposed measures	Methods for monitoring application of the measure
Loss of plant cover.	**Construction phase:** - Construction sites for the mineral separation plant, dredge, pumping station and approaches to the weir; - Sectors designated for the quarry and the temporary camp in Andriambe; - Sector for the storage area for ilmenite and hydrocarbons, at the Ehoala peninsula; - Access road linking the plant and the Ehoala port (north and south sections).	- Rehabilitation of the site for the implementation of the dredge (*); - Site rehabilitation programme, following the dismantling of the plant complex (*); - Rehabilitation of the approaches to the weir; - Restoration of the profile; - Planting on the approaches to the property; - Planting on the sides of the road right of way; - Planting of the banks of the watercourses on which there are crossings;	- Preparation and monitoring of contractual terms; - Transmission of engineering plans and specifications; - Follow-up of the production of organic matter (collection and conservation of top soil, compost, etc.); - Production of plans and specifications for the plantings (species, density, etc.); - Follow-up of the planting programmes and programmes for the community control of ligneous resources by forest authorities; - Monitoring of the work; - Implementation of the monitoring programme with regard to plantings outside the mining sector; - Production of activity reports.
Barrier effect, due to road embankment in the wetland environment, which results in an increase in hydromorphy and an invasion by hydrophilic species.	**Operations phase:** - North section of the road linking the separation plant and the Ehoala port, as well as the section linking the quarry to this road (plant-port).	- Number and adequate design of the structures for water balance (culverts, box drains, etc.).	- Transmission of engineering plans and specifications.

(*) The rehabilitation of open environment zones following operation or dismantling of infrastructures will include, after the initial profile has been restored, the incorporation of organic matter and the establishment of a grass cover, within the framework of ecological restoration, as well as the planting of fast-growing ligneous species.

PROTECTION AND MITIGATION MEASURES - FLORA

Potential impacts	Location of the potential impact	Proposed measures	Methods for monitoring application of the measure
Loss of plant specimens (littoral forest, wetland environments, open environments).	**Operations phase:** - Mined sector (mining plan).	- Maintenance of a conservation zone with a permanent status, thereby allowing it sufficient protection; ; - Rehabilitation of the mined zones (*); - Regeneration and in situ propagation of endemic plant species, both vulnerable and useful, in Mandena; - In situ and ex situ reforestation of native plant species; - Conservation of the seeds of certain endemic, rare or endangered species; - Rehabilitation of open environment zones and of wetlands that were non-productive prior to mining activities; - Information programme for stakeholders and the villagers concerned;	- Production of plans and specifications with regard to the plantings (species, density, etc.); - Follow-up of the production of organic matter (collection and conservation of top soil, compost, etc.); - Follow-up of the planting programmes and programmes for the community control of ligneous resources by forest authorities; - Follow-up, by forest authorities, of the status of conservation zones and the agreements reached with concerned populations (dina, etc.); - Ensuring the supply of quality crops; - Monitoring of the work; - Implementation of monitoring programmes regarding conservation and rehabilitation of the Mandena mining sector as well as the wildlife species and habitats; - Production of activity reports; - Providing information to the stakeholders.
An increase in illegal activity (gathering of ligneous products) following the opening of a new road.	**Operations phase:** - North and south sections of the road linking the separation plant and the Ehoala port.	- Information programme for stakeholders and the concerned populations, including the monitoring proposed in the GELOSE or similar agreements.	- Documentation and reporting of illegal activities to the forest authorities.

(*) The rehabilitation of open environment zones following operation or dismantling of infrastructures will include, after the initial profile has been restored, the incorporation of organic matter and the establishment of a grass cover, within the framework of ecological restoration, as well as the planting of fast-growing ligneous species.

MITIGATION AND PROTECTION MEASURES - FLORA

Potential impacts	Location of the potential impact	Proposed measures	Methods for monitoring application of the measure
Modification of plant life upstream of the weir (increase in the habitat available for freshwater plant species).	**Operations phase:** - Lake Ambavarano, Lake Besaroy and three kilometres of the Mandromodromotra River, upstream of its mouth.	- *Barringtonia sp.*, *Typha angustifolia* and cyperaceae plantings; - Information programme for stakeholders and the villagers concerned.	- Production of plans and specifications for the plantings (species, density, etc.); - Ensuring the supply of quality plants; - Monitoring of the work; - Monitoring of the follow up programs with regard to the conservation and rehabilitation of the Mandena mining sector as well as of the wildlife species and habitats; - Providing information to stakeholders and villagers; - Production of activity reports.
Risk of proliferation of the freshwater plant species introduced (ex. *Azolla* sp. introduced as part of the aquaculture programme).	**Operations phase:** - Lake Ambavarano, Lake Besaroy.	- Rational management of the introduced species.	- Monitoring by competent authorities of the plan for the management of introduced species.
Risk of plant life contamination as a result of a hydrocarbon spill.	**Operations phase:** - Ehoala port site.	- Environmental emergency plan; - Emergency equipment on site; - Recovery of hydrocarbons.	- Implementation of the environmental emergency plan; - Identification of material required and purchase of emergency material; - Periodic verification of the environmental emergency plan's effectiveness; - Production of activity reports.

PROTECTION AND MITIGATION MEASURES - FAUNA

Potential impacts	Location of the potential impact	Proposed measures	Methods for monitoring application of the measure
Loss of wildlife habitats and marine wildlife specimens.	**Construction phase:** - Breakwater construction site, in the Ehoala peninsula sector.	- Optimisation of the breakwater design, so as to promote colonisation by marine organisms, including rock lobster; - Information programme for stakeholders and the villagers concerned.	- Preparation and monitoring of contractual terms; - Transmission of engineering plans and specifications; - Preparation of specifications for the creation of wildlife habitats (specifications to promote introduction of wildlife at the breakwater site); - Inspection of the breakwater design by the competent authorities; - Monitoring of the work; - Monitoring of the programme with regard to the control of marine wildlife in the Ehoala sector; - Providing information to stakeholders and villagers; - Production of activity reports.

PROTECTION AND MITIGATION MEASURES - FAUNA

Potential impacts	Location of the potential impact	Proposed measures	Methods for monitoring application of the measure
Modification of the composition of aquatic populations.	**Construction and operations phases:** - Upstream of the weir.	- Development of the weir so as to enable fish species to migrate between the estuarine and freshwater environments; - Creation of wildlife habitats; - Fish stocking with freshwater fish species upstream of the weir. The fish species will be those species found in the region's lacustrine systems, thus typical of these environments; - Development of spawning grounds, by planting aquatic plant species that promote the reproduction of the introduced species; - Information programme for stakeholders and the villagers concerned.	- Preparation and monitoring of contractual terms; - Transmission of engineering plans and specifications; - Monitoring of the follow-up programme, with regard to the aquatic fauna upstream and downstream of the weir; - Development of specifications for the creation of wildlife habitats (specifications to prom ote the introduction of wildlife); - Monitoring of civil engineering works; - Providing information to stakeholders and villagers; - Production of activity reports.

PROTECTION AND MITIGATION MEASURES - FAUNA

Potential impacts	Location of the potential impact	Proposed measures	Methods for monitoring application of the measure
Loss of fauna specimens; Loss of wildlife habitats; Relocation of animals.	**Operations phase:** - Sector downstream of the dredge.	- Maintenance of a conservation zone (see measures – flora); - Rehabilitation of the mined zones (see measures – flora); - Restoration of the wildlife habitats typical of the littoral forest and the wetland environment; - Development of attractive sites to promote the return of wildlife: perches, refuges, etc.; - Translocation of wildlife specimens to the conservation zone; and - Information programme for stakeholders and the villagers concerned.	- Verification of the mining plan; - Fauna inventory, prior to dredging works; - Capturing of target species and translocating to favourable zones; - Development of specifications for the creation of wildlife habitats (specifications for promoting the introduction of wildlife); - Monitoring of rehabilitation work; - Control of the plan for restoring wildlife habitats by forest authorities; - Monitoring of the follow-up programme with regard to conservation and rehabilitation of the Mandena mining sector as well as the wildlife species and habitats; - Providing information to stakeholders and villagers; - Production of activity reports.
Disturbance of marine mammals, more specifically whales, by the noise resulting from construction work, dredging and other activities.	**Construction and operations phases:** - The areas in and around Fausse Baie des Galions and Fort-Dauphin.	- Respect of international agreements and laws of Madagascar concerning maritime transport; - Provide maritime operators with information on the measures to be followed when whales are present (ex. slowing down speed of ships).	- Development of an information programme for ship owners; - Monitoring of the programme for the follow-up of marine wildlife in the Ehoala sector; - Production of activity reports.

PROTECTION AND MITIGATION MEASURES - FAUNA

Potential impacts	Location of the potential impact	Proposed measures	Methods for monitoring application of the measure
Loss of wildlife habitats and habitat fragmentation.	**Construction phase:** - North and south sections of the road linking the separation plant and the Ehoala port.	- Planting along the rights-of-way; - Design of the culverts taking into consideration flow of water and promoting the passage of herpetofauna.	- Preparation and monitoring of contractual terms; - Transmission of engineering plans and specifications; - Production of plans and specifications for the plantings (species, density, etc.); - Monitoring of the work; - Follow-up of the programmes concerning the monitoring of plantings outside of the mining sector as well as wildlife species and habitats; - Production of activity reports.
Increase in illegal activities (poaching) following the opening of a new road.	**Operations phase:** - North and south sections of the road linking the separation plant to the Ehoala port.	- Information programme for stakeholders and the concerned populations, including the monitoring proposed in the GELOSE and similar agreements.	- Documentation and reporting of illegal activities to the authorities.
Habitat fragmentation; Risk of accidents involving QMM trucks.	**Operations phase:** - South, central and north sections of the road linking the separation plant to the Ehoala port.	- Planting along the sides of the roads; - Vehicular traffic prohibited and along the rights-of-way.	- Production of plans and specifications for the plantings (species, density, etc.); - Ensuring the supply of quality plants; - Monitoring of the work; - Reports of accidents involving wildlife; - Information awareness programme for QMM employees; - Production of activity reports.

PROTECTION AND MITIGATION MEASURES - FAUNA

Potential impacts	Location of the potential impact	Proposed measures	Methods for monitoring application of the measure
Disturbance of aquatic habitats.	**Construction phase:** - South and north sections of the road linking the separation plant and the Ehoala port.	- Clean up of the watercourses; - Planting of the banks of the watercourses; - Development of culverts and construction of bridges that take into account the hydrological characteristics of the watercourses.	- Production of plans and specifications for the plantings (species, density, etc.); - Preparation of a guide of sound environmental practices with regard to the crossing and the building of structures crossing the watercourses; - Monitoring of the work; - Information and awareness programme for QMM employees; - Production of activity reports.

Social components

Health

- Air emissions
- Noise environment
- Community health
- Public safety
- Occupational health and safety

PROTECTION AND MITIGATION MEASURES - HEALTH (Air emissions)

Potential impacts	Location of the potential impact	Proposed measures	Methods for monitoring application of the measure
Increase in the rate of particles and pollutants in the air.	**Construction phase:** - Improved road network and mining sector access roads; - Transport of material and equipment to the various construction sites; - Dredge and floating separator; - Mineral separation plant; - Weir and pumping station; - Fort-Dauphin unloading dock; - Andriambe quarry; - Ehoala storage area and breakwater; - Road linking the quarry to the Ehoala port; - New road between the separation plant and the Ehoala port; - Existing, improved road between the quarry and the unloading dock; - Existing, improved road between the separation plant and the unloading dock.	- Planting along the sides of the road; - Construction site equipment and trucks in good working condition; - Installation of tarpaulins on the truck boxes; - Spreading of dust-control liquid; - Promote daytime work; - IEC occupational health and safety programme; - Application of work standards with regard to the building of infrastructures; - Workers wearing suitable dust-control respirators; - Respect of the speed limit by all rolling stock; - Maintenance and inspection of rolling stock	- Production of plans and specifications for the plantings (species, density, etc.); - Ensuring the supply of quality plants; - Monitoring of the work; - Implementation of an environment management process regarding air emissions; - Purchase of dust-control liquid; - Handling and follow-up of complaints; - Development of maintenance and inspection programmes for rolling stock; - Production of activity reports; - Implementation of the IEC programme; - Monitoring of the follow-up programme; - Purchase and effective use of dust-control respirators; - Implementation of sound environmental practices for the building of infrastructures; - Preparation and publishing of reports; - Development and implementation of the maintenance and inspection programme for rolling stock; - Inspection and monitoring of air quality.

PROTECTION AND MITIGATION MEASURES - HEALTH (Air emissions)

Potential impacts	Location of the potential impact	Proposed measures	Methods for monitoring application of the measure
Increase in the rate of airborne particles and pollutants as a result of the operations of various infrastructures.	**Operations phase:** - Transhipment of ores at the Ehoala port; - Storage of ores at the Ehoala storage area; - Traffic on the road linking the separation plant and the Ehoala port; - Activities at the separation plant site; - Operations at the mining site (stripping, rehabilitation); - Mineral mining activities.	- Construction site equipment and trucks in good working condition; - Installation of tarpaulins on the truck boxes; - Spreading of dust-control liquid; - Clean up of road surfaces; - Storage of ilmenite in silos; - IEC occupational health and safety programme; - Wearing of dust-control respirators; - Use of signage; - Use of screens in critical areas; - Levelling of light sand dunes in the floating separator plant sector; - Reduction of airborne emissions from the power plant; - Trapping of dust at the hood exits; - Maintenance and inspection of rolling stock.	- Preparation and monitoring of contractual terms; - Transmission of engineering plans and specifications; - Implementation of an environment management procedure regarding airborne emissions; - Monitoring of the follow-up programme with regard to air emissions; - Purchase of dust-control liquid; - Maintenance of the sites of operations; - Handling and follow-up of complaints; - Production of activity reports; - Follow-up of the application of the IEC programme; - Purchase and effective use of dust-control respirators; - Implementation of the road safety regulations in force; - Installation of signage; - Development and implementation of the inspection and maintenance programme for rolling stock; - Inspection and monitoring of air quality.

PROTECTION AND MITIGATION MEASURES - HEALTH (Air emissions)

Potential impacts	Location of the potential impact	Proposed measures	Methods for monitoring application of the measure
Increase in the rate of airborne particles and pollutants as a result of the operations of various infrastructures.	**Operations phase:** - Mining site (stripping, rehabilitation).	- Maintenance of a green zone around the mining sector; - Wearing of dust-control respirators.	- Specifications to the mining plan; - Monitoring of the work; - Marking of the zone; - Production of activity reports; - Purchase of dust-control respirators.
	Operations phase: - Power plant and dryer.	- Equipment for trapping airborne emissions at the power plant and the dryer; - Use of anti-pollution systems that meet the international standards in force.	- Preparation and monitoring of contractual terms; - Transmission of engineering plans and specifications; - Monitoring of the follow-up programme with regard to air emissions; - Follow-up of complaints; - Production of activity reports.

PROTECTION AND MITIGATION MEASURES - HEALTH (Noise environment)

Potential impacts	Location of the potential impact	Proposed measures	Methods for monitoring application of the measure
Disturbance of urban residents and villagers by the noise and vibrations resulting from the works.	**Construction phase:** - Port community of Fort-Dauphin and villages of Bezavo and Tananado: construction and unloading dock operations; - Central areas in Fort-Dauphin: improvement to sections of RN12A; - Village of Lafitsinana and Club nautique Vinanibe: construction and operation of the temporary camp and the quarry at Andriambe; - Villages of Evatraha and Andrakaraka: improvements to RN12A and the trail south of the Mandromodromotra River, as well as construction of the weir; - Communities of Bezavona and Ampamakiambato: construction and use of the central section of the road linking the separation plant and the Ehoala port; - Villages of Ambinanibe and Ampasy-Nahampoana: construction and use of the north and south sections of the road linking the separation plant and the Ehoala port; - Villages of Ampasy, Imangaika and Andrakaraka: construction of the separation plant and operation of the dredge and the floating separator; - Village of Andrakaraka: operations of the pumping station on the shore of Lake Ambavarano; - Village of Ambinanibe: construction of the port and the storage area on the Ehoala peninsula.	- Emphasize daytime work; - Construction site equipment and trucks in good working condition and in compliance with noise emission standards; - Construction of a sound barrier with fill, on the perimeter of the Andriambe quarry; - Information programme for stakeholders and the villagers concerned.	- Preparation and monitoring of contractual terms; - Transmission of engineering plans and specifications; - Determination of work methods; - Monitoring of the work; - Inspection of construction site equipment; - Optimisation of work planning (carrying out noisy activities during the day); - Monitoring of the follow-up programme with regard to the noise environment; - Development of additional noise abatement structures, if necessary; - Follow-up on complaints; - Preparation of incident reports documenting residents' concerns and the effectiveness of the proposed corrective measures (statistics on the effects of noise): - Providing information (IEC); - Production of activity reports.

PROTECTION AND MITIGATION MEASURES - HEALTH (Noise environment)			
Potential impacts	**Location of the potential impact**	**Proposed measures**	**Methods for monitoring application of the measure**
Disturbance of urban residents and villagers by the noise and vibrations resulting from the works.	**Operations phase:** - Communities of Bezavona and Ampamakiambato: use of the central section of the road linking the separation plant and the Ehoala port; - Villages of Ambinanibe and Ampasy-Nahampoana: use of the north and south sections of the road linking the separation plant and the Ehoala port; - Villages of Ampasy, Imangaika and Andrakaraka: operation of the separation plant, the dredge and the floating separator; - Village of Andrakaraka: operation of the pumping station on the shore of Lake Ambavarano; - Village of Ambinanibe: operation of the port and storage area at the Ehoala peninsula.	- Clean up of road surfaces; - Maintenance of a green zone around the mining sector; - Information programme for stakeholders and the villagers concerned.	- Determination of work methods; - Monitoring of the work; - Inspection of construction site equipment; - Optimisation of work planning (noisy activities during the day); - Monitoring of the follow-up programme with regard to the noise environment; - Development of additional noise abatement structures, if necessary; - Follow-up on complaints; - Preparation of incident reports documenting residents' concerns and the effectiveness of the proposed corrective measures (statistics on the effects of noise): - Distribution of information (IEC); - Production of activity reports.

PROTECTION AND MITIGATION MEASURES - HEALTH (Community health)			
Potential impacts	**Location of the potential impact**	**Proposed measures**	**Methods for monitoring application of the measure**
Potential increase in community health problems (STDs, HIV/AIDS, etc.) resulting from the presence of workers from outside the region.	**Construction phase:** - Site of the temporary camp and the quarry at Andriambe ; - Site of the temporary camp and the separation plant at Mandena.	- Construction of camps far from inhabited areas; - Medical examination of workers prior to their arrival at the temporary camp; - Programme of regular medical check-ups for workers; - Awareness programme for workers; - Monitoring of off-site activities outside of working hours; - Awareness campaign for the populations at risk in Fort-Dauphin, with the assistance of medical authorities and concerned community organisations.	- Prescription of the off-site activities restricted by the employer outside of working hours; - Monitoring of workers' off-site activities outside of working hours; - Monitoring of the follow-up programme with regard to poverty in the Fort-Dauphin region ; - Identification of additional measures, with the assistance of medical authorities and concerned community organisations, if necessary as a result of an evolution in the state of health of the populations at risk; - Distribution of information (IEC); - Production of activity reports; - Periodic and systematic medical follow-up of workers
Potential increase in community health problems (STDs, HIV/AIDS, etc.) resulting from the presence of workers from outside the region.	**Operations phase:** In the Fort-Dauphin region.	- Awareness development programmes for employees and their families, on the health issues related to their presence in the region; - Strict rules concerning interaction with local populations; - Medical follow-up of employees: - Awareness campaign for the populations at risk in Fort-Dauphin, with the assistance of medical authorities and concerned community organisations.	- Monitoring of the follow-up programme with regard to poverty in the Fort-Dauphin region; - Identification of additional measures, with the assistance of medical authorities and concerned community organisations, if necessary as a result of an evolution in the state of health of the populations at risk; - Distribution of information (IEC); - Production of activity reports; - Periodic and systematic medical follow-up of workers.

PROTECTION AND MITIGATION MEASURES - HEALTH (Community health)

Potential impacts	Location of the potential impact	Proposed measures	Methods for monitoring application of the measure
Increase in waterborne diseases, such as bilharzias, as a result of the transformation of Lake Ambavarano into a freshwater lake.	**Operations phase:** - Mining site; - Lake Ambavarano.	- Introduction of fish, compatible with the ecosystem, that prey on the intermediate hosts in the lake.	- Assessment of the prevalence of waterborne diseases prior to the change from salt water to fresh water; - Monitoring of vectors and intermediate hosts for the presence of pathogens; - Control of water quality; - Monitoring of statistics on waterborne diseases.
Change in the quality of the water from wells or drinking water sources, as a result of the dust raised by the work and the movement of trucks.	**Construction and operations phases:** - Communities of Bezavona and Ampamakiambato in Fort-Dauphin: construction and use of the central section of the road linking the separation plant to the Ehoala port.	- Construction site equipment and trucks in good working condition; - Spreading of dust-control liquid; - Installation of tarpaulins on the truck boxes; - Protection of wells and water sources; - Ban on the use of wells and potable water sources for work-related purposes; - Information programme for stakeholders and the villagers concerned.	- Preparation and monitoring of contractual terms; - Identification of sources of water that are at risk and determination of work methods; - Inspection of construction site equipment and trucks; - Monitoring of work close to sources of water that are at risk; - Monitoring of the follow-up programme with regard to domestic water quality; - Production of incident reports documenting cases of contamination, complaints and the effectiveness of the proposed corrective measures; - Production of activity reports.

PROTECTION AND MITIGATION MEASURES - HEALTH (Public safety)

Potential impacts	Location of the potential impact	Proposed measures	Methods for monitoring application of the measure
Risk of accidents involving QMM vehicles and potential danger for villagers, in the work zones and the various zones of activity at the sites.	**Construction phase:** - Unloading dock in the Fort-Dauphin Port; - Road sections used at Fort-Dauphin; - Site of the temporary camp and the quarry at Andriambe; - Site of the temporary camp and the separation plant at Mandena; - Dredge and floating separator sector in Mandena; - Pumping station at Lake Ambavarano; - Weir at the outflow of Lake Ambavarano; - Port and storage area at the Ehoala peninsula.	- Work areas fenced and secured; - Maintenance of a public access to the beach, near the Ehoala port; - Development of a foot path, parallel to the highway, near the Ehoala port; - Movement of trucks in secured convoys; - Training and awareness development of truck drivers; - Respect for speed limits and implementation of adequate signs; - Information programme for stakeholders and the villagers concerned; - Establishment of major guarded crossings or of wide-turn crescents or, of any other installation allowing the safe movement of users (which will be defined during the final feasibility phase). - In the activity inhabited zones, eventual construction of a lane reserved to villagers or widening of the road; - Implementation and respect of procedures for peaceful resolution of potential conflicts resulting from accidents involving persons or livestock.	- Preparation and monitoring of contractual terms; - Transmission of engineering plans and specifications; - Monitoring of the follow-up programme for road safety; - Determination of work methods; - Monitoring of the work; - Monitoring of the roads; - Verification of driver skills; - Production of incident reports documenting accidents, the concerns expressed by the populations and the effectiveness of the proposed corrective measures (Identification of black spots); - Distribution of information (IEC); - Production of activity reports; - Emergency assistance in the case of an accident involving a QMM vehicle; - Periodic medical check-ups and follow-ups of employees; - Periodic inspection of motor vehicles and construction site equipment.

PROTECTION AND MITIGATION MEASURES - HEALTH (Public safety)

Potential impacts	Location of the potential impact	Proposed measures	Methods for monitoring application of the measure
Risk of accidents with QMM vehicles and potential danger for villagers, in the work zones and the various zones of activity at the sites.	**Operations phase:** - Ehoala port and storage area sector; - Separation plant; - Dredge and floating separator sector; - Weir; - Road linking the plant to the Ehoala port.	- Road surface sufficiently wide so as to ensure the safety of all pedestrian and motor traffic; - Development of reserved lanes for traffic other than motor vehicles (port zone); - Secured activity areas; - Training and awareness development programme for truck drivers regarding safety rules; - Respect for speed limits and implementation of appropriate signs; - Information programme for stakeholders and the villagers concerned.	- Preparation and monitoring of contractual terms; - Transmission of engineering plans and specifications; - Implementation of the road safety monitoring programme; - Determination of work methods; - Monitoring of the roads; -Verification of driver skills; - Production of incident reports documenting accidents, concerns expressed by the populations and the effectiveness of the proposed corrective measures (identification of black spots); - Distribution of information (IEC); - Production of activity reports; - Periodic medical check-ups and follow-ups for employees; - Periodic inspection of motor vehicles and construction site equipment.

PROTECTION AND MITIGATION MEASURES - HEALTH (Occupational health and safety)

Potential impacts	Location of the potential impact	Proposed measures	Methods for monitoring application of the measure
Potential occupational accidents involving QMM employees.	**Construction phase:** - Unloading dock in the Fort-Dauphin port; - Construction and improvement of stretches of road in Fort-Dauphin; - Site of the temporary camp and quarry at Andriambe; - Site of the temporary camp and separation plant at Mandena; - Dredge and floating separator sector in Mandena; - Pumping station at Lake Ambavarano; - Weir at the outflow of Lake Ambavarano; - Port and storage area at the Ehoala peninsula. **Operations phase:** - Storage area and port sector in Ehoala; - Separation plant; - Dredge and floating separator sector in Mandena; - Road linking the plant and the Ehoala port.	- Occupational health and safety training programmes; - Respect, by the workers, of safety measures; - Compliance by QMM with the health and safety standards in force in Madagascar; - Compliance by QMM with the health and safety standards prescribed by Rio Tinto; - Promote the daytime transport of material and equipment.	- Preparation and monitoring of contractual terms; - Determination of work methods; - Monitoring of the health and safety of workers; - Optimisation of work planning (carry out noisy activities during the daytime); - Production of incident reports documenting accidents, concerns expressed by the workers and the effectiveness of the proposed corrective measures; - Production of activity reports; - Periodic medical check-ups and follow-ups for employees; - Periodic inspection of motor vehicles and construction site equipment.

PROTECTION AND MITIGATION MEASURES - HEALTH (Occupational health and safety)

Potential impacts	Location of the potential impact	Proposed measures	Methods for monitoring application of the measure
Risk of accidental exposure to radiation for QMM employees.	**Operations phase:** - Separation plant complex in Mandena; - Mining site, at the site of dredging operation sites; - Zircon storage area; - Transhipment of minerals at the port.	- Occupational health and safety training programmes; - Radiation was taken into consideration during the engineering phase and with respect to operational practices; - Respect of safety measures; - Installation of protective screens between the workers and the source of pollution; - Management of exposure in high-radiation sectors;	- Determination of work methods; - Monitoring of the follow-up programme regarding radioactivity, in compliance with the laws of Madagascar on radiation protection; - Production of incident reports documenting accidents, concerns expressed by the workers and the effectiveness of the proposed corrective measures; - Production of activity reports.

Social components

Land use

- Residential, industrial, commercial and institutional buildings
- Public utilities
- Exploitation of agricultural and grazing resources
- Exploitation of halieutic resources
- Exploitation of forest resources
- Tourism potential

PROTECTION AND MITIGATION MEASURES - USE OF THE TERRITORY

Potential impacts	Location of the potential impact	Proposed measures	Methods for monitoring application of the measure
Potential loss of forested areas.	**Construction phase:** - Villages of Ampasy-Nahampoana and Mandromodromotra: construction of the north section of the road linking the separation plant to the Ehoala port; - Village of Ambinanibe: construction of the road linking the Andriambe quarry and the Ehoala port. **Operations phase:** - Mining site.	- QMM will comply with the procedures prescribed by the laws of Madagascar; - Planting by QMM of 500 ha of trees by QMM over 5 years (2002-2007); - Information programme for stakeholders and the villagers concerned; - Compensation of owners in compliance with the mining code; - Compensation for loss of revenue by the users concerned, by indemnification or support for other revenue-generating activities in compliance with the mining code.	- Production of plans and specifications for the plantings (species, density, etc.); - Ensuring the supply of quality plants; - Monitoring of the work; - Monitoring of the follow-up programme for plantings outside the mining sector; - Distribution of information; - Production of activity reports; - Following of the monitoring programme for indemnification and compensation .
Relocation of residential and commercial buildings.	**Construction phase:** - Communities of Bezavona and Ampamakiambato: construction of the central section of the road linking the separation plant and the Ehoala port; - Village of Ambinanibe: development of the storage area at the Ehoala peninsula.	- QMM will comply with the procedures prescribed by the laws of Madagascar; - Optimisation of the detailed plans and specifications for the Fort-Dauphin bypass road (central section) so as to avoid having to move buildings; - Information programme for stakeholders and the villagers concerned; - Indemnification of owners in compliance with the mining code.	- Preparation and monitoring of contractual terms; - Transmission of engineering plans and specifications; - Monitoring of the work; - Monitoring of the follow-up programme regarding use of the territory; - Production of incident reports documenting the concerns expressed by the population and the effectiveness of the proposed corrective measures; - Distribution of information; - Production of activity reports; - Monitoring of the follow-up programme for indemnification and compensation .

PROTECTION AND MITIGATION MEASURES - USE OF THE TERRITORY

Potential impacts	Location of the potential impact	Proposed measures	Methods for monitoring application of the measure
Creation of precarious housing units.	**Construction and operations phases:** - In the vicinity of the operations and construction sites.	- QMM will favour the recruitment of local workers, in so far as the needed skills are available and within the limits prescribed by regulations; - Support for the establishment and implementation of a plan for land use by competent bodies.	- Monitoring of the follow-up programme regarding use of the territory ; - Monitoring of the follow-up programme regarding economic spin-offs from the project; - Production of reports documenting the building of precarious housing units and the effectiveness of the proposed mitigation measures; - Distribution of information; - Production of activity reports.
Relocation of public utilities equipment (electricity poles, water mains, etc.).	**Construction phase:** - Communities of Bezavona and Ampamakiambato: construction of the central section of the road linking the separation plant and the Ehoala port; - Village of Ambinanibe: development of the storage area on the Ehoala peninsula; - Improvement of certain stretches of road.	- QMM will comply with the procedures prescribed by the laws of Madagascar; - Implementation of the necessary measures for maximum reductions of service interruptions; - Information programme for stakeholders and the villagers concerned.	- Preparation and monitoring of contractual terms; - Transmission of engineering plans and specifications; - Monitoring of the work; - Monitoring of the follow-up programme regarding use of the territory; - Production of incident reports documenting the concerns expressed by the population and the effectiveness of the proposed corrective measures; - Distribution of information; - Production of activity reports.

PROTECTION AND MITIGATION MEASURES - USE OF THE TERRITORY

Potential impacts	Location of the potential impact	Proposed measures	Methods for monitoring application of the measure
Loss of agricultural and grazing lots and felling of fruit trees.	**Construction phase:** - Communities of Bezavona and Ampamakiambato: construction of the central section of the road linking the separation plant and the Ehoala port; - Fort-Dauphin: road linking the Andriambe quarry and the Ehoala port; - Village of Ambinanibe: development of the storage area at the Ehoala peninsula.	- QMM will comply with the procedures prescribed by the laws of Madagascar; - Optimisation of the detailed design of the plans and specifications so as to avoid the loss of agricultural and grazing land; - Indemnification for the operators, or compensation by other revenue - generating activities, in compliance with the mining code; - Programme supporting the relocated operations; - Information programme for stakeholders and the villagers concerned, with the aim of organizing a system of community management.	- Preparation and monitoring of contractual terms; - Transmission of engineering plans and specifications; - Monitoring of the work; - Follow-up of the monitoring programme regarding use of the territory; - Production of incident reports documenting the concerns expressed by the population and the effectiveness of the proposed corrective measures; - Distribution of information; - Production of activity reports.
Potential damage to crops as a result of the work and the movement of trucks.	**Construction phase:** - Villages of Ambinanibe and Ampasy-Nahampoana: construction and use of the north and south sections of the road linking the separation plant and the Ehoala port.	- QMM will comply with the procedures prescribed by the laws of Madagascar; - Demarcation of agricultural zones; - Installation of barriers; - Identification of bypasses to agricultural land; - Use of tarpaulins on the truck boxes; - Compensation for losses in compliance with the mining code; - Information programme for stakeholders and the villagers concerned.	- Preparation and monitoring of contractual terms; - Transmission of engineering plans and specifications; - Monitoring of the work; - Monitoring of the follow-up programme regarding use of the territory; - Production of incident reports documenting the concerns expressed by the population and the effectiveness of the proposed corrective measures; - Distribution of information; - Production of activity reports.

PROTECTION AND MITIGATION MEASURES - USE OF THE TERRITORY

Potential impacts	Location of the potential impact	Proposed measures	Methods for monitoring application of the measure
Possible disturbance of villagers' agricultural activities and lifestyle.	**Operations phase:** - Villages of Ampasy-Nahampoana and Mandromodromotra: operation of the separation plant, dredge and floating separator at Mandena.	- QMM will comply with the procedures prescribed by the laws of Madagascar; - Rehabilitation of grazing land; - Programme supporting the relocated operations; - Information programme for stakeholders and the villagers concerned aimed at organizing a system of community management.	- Preparation and monitoring of contractual terms; - Determination of work methods; - Monitoring of the work; - Monitoring of the follow-up programme regarding use of the territory; - Production of incident reports documenting the concerns expressed by the population and the effectiveness of the proposed corrective measures; - Distribution of information; - Production of activity reports.
Loss of aquatic resources and loss of revenue for fishermen.	**Construction phase:** - Villages of Evatraha and Andrakaraka: construction of the weir; - Fort-Dauphin port sector: construction and operation of the unloading dock at Fort-Dauphin.	- Programme for the seeding (or) raising (aquaculture) of those aquatic species sought by fishermen; - Information programme for the concerned fishermen, aimed at organizing a system of community management of resources; - Indemnification for the fishermen, or support with regard to other similar revenue-generating activities.	- Preparation and monitoring of contractual terms; - Transmission of engineering plans and specifications; - Monitoring of the work; - Monitoring of the follow-up programme with regard to the exploitation of aquatic resources upstream and downstream of the weir and in the marine environment (Ehoala peninsula); - Production of incident reports documenting the concerns expressed by the population and the effectiveness of the proposed corrective measures; - Distribution of information; - Production of activity reports.

PROTECTION AND MITIGATION MEASURES - USE OF THE TERRITORY

Potential impacts	Location of the potential impact	Proposed measures	Methods for monitoring application of the measure
Loss of the dugout canoe draw-up site on the eastern shore of the Ehoala peninsula (Fausse Baie des Galions side), with possibility of conflict between the fishermen.	**Construction phase:** - Village of Ambinanibe: construction of the port and the storage area at the Ehoala peninsula.	- Relocation of the site to draw boats and establishment of a trail leading to it or, alternatively, another acceptable mitigation solution to be defined during the final feasibility phase; - Information programme for the concerned fishermen, aimed at organizing a system of community management of resources.	- Preparation and monitoring of contractual terms; - Transmission of engineering plans and specifications; - Monitoring of the work; - Production of incident reports documenting the concerns expressed by the population and the effectiveness of the proposed corrective measures; - Distribution of information; - Production of activity reports.
Loss of riparian fishing sites.	**Construction phase:** - Village of Andrakaraka: construction and operation of the pumping station on the banks of Lake Ambavarano.	- Information programme for the concerned fishermen, aimed at organizing a system of community management of resources; - Compensation for loss of revenue through indemnification or other similar revenue-generating activities.	- Preparation and monitoring of contractual terms; - Transmission of engineering plans and specifications; - Monitoring of the work; - Monitoring of the follow-up programme with regard to the exploitation of aquatic resources upstream and downstream of the weir and in the marine environment (Ehoala peninsula); - Production of incident reports documenting the concerns expressed by the population and the effectiveness of the proposed corrective measures; - Distribution of information; - Production of activity reports.

PROTECTION AND MITIGATION MEASURES - USE OF THE TERRITORY

Potential impacts	Location of the potential impact	Proposed measures	Methods for monitoring application of the measure
Increase in halieutic resources near the Ehoala peninsula.	**Operations phase:** - Breakwater sector.	- Creation of new fauna habitats following the set up of the derrick stones for construction of the breakwater; - Information programme for the concerned fishermen, aimed at organizing a system of community management of resources.	- Preparation and monitoring of contractual terms; - Transmission of engineering plans and specifications; - Monitoring of the work; - Monitoring of the follow-up programme with regard to the exploitation of aquatic resources upstream and downstream of the weir and in the marine environment (Ehoala peninsula); - Periodic production of reports on the effect of the breakwater on the halieutic activities of neighbouring villages; - Distribution of information; - Production of activity reports.

PROTECTION AND MITIGATION MEASURES - USE OF THE TERRITORY

Potential impacts	Location of the potential impact	Proposed measures	Methods for monitoring application of the measure
Loss of aquatic resources and revenue, as well as impediment to navigation for fishermen.	**Operations phase:** - Villages of Evatraha and Andrakaraka: presence and operation of the weir.	- Hiring of a resource specialised in the area of aquatic fauna and fisheries management; - Support for a reorientation towards other revenue-generating activities; - Indemnification for the construction phase, in compliance with the mining code; - Consultation with public utilities and fishermen for the structure's design; - Conducting a study on the aquatic populations and their exploitation, as well as on the potential market and consequences on eating habits; - Restoration of aquatic environments (aquaculture, development of spawning grounds); - Conservation and sustainable management of freshwater species (evaluation of the Andrakaraka fishing ground, group of freshwater and brackish water fishermen); - Conservation and sustainable management of the coastal zone (evaluation of the Evatraha fishing ground, marine fishermen grouping); - Information programme for the concerned fishermen, aimed at organizing a system of community management of resources.	- Monitoring of the follow-up programme with regard to the exploitation of aquatic resources upstream and downstream of the weir and in the marine environment (Ehoala peninsula); - Production of incident reports documenting the concerns expressed by the population and the effectiveness of the proposed corrective measures; - Distribution of information; - Production of activity reports; - Support the supply of species that have adapted to the environment's new conditions.

PROTECTION AND MITIGATION MEASURES - USE OF THE TERRITORY

Potential impacts	Location of the potential impact	Proposed measures	Methods for monitoring application of the measure
Disturbance of villagers' lifestyle as well as that of the forest resource operators.	**Construction and operations phases:** - Villages of Ampasy-Nahampoana and Mandromodromotra: operation of the separation plant and of the dredge and floating separator at Mandena.	- Rehabilitation and restoration of mining areas (see measures – flora); - Planting by QMM of 500 ha of trees over 5 years (2002-2007); - Maintenance of a conservation zone (see measures – flora); - Reintroduction of prized wildlife species in conjunction with villagers; - Definition of the appropriate mitigation measures with regard to the impacts of this introduction; - Information programme for stakeholders and the villagers concerned aimed at organizing community management of resources.	- Production of plans and specifications for the plantings (species, density, etc.); - Ensuring the supply of quality plants; - Monitoring of a follow-up programme with regard to the wildlife species introduced; - Monitoring of the work; - Follow-up of the programme for the monitoring of the Mandena mining sector conservation and rehabilitation as well as the exploitation of plant resources in the mining sector prior to mining activities; - Production of incident reports documenting the concerns expressed by the population and the effectiveness of the proposed corrective measures; - Distribution of information; - Production of activity reports.
Disturbance of villagers' lifestyle in the Mandena zone, with regard to the exploitation of the wetlands.	**Operations phase:** - Mining site.	- QMM will comply with the procedures prescribed by the laws of Madagascar; - Restoration of the wetlands, as part of the rehabilitation of the mined areas.	- Production of plans and specifications for the plantings (species, density, etc.); - Ensuring the supply of quality plants on the wetlands targeted for rehabilitation, so as to ensure that they are sufficient (quantity and quality); - Monitoring of the work; - Documentation of the concerns expressed by the population and with regard to the effectiveness of the proposed corrective measures; - Distribution of information; - Production of activity reports.

Social components

Culture and heritage

- Burial sites, sacred sites and heritage sites
- Landscapes of interest

PROTECTION AND MITIGATION MEASURES - CULTURE AND HERITAGE (Funeral sites)

Potential impacts	Location of the potential impact	Proposed measures	Methods for monitoring application of the measure
Concerns with regard to the proximity of QMM's activities and the potential loss or desecration of burial sites or sacred sites as well as a potential loss of the sense of place of the surrounding environment.	**Construction and operations phases:** - Communities of Bezavona and Ampamakiambato: construction and use of the central section of the road linking the separation plant to the Ehoala port; - Villages of Ambinanibe and Ampasy-Nahampoana: construction and use of the north and south sections of the road linking the separation plant and the Ehoala port; - Villages of Ampasy, Imangaika and Andrakaraka: construction of the separation plant and operation of the dredge and the floating separator; - Village of Andrakaraka: operation of the pumping station on the shore of Lake Ambavarano; - Village of Ambinanibe: construction of the port and the storage area at the Ehoala peninsula.	- QMM will comply with the procedures prescribed by the laws of Madagascar; - Respect for the distance requirements called for under the Mining Code of Madagascar; - Informing the villagers concerned; - Concertation with the villagers concerned, for the implementation and monitoring of measures for the protection of burial sites and for the identification and at implementation at QMM's expense, of means of removing constraints; - Ensuring access to the burial sites; - Control of the movements of the foreign labour force; - Preparation and distribution of a guide of conduct for employees; - Information programme for stakeholders and the villagers concerned.	- Preparation and monitoring of contractual terms; - Transmission of engineering plans and specifications; - Determination of work methods; - Monitoring of the work; - Monitoring of the follow-up of the programme of traditions and sacred sites; - Production of incident reports documenting the concerns expressed by the population and the effectiveness of the proposed corrective measures; - Distribution of information; - Production of activity reports.

PROTECTION AND MITIGATION MEASURES - CULTURE AND HERITAGE (Landscapes of interest)

Potential impacts	Location of the potential impact	Proposed measures	Methods for monitoring application of the measure
Modification of the landscape.	**Construction and operations phases:** - Storage area and breakwater at the Ehoala peninsula; - Weir at the mouth of Lake Ambavarano; - Pumping station on the shore of Lake Ambavarano; - Quarry at Andriambe; - Central and south sections of the road linking the separation plant to the Ehoala port.	- Optimisation of the detailed design of the plans and specifications for the port facilities, the weir and the pumping station, so as to foster their integration into the existing landscape; - Landscape development, including the planting of trees and floral species to make the presence of the weir and the pumping station less conspicuous; - Landscape arrangement including the planting of screens of trees or robust hedges along the rights-of-way of the central and south sections of the road linking the separation plant and the Ehoala port; - Information programme for stakeholders and the villagers concerned.	- Preparation and monitoring of contractual terms; - Transmission of engineering plans and specifications; - Production of drawings and specifications for the plantings (species, density, etc.); - Ensuring the supply of quality plants; - Monitoring of the work; - Monitoring of the follow-up programme with regard to plantings outside of the mining sector; - Once the work is completed, production of a report on the impacts of the works on the landscape; - Distribution of information; - Production of activity reports.

Social components

Economic activities

- Formal sector
- Informal sector
- Local employment
- Land and real estate
- Movement and transport of goods

PROTECTION AND MITIGATION MEASURES - ECONOMIC ACTIVITIES

Potential impacts	Location of the potential impact	Proposed measures	Methods for monitoring application of the measure
Direct and indirect purchases of goods and services, hence a risk of local inflation.	**Construction phase:** - Unloading dock at the Fort-Dauphin port; - Sections of the road at Fort-Dauphin; - Site of the temporary camp and quarry at Andriambe; - Site of the temporary camp and the separation plant at Mandena; - Dredge and floating separator at Mandena; - Pumping station at Lake Ambavarano; - Weir at the outflow of Lake Ambavarano; - Port and storage area at the Ehoala peninsula.	- Purchasing policy that favours, given equal skills and competitive pricing, local suppliers; - Support for local companies and supplier groupings; - Information programme for stakeholders and the populations concerned; - Support for the reinforcement and grouping of local suppliers, including collaboration with suppliers' micro-credit organisations and, creation of a purchasing co-operative.	- Preparation and monitoring of contractual terms; - Production of incident reports documenting the concerns expressed by the population and the effectiveness of the proposed corrective measures; - Distribution of information; - Production of activity reports.
	Operations phase: - Port facilities at the Ehoala peninsula; - Separation plant in Mandena; - Dredge and floating separator in Mandena - Weir at the outflow of Lake Ambavarano; - Road linking the plant to the Ehoala port.	- Purchasing policy that favours, given equal skills and competitive pricing, local suppliers; - Support for local companies and supplier grouping; - Information programme for stakeholders and the populations concerned; - Support for the reinforcement and grouping of local suppliers, including collaboration with suppliers' micro-credit organisations and, creation of a purchasing co-operative; - Contribution to studies on development of the plains for food crops, within the framework of the RDC.	- Preparation and monitoring of contractual terms - Monitoring of the follow-up programme with regard to the purchasing of goods and services and the creation of jobs; - Production of incident reports documenting the concerns expressed by the population and the effectiveness of the proposed corrective measures; - Distribution of information; - Production of activity reports.

PROTECTION AND MITIGATION MEASURES - ECONOMIC ACTIVITIES

Potential impacts	Location of the potential impact	Proposed measures	Methods for monitoring application of the measure
Job creation.	**Construction phase:** - Unloading dock at the Fort-Dauphin port; - Sections of the road at Fort-Dauphin; - Site of the temporary camp and quarry at Andriambe; - Site of the temporary camp and the separation plant at Mandena; - Dredge and floating separator at Mandena; - Pumping station at Lake Ambavarano; - Weir at the outflow of Lake Ambavarano; - Port and storage area at the Ehoala peninsula;	- Objective of hiring at least 35 % of the construction labour force in Madagascar; - Training programme of the "on-the-job-training" type; - Calling upon local suppliers; - Information programme for stakeholders and the populations concerned.	- Preparation and monitoring of contractual terms; - Production of incident reports documenting the concerns expressed by the population and the effectiveness of the proposed corrective measures - Distribution of information; - Production of activity reports.
	Operations phase: - Port facilities at the Ehoala peninsula; - Separation plant in Mandena; - Dredge and floating separator in Mandena - Weir at the outflow of Lake Ambavarano; - Road linking the plant to the Ehoala port.	- Creation of 500 to 600 permanent jobs, for a production rate of 750,000 tonnes per year; - Objective of hiring about 80 % of the labour force in Madagascar; - Training programmes for local labour force (ex: "on-the-job-training"); - Calling upon local suppliers; - Information programme for stakeholders and the populations concerned.	- Preparation and monitoring of contractual terms; - Production of incident reports documenting the concerns expressed by the population and the effectiveness of the proposed corrective measures; - Distribution of information; - Production of activity reports.
Scarcity and high cost of housing in Fort-Dauphin, following the arrival of a pool of about 600 workers in the city.	**Operation Phase:** - City of Fort-Dauphin.	- Agreements with local promoters to ensure the construction of housing units and the provision of the services required (water, electricity, etc.) for QMM employees, while respecting the development orientation of the City of Fort-Dauphin;	- Preparation and monitoring of contractual terms; - Transmission of engineering plans and specifications; - Monitoring of the work;

PROTECTION AND MITIGATION MEASURES - ECONOMIC ACTIVITIES

Potential impacts	Location of the potential impact	Proposed measures	Methods for monitoring application of the measure
		- Collaboration with construction companies' micro-credit organisations; - Support for the reinforcement of their financial and technical capabilities for carrying out the work; - Regional and national communication programme, to avoid a surplus of migrants arriving in the region in search of work.	- Production of incident reports documenting the concerns expressed by the population and the effectiveness of the proposed corrective measures; - Providing information; - Production of activity reports.
Increase in land and real estate values.	**Operations phase:** - City of Fort-Dauphin (sector of the road bypassing Fort-Dauphin, airport sector and those Fort-Dauphin sectors impacted by the improvement of stretches of road).	- Optimisation of the road lie, during the detailed design of the plans and specifications, in order to promote sustained development of these sectors of the City of Fort-Dauphin while respecting the development orientations of the Fort-Dauphin commune.	- Preparation and monitoring of contractual terms; - Transmission of engineering drawings and specifications; - Monitoring of the work; - Production of activity reports.
Loss of customary rights and land and real estate speculation in the sectors serviced by the roads.	**Preliminary and construction phases:**	- Support to departments responsible for preparing the administrative texts required for transactions involving State property, either by creation of land banks or any other appropriate administrative measure.	- Transmission of engineering plans, so as to delineate the reserved zones.
Increase in potential urban growth southwest of Fort-Dauphin, as a result of port infrastructures development at the Ehoala peninsula.	**Operations phase:** - City of Fort-Dauphin.	- Support for local organizations and supplier groupings; - Information, education and communication programme in collaboration with the authorities, in order to maximise the positive effects and mitigate the negative effects; - Support to the concerned authorities responsible for establishing and implementing a programme for the	- Preparation and monitoring of contractual terms; - Monitoring of the follow-up programme with regard to the purchasing of goods and services and the creation of jobs; - Distribution of information; - Production of activity reports.

PROTECTION AND MITIGATION MEASURES - ECONOMIC ACTIVITIES

Potential impacts	Location of the potential impact	Proposed measures	Methods for monitoring application of the measure
		development of the Fort -Dauphin commune.	

PROTECTION AND MITIGATION MEASURES - ECONOMIC ACTIVITIES

Potential impacts	Location of the potential impact	Proposed measures	Methods for monitoring application of the measure
Modification of the tourism development potential following installation of project components.	**Construction and operations phases:**	- Integration of the potential impacts on the tourism sector in the detailed engineering studies of the project components (port, weir, roads, pumping station), in concertation with the operators and technical services affected; - Promoting the safety of tourists when designing path of the weir; - Promoting other revenue-generating activities (village of Evatraha); - Promoting of new tourism products (visits of the mine, cruises, …); - QMM assuming responsibility for equivalent developments and modifications of circuits during the construction phase and of the conservation zone for tourism purposes, in concertation with operators and the services affected; - Study on the sector's perspectives, while taking into account modifications as a result of the development of the mine, and the features of Fort-Dauphin as a "destination", in concertation with operators; - Rehabilitation of certain sections of the mining site, taking into account the possible development of a tourism or recreational zone after closing.	- Preparation and monitoring of contractual terms; - Transmission of engineering plans and specifications; - Monitoring of the work; - Production of incident reports documenting the concerns expressed by the population and the effectiveness of the proposed corrective measures; - Distribution of information; - Production of activity reports.

MARITIME TRANSPORT AND TRAFFIC IN THE ANONY LAGOON SYSTEM AND AT THE EHOALA PORT			
Development of maritime shipping activities at the Ehoala peninsula and in the Fort-Dauphin Port. Relocation of certain activities from the Fort-Dauphin Port.	**Operations phase:** - Port facilities at the Ehoala port; - Fort-Dauphin Port.	- Promotion of the maximum use of the new port by third parties; - Promotion of the port's multiple uses.	- Preparation and monitoring of contractual terms; - Transmission of engineering plans and specifications; - Monitoring of the follow-up programme with regard to the purchasing of goods and services and the creation of jobs; - Distribution of information; - Production of activity reports.
Disruption of the tour boat operators, fishermen and the villagers using the water ways to move about or for the transport of goods.	**Construction and operations phases:** - Weir at the mouth of Lake Ambavarano.	- QMM will comply with the procedures prescribed by the laws of Madagascar; - Facilities enabling continued passage of tour boats and the villagers' fishing boats, during construction; - Optimisation of the detailed design of the plans and specifications for the weir, so as to allow the passage of tour boats; - Visual integration of the weir into the surrounding landscape; - Development of the conservation zone's tourism potential; - Collaboration by QMM with tour companies, in order to identify and develop synergies between tourism activities and the mining project.	- Preparation and monitoring of contractual terms; - Determination of work methods; - Follow-up of the application of the plans and specifications for the weir; - Monitoring of the work; - Periodic production of reports on the impacts of the weir's presence on tourism and halieutic activities potentially affected by the structure.

3.2 Organisational framework

The PEMP includes a draft of the programme of activities to ensure protection of the environment and the implementation of measures for the elimination, mitigation and compensation for the project's impacts on the social and natural environments.

The proposed environmental measures programme includes a number of means to ensure their implementation, while the environmental monitoring programme was developed taking into account the specific objectives critical to any such programme.

QMM assumes overall responsibility for the development and implementation of these measures, even in those instances where they may require the participation of local communities, groups of operators or local authorities. Furthermore QMM will define field work, make decisions in the case of unexpected events, prepare reports and report to the Madagascar authorities.

The organisational framework for the application of environmental measures is presented below.

3.2.1 Environmental monitoring

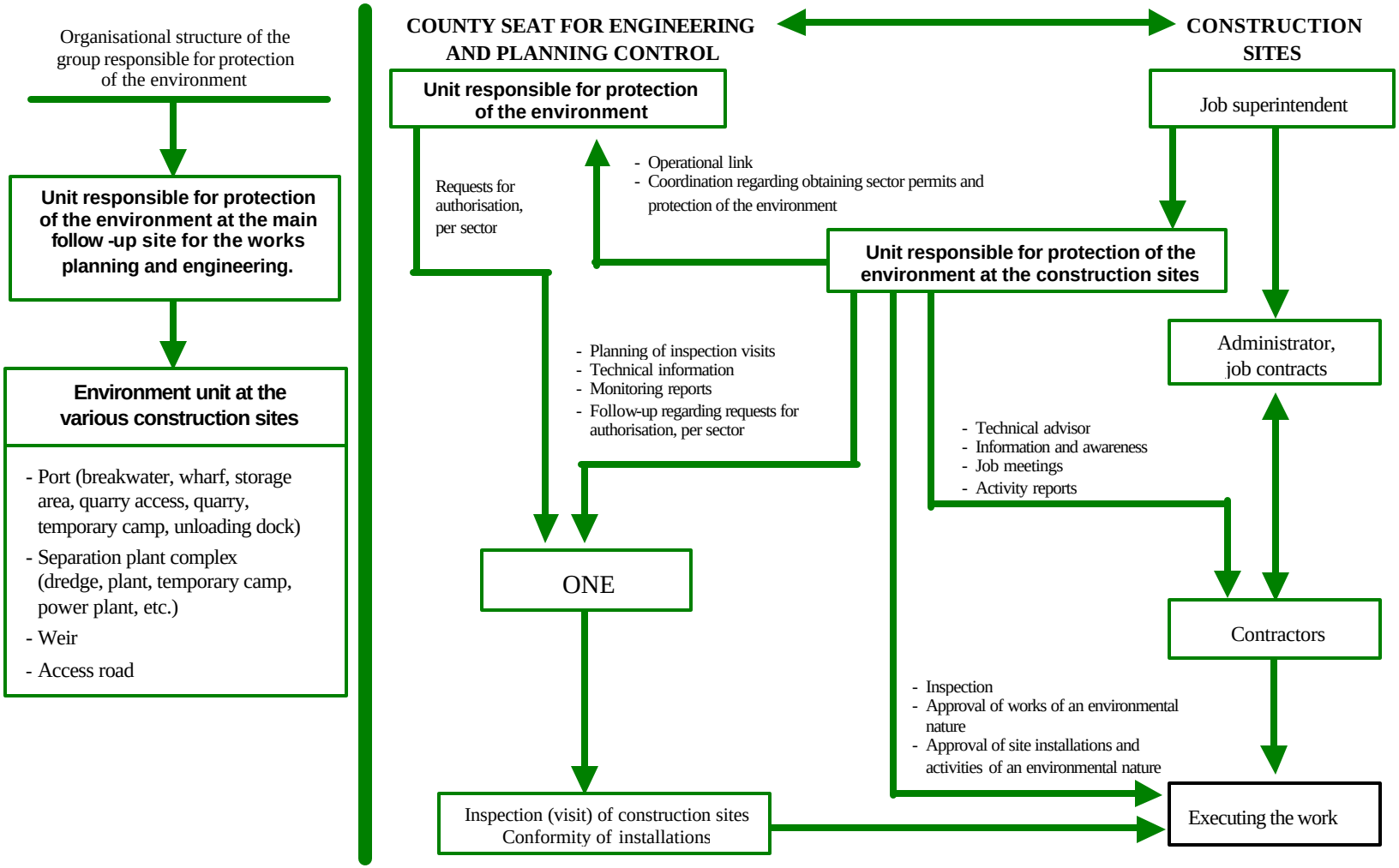
Environmental monitoring involves ensuring that all laws, regulations, instructions and contractual terms of an environmental nature are respected on various QMM sites. Furthermore, one of the aims of the environmental monitoring programme is the assurance that the environment is taken into account in all construction and operations activities.

The construction phase is a very important one, from the point of view of protection of the environment. This phase thus requires a significant level of organisational structure as well as follow-up and intervention methods suitable to each line of action. To this effect, a team responsible for the protection of the environment will be set up for each of the fields of activity and the various construction sites (port, separation plant complex, weir, access roads). This team will have two important mandates: firstly, ensure that the environmental requirements related to the project are taken into account during design of the various project components and are included in the drawings and specifications as well as the related books of specifications, and secondly, monitor the construction activities at the various sites.

The activities of the team responsible for the protection of the environment will include the distribution of information and a daily follow-up of the facilities and of the construction activity in progress. The persons in charge will produce monitoring reports covering any instances of non-compliance, along with the work approval reports. Lastly, QMM will act as a liaison between construction sites and the various government authorities or others who have an interest in the performance of construction activities.

The following figure presents the organisational structure of the teams responsible for the protection of the environment that is being considered for the construction phase:

Figure 1: Example of the organisational structure of the teams responsible for protection of the environment



3.2.2 Implementation of the mitigation, development and compensation measures

A consensus-building approach for the implementation of environmental measures will be used. Whenever possible, final measures will be chosen, designed and implemented in conjunction with the villagers and residents of the impacted communities as well as with government authorized concerned and other interested bodies.

This approach aims at creating a correspondence between the proposed measures and true needs of the communities and individuals affected by the construction and operations of the various infrastructures required for the mining of mineral sands.

The organisational structure proposed for the implementation of measures could be as follows:

- A team of QMM specialists acting as technical advisors in charge of monitoring the development and/or application of the environmental measures, as well as managing the environmental monitoring programme;
- Liaison committees including representatives from QMM, the communities affected and the authorities concerned, as applicable. These committees could, for example, have the following mandate:

    - Participation in discussions, for optimising the design of structures or of various aspects of project components during feasibility studies;
    - The implementation of indemnification and measures, in accordance with the laws and regulations in force;
    - The identification and implementation of measures enabling lifting of constraints with regard to the sacred nature of certain sites, taking the necessary steps for ensuring that these are accessible and safeguarding their physical integrity;
    - The implementation of mechanisms for ensuring security on the periphery of and on the construction sites located near areas where villagers carry out certain activities;
    - Monitoring of road traffic and formulation, as needed, of recommendations deemed appropriate;
    - The planning and implementation of measures such as: the use and sustainable management of resources, the development of residual resources upstream of the mining activities, the choice of sites and types of trees to plant in the planting areas outside the Mandena mining sector, the choice of types of rehabilitation or uses (e.g., planting of trees, agricultural land, grazing, recreational/tourism activities, etc.) following mining activities (closing of the site).

Other organisations may prove to be necessary. Examples of these include labour force training, public services, use of land, education, support for agricultural activities and the production of livestock, etc., all of which are administered by government bodies with authority in these areas. The measures will be developed and applied by the bodies in question, with QMM's support. Notably, QMM finance the creation of an economic, community and social development fund in this regard.

4 Environmental monitoring programme

Environmental monitoring will enable monitoring of the evolution of the state of the environment, more specifically in terms of the sensitive environmental elements and the major operation activities, by means of environmental indicators, and this throughout the 25-year period proposed for the mining of Mandena's mineral sands. It represents, in fact, a scientific approach for monitoring the evolution of certain components of the natural and human environments impacted by the project. As such, identified elements that are monitored become measurable, using recognized methods, and the results of this monitoring provide an overview of the changes that have occurred.

The monitoring programme, as related to the project, must target the following objectives:

- Verification of the accuracy of the forecasts and the assessment of certain impacts, particularly those for which there still are uncertainties at the time of the impact study;
- The identification of impacts that would not have been anticipated and, if necessary, the implementation of appropriate environmental measures;
- An assessment of the effectiveness of the implemented environmental measures; and
- Obtaining information and/or knowledge enabling an improvement of the methods for forecasting the impacts of similar projects.

In the case of certain measures, however, provided under legal requirements or corporate concerns, the objectives are more elaborate. Such is the case for the rehabilitation and conservation measures for the forest and wetlands.

The approach chosen for developing the monitoring programme takes into account the various environments that will be impacted, as well as the range of issues identified. The presentation of the monitoring programme for environmental elements follows the order of the presentation of these elements in the impact assessment report.

QMM's monitoring programme use a methodology that will make an ISO 14001 certification possible. It will be subject to inspection by the competent authorities and bodies of Madagascar, in order that these may verify that the measures contained in the SEIA are properly implemented.

4.1 Water

FRESHWATER-ESTUARINE ENVIRONMENT

4.1.1 Freshwater recharge in the Mandena mining sector

Context

The dredging and mineral separation activities will require the use of water (72,000 m^3/day). A portion of this water, needed for the mining of the sands, will come from the water-table. However, because of the time lag between the rate of extraction and the rate at which the water is returned to the water-table, the volume of returned water will not be immediately

available, thereby creating a temporary deficit in the system. Part of the water supply will thus be drawn from Lake Ambavarano (between 5,000 and 20,000 m^3/day, with possibilities of up to 40,000 m^3/day occasionally).

Generally speaking, the extraction basin will have very little impact on the water-table in nearby areas. Likewise, in certain circumstances, the basin's water level could be lowered so that mining of ore-bearing zones located at a depth greater than 15m from the surface can be carried out. The lowering of the water level will bring about a temporary local lowering of the water-table. The water-table level, however, will be re-established in all zones affected, and this as soon as the extraction basin has moved on. At the end of mining activities, dredging operations will have in effect eliminated the sands' necessary stratification and as a result, increased their permeability (especially vertical permeability). The lowering of the water-table level, which will be between 1 and 2 m on average, will reach up to 3 to 4 m in the northern section of the mining sector.

The studies carried out on the various hydrological features of the Mandena sector's aquatic ecosystems indicate that:

- The water supplied by the Anandrano and Mandromodromotra Rivers will be sufficient for meeting the dredging needs as well as the needs of the mineral separation plant;
- Dredging operations will have very little effect on the levels of Lake Lanirano and Lake Ambavarano;
- The flow of the upper sections of surface watercourses may sometimes be lessened, in periods where is less rain, and mining activities are taking place nearby;
- The underground water recharge from Lake Ambavarano will vary when the extraction basin is located closer to the lake. Seepage will most likely be recorded, but it should be less than 700 m^3/day. The anticipated water recharge from the Mandromodromotra River will most likely compensate for this loss.

Monitoring methods

Measurement of flows in watercourses and lakes

- Inflows into the Anandrano River and Mandromodromotra River constitute an important element in the freshwater supply of the Mandena estuary. Water level data recorders are already in place in the Anandrano, Mandromodromotra and Anony Rivers. Data will continue to be recorded until the close of mining operations in the Mandena sector;
- The rate of recharge, as well as seasonal variations in the watercourse levels, will be documented. Flows will be measured every month, and even more often during major flow periods, ideally during each major storm. The measurement programme has already begun, and will continue, in an ongoing manner, during the entire construction and operations period;
- As soon as the environmental permit is obtained, measuring devices will be installed in Lake Lanirano and Lake Ambavarano, in order to establish baseline conditions prior to building the weir. These measurements will also be taken in the same periods as those identified for the Anandrano, Mandromodromotra and Anony Rivers. Data will continue to be recorded until the end of mining operations in the Mandena sector.

Water level in the Anony estuary

- A recording device will be installed in the Fort-Dauphin port in order to document the water dynamics between the tidal oscillation and the water level in the lacustrine and estuarine environment. Recording will begin in 2002, and continue for a five-year period after the beginning of activities in the mining sector. Thereafter, measurements could be carried out every five years, until the end of mining operations in the Mandena sector. These measurements will also be taken in the same periods as those identified for the Anandrano, Mandromodromotra and Anony Rivers.

Variations in water-table levels

- Beginning in 2002, aquifer measurements will be taken at various times of the year. These measurements will ensure on-going information gathering with regard to the ground water flow dynamics and to check the expected effects of the mining of mineral sands on zones near the extraction basins. These measurements will continue to be taken until the end of activities in the mining sector;
- Monitoring of water-table levels will be carried out using the network of existing wells (25). Piezometric measurement will be conducted on a monthly basis for the next several years, until the construction phase begins. During the operations phase, levels will be regularly measured, following an as yet undefined on the basis of the mining plan chosen.

Set up of a database and data reporting system

- An electronic and paper database system will be set up. Given the significant amount of data to be collected, it will be important that the system established be effective at producing and retrieving data. Periodic reports will be prepared so as to provide summaries of the information gathered.

4.1.2 Water quality for aquatic life

Context

The implementation of the weir will affect an area, as regards the aquatic ecosystems, of around 590 ha. The freshwater environment constitutes 24% (140 ha) of this area, and the estuarine environment, 76% (448 ha). The construction of the weir will result in a permanent decrease in the salinity of waters upstream of the structure. As such, Lakes Besaroy and Ambavarano, as well as three kilometres of the Mandromodromotra River, will be transformed into a freshwater environment. The salinity of these bodies of water will decrease slowly, given the actual salt concentration within their sediments (32-34 g/kg). Once the weir is set up, wind and rain will stir up the waters and rid the new freshwater system of turbidity and salinity. Over the medium term, the waters of the new freshwater system will acquire the physicochemical characteristics of the waters of the Lanirano and Mandromodromotra Rivers. Despite a modification of the physicochemical characteristics of the waters upstream of the weir, the aquatic systems will remain favourable to aquatic life.

Downstream of the weir, the Anony River will maintain its existing features, namely those of an estuarine environment.

Monitoring methods

The programme for monitoring the project should include the following variables: salinity, temperature, dissolved oxygen, depth of the Secchi disk, nutrients and the wind and current directions. The entire water column will be monitored. Heavy metals and organic components will be analysed prior to, as well as one year after, the weir's construction.

In order to follow changes in the water quality, a monthly sampling from sampling stations will need to be taken every two years, until the weir is built. Once construction is completed, sampling will take place every month for a two-year period. Following this, sampling will be once per quarter. Measurement protocols will need to be supplied, and thereafter validated by the competent authorities, and follow-up analyses will need to be carried out in two independent laboratories.

The proposed network of sampling stations is as follows:

Upstream of the weir:

- Lanirano River: one station upstream, before the watercourse crosses the Mandena mining sector, one station at the mouth of the river and, one station midway between the mouth and the mining site;
- Mandromodromotra River: one station upstream, before the watercourse begins to run alongside the Mandena mining sector, one station at the mouth of the river and, one station midway between the mouth and the mining sector;
- Lake Lairing, the Riviera a meanders (*meandering river*), Lake Beardy, Lake Ambavarano and upstream of the weir: sampling on the water column, at its deepest point.

Downstream of the weir:

- One station 250 m downstream of the weir and two stations located between the weir and the station at the mouth.

Note: Stations used for the characterisation of the environment, during the course of impact studies, will be kept, and water sampling will be carried out in conjunction with the aquatic fauna sampling periods.

4.1.3 Sedimentation rate in Mandena's internal waters

Context

The processes for the transport of sediments between the Lanirano River and the head of the Anony River are determined by the material coming from the Lanirano and Mandromodromotra Rivers and flowing between Lakes Lanirano, Besaroy and Ambavarano. Exchanges between the systems are dynamic, and affected by seasonal precipitation levels and variations in the flow of the rivers. Furthermore, it has been noted that the wetland stations where sediments would become coarser from the rainy season to the dry season were all located near the rivers of Lake Lanirano, the rivers and lakes close to the Mandromodromotra River and near the rivière à méandres.

The TOC (total organic carbon) content of sediments in the Anony River and in marine environments falls somewhere between the TOC values of Mandena's lakes and rivers. Within the study zone, no discernable differences were observed between the sediments' TOC content in rainy seasons or dry seasons. As well, all values measured fell within the normal range of values expected for all of the studied environments (Broecker, 1974; Parsons et Takahashi, 1977; Rochon, 1985C; CCME, 1996; Directive 78/659/EAP, 2000; Directive 76/160/EAP, 2000).

One of the impacts of the weir will be the elimination of the two-layer flow that allows salt and sediments exchanges between Lake Ambavarano, the Mandromodromotra River and the Anony River. As such, salt and suspended particles from the estuary will no longer penetrate into the lagoons of Lake Besaroy or in the Mandromodromotra River (up to three kilometres from the river's mouth). As it creates an obstacle to the confluence of the three aquatic systems, the weir's presence could result in an accumulation of sediment upstream of the structure. As such, the bodies of water upstream of the weir would see their sedimentary balances altered, as would the Anony River downstream of the structure. Moreover, the geometry and bathymetry of the beds of the bodies of water will be modified as a result of the hydrodynamic and morpho-sedimentological changes upstream and downstream of the weir.

Monitoring methods

Sampling of solid flows

The origin and concentration of flows of solids in Mandena's internal waters will be monitored at the following locations:

Upstream of the weir:

- Lanirano River: one station upstream, before the watercourse crosses the Mandena mining sector, one station at the mouth of the river and, one station midway between the mouth and the mining site;
- Lake Lanirano and Lake Ambavarano;
- Mandromodromotra River: one station upstream, before the watercourse begins to run alongside the Mandena mining sector, one station at the mouth of the river and, one station midway between the mouth and the mining sector.

Downstream of the weir:

- One station immediately downstream of the weir and three stations located between the weir and the mouth.

Beginning in 2002 and continuing until such time as the construction of the weir is completed, measurement of flows of solids will be carried out at monthly intervals, particularly following weather events such as heavy rains. During the operations phase, flows of solids will be measured using a gravimetric method (total suspended solids) or on the basis of turbidity (photometric method), expressed as nephelometric turbidity units (NTUs).

Assessment of sedimentation rates

A precise bathymetric study will be conducted, and a map prepared, of Lakes Lanirano and Ambavarano. The bathymetric profile will be carried out the year prior to the construction of the weir as well as during the first year of its operation. Thereafter, a profile will be carried out every five years. Furthermore, a series of transects will be carried out downstream and upstream of the weir, every three months during the first two years of operations and every five years thereafter.

Sediment samples will also be collected (the year prior to and the year following construction of the weir) and analysed with respect to their particle-size distribution, heavy metals and total organic carbon. Samplings will then be carried out every five years.

The initial state as regards to sedimentation will be established as soon as the environmental permit is obtained, and again after the end of the first dry season following construction of the weir (cyclone, ten-year flood…).

Aerial coverage will enable viewing of the sedimentation, its extent and its evolution. Aerial photographs will be taken, at a low altitude, the year before the weir is built and again after the first year of operations (at the end of the dry period). Thereafter, aerial photographs will be taken every five years. A map will also be produced for each of the periods for which data is gathered.

Evolution of banks and shoals

- The "rivière à meanders", Lake Besaroy, Lake Ambavarano and the first few kilometres (3) of the Mandromodromotra River.

The evolution of the banks of the various aquatic ecosystems will be documented (state of the bank, periods when the bank retreats, annual retreat, etc.), using bimonthly land measurements, the year before construction and again after the first year of operations. Measurements will be taken more frequently during flood periods and, if applicable, according to the results obtained. Therefore, measurements frequency could be modified if changes are observed during the course of other monitoring activities being carried out (e.g., monitoring of biodiversity, monitoring of the quality of water, monitoring of fish stocks). Thereafter, measurements will be carried out once every five years. A map will also be produced for each of the periods for which data is collected. In order to proceed to such monitoring, fixed reference markers will be set up at different points along the banks.

- Lake Besaroy

Evolution of the shoals (surface, position, direction of the movement) will be documented at the western tip of the lake using aerial photographs taken at a low altitude the year before construction of the weir and again after the first year of operations (at the end of the dry season). Thereafter, aerial photographs will be taken every five years. A map will also be produced for each of the periods for which data is collected.

- Lake Ambavarano

Evolution of the shoals at the mouth of the channel from Lake Besaroy, at the western tip of Lake Ambavarano, will be documented using aerial photographs taken at a low altitude the year before construction of the weir and again after the first year of operations (at the end of the dry season). Thereafter, aerial photographs will be taken every five years. A map will also be produced for each of the periods for which data is collected.

- Anony estuary

Evolution of the intertidal zones and the shoals (surface, position, materials) will be documented using aerial photographs taken at a low altitude and by a sampling of the terrain. This monitoring will be carried out twice per year (rainy season and dry season) the year before construction of the weir and again after the first year of operations (at the end of the dry season). Thereafter, monitoring will take place every five years. A map will also be produced for each of the periods for which data is collected

MARINE ENVIRONMENT

4.1.4 Modification of the hydrodynamic characteristics and the quality of water in Fausse Baie des Galions and the Fort-Dauphin Bay

Context

In the natural state, active erosion zones can be observed in the Ehoala peninsula sector. These are mostly the result of the convergence of short, high-energy waves generated locally by the prevailing north-eastern winds. A significant source of sand can actually be found on the high-erosion slopes of the Ehoala peninsula, which bring large quantities of material to Fausse Baie des Galions.

As facilities are built, construction of the breakwater and port, as well as construction activities in the peninsula's northern sector, will, gradually alter the currents, height of the waves and sedimentary balance of Fausse Baie des Galions. This sector's marine environment will thus evolve constantly for a three-year period, and new dynamics will evolve by the end of the construction phase. Elsewhere, the arrival and departure of transport barges at the Fort-Dauphin unloading dock will result in a turbidity of the waters within the port and in Fort-Dauphin Bay.

During the construction phase, the water column will undergo physicochemical changes, an immediate effect of dredging. These changes could include an increase in turbidity and localized variations in the water's chemical make-up (e.g., nutrient concentrations). There could be sanding up of the port sector over the course of the years when mining activities are

carried out. Furthermore, the erosion of the foredune, in the western sector of Fausse Baie des Galions, could further this sanding up.

During the construction phase, changes to the sea bottom as a result of possible dredging, needed for reasons of maritime security, will bring about changes in the zone's hydrodynamics, thereby affecting currents and sedimentary dynamics. We also need to take into consideration disruption of the environment, during the operations phase, as a result of the maintenance dredging which might be necessary at the Ehoala port. However, we must specify that maintenance dredging of the harbour would generate smaller impacts than those associated with the construction phase. Elsewhere, construction of the weir could also bring about changes in the quality of the water along the shores of Fort-Dauphin Bay. A fan of turbidity could then be observed.

Monitoring methods

The proposed monitoring programme would be the following:

The intertidal zones of Fort-Dauphin Bay

- The evolution of the beach profiles will be documented so as to assess the extent of the seasonal variations and to check the annual balance of eroding, stable or growing intertidal zones. Particle-size analysis of the sediments will be carried out in order to verify patterns already observed (fine sediments in the east and coarser sediments in the west).

The monitoring stations will include:

- One station at the eastern tip;
- One in the centre; and
- One at the western tip of the bay.

The foredune of Fort-Dauphin Bay

- The state of the foredunes in the centre of Fort-Dauphin Bay will be documented, notably near Lake Ambavarano, in order to separate the seasonal sapping from the sapping able to destroy the foredune and result in the erosion of dunes.

The intertidal zones of Fausse Baie des Galions

The evolution of beach profiles will be documented and particle-size analysis of the sediments will be carried out. To do so, surveys of the littoral profile (horizontal and vertical) will be conducted using fixed and stable reference markers installed at the appropriate locations. Sediment samplings will also be collected at these various stations.

The lateral migration of intertidal zone sediments (possible fouling of the Anony estuary)

The evolution of the movement of sediments from the intertidal zones of the Fort-Dauphin Bay, the extent as well as the direction of movement and seasonal variations, along with the annual balance and the volumes of sediments involved, will all be documented.

Digital modelling

- A mathematical simulation of the hydrodynamics and the sediment balance in the construction area of the port will be conducted. This simulation will be repeated on the basis of the results of the monitoring activities presented above.

The parameters identified for the monitoring purposes will need to be measured twice per year (dry season and rainy season) during the course of the last two years prior to construction as well as during the course of the first two years of operations. Thereafter, the frequency of sampling will be once every five years, after the dry season, which means the month of November. The field and laboratory techniques used will follow the procedures used and described in the supplementary report "***Study of the Aquatic Ecosystem, Fort-Dauphin region, Madagascar; Volume 1 – Report".

4.2 Flora and fauna

FOREST, WETLAND AND OPEN ENVIRONMENTS

4.2.1 Mandena mining sector conservation and rehabilitation activities

Context

The Mandena sector includes three types of environments: the littoral forest (10%), the wetlands (17%) and the open environment (73%). These three environments were described in Chapter 3 of the SEIA, in terms of the flora and fauna that characterise them. The inventories and the identification and research work carried out showed that the Mandena littoral forest harbours a great diversity of flora and fauna. 22 plant species have been identified as endemic to the Mandena zone. No identified wildlife species are endemic to the Mandena zone, although many are endemic to south-eastern Madagascar and classified as vulnerable and endangered. Furthermore, the population makes intensive use of the natural forest's resources (flora and fauna), processing them in various ways: building timber, fuel, charcoal, medicinal plants, basketry material, fruit, honey, game, etc.

The floral and faunal species inventoried in the wetland environments are not endemic or rare, and are all found elsewhere in Madagascar. A few types found in the wetlands however, are extensively used by the populations (mahampy rushes and ravinala).

The floral and faunal species inventoried in the open environments are common, abundant, and widespread elsewhere in Madagascar or outside of the country. The resources found in this environment are little used; Philippia, which covers 90% of the surface of this environment, is not used by the populations.

Flora and fauna composition of the littoral forest has thus been recognized as extremely important and highly endangered, given the growing pressure from human impacts on the region. At present, we note a profoundly modified forest area, the result of a long process of deforestation and degradation. 74 % of Mandena's forest area disappeared between 1950 and 2000 (this figure is 60 % for the entire littoral zone), at an average rate of 27 ha/year. The various pressures to which the littoral forest has been subjected have brought about the near-disappearance of forest areas. This situation has resulted in a decrease in the diversity of plant and wildlife animal species and in a significant disruption of the structure of forest communities. Moreover, the increasingly marked fragmentation and the forest's advanced state of degradation caused changes that, in turn, rendered the process irreversible and the increasing loss of the ecosystem's biodiversity more and more pronounced.

In order to minimise the impacts on the population that utilises these resources and to save and protect the inherent properties of the Mandena sector's wetlands and littoral forest (flora and fauna), QMM proposes a combination of conservation and rehabilitation measures. It should be noted that the final decision with regard to the type of rehabilitation will belong to the landowner, that is, the State, in conjunction with the traditional users (the villagers). The main measures proposed are as follows:

- The conservation of an area of 160 ha of littoral forest in the Mandena zone, including two of the largest, least deteriorated residual blocks. The protected zone will also include 70 ha of wetland forest, located between the littoral forest blocks, for a total area of 230 ha. This conservation zone, removed from the mining circuit, will help preserve the important flora and fauna of this type of forest and these wetlands, as well as protecting all of the identified endemic plant species. This zone will serve as a seed reservoir, for future ecological restoration activities. This zone will, moreover, make it possible to safeguard certain uses necessary to the villagers (gathering of medicinal plants, beekeeping, etc.). It will help the "spirit of the place" that villagers associate with this sector. Given that the size of this protected zone will be limited, the State will have to give it a protected status, in order to promote the conservation of plant and animal species, yet allow for exploitation of certain resources, such as medicinal plants or dead wood, by the riparian populations. While preventing entry of domestic animals (zebus, etc.), this area will need to be forbidden. Involvement by the local populations and the Forests and Water administrators in the conservation process will be ensured by formal and informal agreements (dina);

- Enhancement of the conservation zone (already degraded) by using targeted species of plants (seeding) and animals (translocation);

- Rehabilitation of the entire mined zone (2,120 ha). Two methods are proposed: the restoring of ecosystems and the planting of fast-growing, utilitarian species:

    - Restoration of ecosystems will represent about 25% of all rehabilitation (forest 10% and wetlands 15%). This measure will enable restoration of the ecosystems' natural conditions, as well as valuable, rare, endemic or endangered of plant species. Restoration of the habitat will also enable extension of the home range of several types of wildlife;
    - The rest of the area (75 %) will be enhanced with fast-growing, valuable species. These plantings will enable traditional uses such as felling building

timber, producing charcoal and gathering fuel wood, by means of various species offering the maximum possible number of forest products. The planting of fast-growing species will make it possible to maintain, and even increase, the area that can be used for the gathering and development of the various products sought by the populations. The success of wood plantings will be aided by (i) adding organic or other matter to the soil (terracotem), either from the top soil set aside, or produced specifically to meet the requirements of the project (compost, etc.) or, purchased (ii) the previous set up of a cover of wild grass or wind screens to limit the effects of wind erosion whenever necessary.

- The development sustainable resources management plan with the stakeholders. This management system will be established by agreements submitted for approval to the local Waters and Forest Department.

Note: The planting of fast-growing species over 75% of the area (1,590 ha), most of which is presently bare (open environment), would represent a significant measure for the compensation of impacts, as defined by applicable regulations.

Monitoring methods

Each year, an area of about 100 ha will be rehabilitated. Rehabilitation work will be carried concurrently with mining activities. They will constitute part of a five-year rehabilitation programme that includes annual implementation plans. The five-year plan will need to be prepared in partnership with the land owner, the State, and representatives from the communities concerned.

The sectors where reforestation or restoration will take place will be the subject of monitoring activities. In order to evaluate the yield and quality of the work done (restoration of the forest, wetlands, planting of fast-growing species), different parameters will be measured and analysed according to strict sampling procedures. The conservation zone will also be monitored for biodiversity and the zone's long-term viability.

As part of this monitoring programme, information would be collected, though not limited to the following:

- An ongoing inventory of the biodiversity (floral and faunal composition) of the conservation zone (forest and wetland) and the restored zones;
  - The physical parameters (temperature and humidity);
  - The density, distribution and representatively of endemic plant species;
  - The state of the populations of various animal populations: abundance, diversity of species, diet, home range, etc.;
  - The % of native plant and animal species returning naturally to restored zones;
- A comparison of the biological parameters with other forest environments and according to various stages of degradation;
- An assessment of the survival rate in cases of restoration and reforestation;
- An assessment of the average increase of populations;
- The size of the biomass produced;
- The viability of the banking of top soil, over time.

The monitoring of reforestation and restoration will enable adjustments to be made to the rehabilitation programme over the course of time if needed. Several elements of the proposed monitoring programme are presented in Appendix 14 of the SEIA "A Biodiversity Plan for Conservation and Management of the Littoral Forest in South-Eastern Madagascar".

4.2.2 Planting outside of the mining sector

Background

At present, the population of the Fort-Dauphin region is dependent on exploitation of the littoral forest for its daily needs as regards wood for cooking food and building homes. The coalers are in turn dependent on the production and sale of wood charcoal. This dependence is one of the primary causes of the deforestation of the Fort-Dauphin region.

In order to be prepared for the upcoming shortage of wood in the zone, it is proposed to plant fast-growing valuable species (e.g., *Eucalyptus camaldulensis, Eucalyptus robusta, Eucalyptus citriodora, Casuarinas cunninghamiana, Acacia mangium*) over a 500 ha area, outside of the Mandena block, over the next five years. The plantings site and the choice of species remain to be defined with the partners. They will, in fact, be addressed in an agreement with the communities and the regional authorities, as part of a plan for the sustainable management of resources that will be submitted for approval to the local Forests and Water Department.

The species planted will enable enhancement of land that is actually ill-suited to agriculture and not usable. Annual wood yields per hectare will be able to supply on a sustained basis some 10,000 villagers with fuel wood or, 4,000 people with charcoal. The first plantings will be ready for harvest within 6 to 10 years, depending on the species.

Monitoring methods

The sectors where plantings will be carried out will be monitored on a monthly basis. In order to assess the yield and quality of plant resources, various parameters will be measured and analysed.

Below are examples of some of the information that could be collected:

- Assessment of the plantings' survival rates;
- The average height and diameter of the species;
- Assessment of average growth;
- Assessment of the biomass produced;
- Average temperature at the site, humidity, direction of winds, etc.

Monitoring of plantings in the preliminary phase would enable necessary adjustments to the mining sector planting programme to be made.

FRESHWATER-ESTUARINE ENVIRONMENTS

4.2.3 Aquatic fauna downstream and upstream of the weir

Background

The wildlife species inventoried in the freshwater and estuarine ecosystems are common, abundant and widespread in Madagascar as well as elsewhere in Africa. Freshwater environments, in fact, are very typical of what is found elsewhere on the planet in similar tropical coastal conditions: fairly shallow water, characterised by a weak productivity and relatively unabundant fish and benthic populations. The species most commonly found in the freshwater and estuarine ecosystems mostly include fish such as perch and clingfish. Shrimp, such as the species *Penaeus* and *Macrobrachium*, and crab (*Scylla serrata*) are also present.

The physicochemical changes from a transformation from an estuarine environment to a freshwater one will bring about modifications in terms of halieutic resources. A few migratory species use either the estuaries or freshwater environments as a habitat for various stages of their life cycles. These species will no longer have access to these conditions, as the weir will constitute an obstacle. Therefore, the fish community that is actually found in the estuarine environment upstream of the proposed weir will be replaced by a freshwater community similar to that found upstream of Lake Besaroy. The populations of those species located downstream of the structure will not be impacted.

The new benthic populations colonising the lake and river upstream of the weir will, in all likelihood, form a community similar to that of the existing freshwater environments. The populations of those species located downstream of the structure will not be impacted.

As regards other wildlife species, only the African crocodile (*Crocodylus nilotica*) presents a particularity. Actually, the wild populations of this species in Madagascar are classified in Appendix II of the Convention on International Trade in Endangered Species. Changes to the aquatic environment upstream of the weir should not affect this species, which lives in the freshwater environment. In fact, an increase in the freshwater zone could even prove beneficial.

A conservation and restoration programme for the aquatic environments is proposed. It will be presented to the authorities for approval, and consists of the following elements:

- Monitoring of aquatic wildlife populations and their exploitation;
- Restoration of the aquatic environments (aquaculture, development of spawning grounds through the planting of appropriate aquatic vegetation);
- Conservation and sustainable management of freshwater species (assessment of the Andrakaraka fishing ground, organisation of fishermen that fish in both freshwater and brackish water);
- Conservation and sustainable management of the coastal zone (assessment of the Evatraha fishing ground, organisation of marine fishermen).

Over the medium and long term, the programme proposed for the development of aquatic environments could promote the development of aquatic resources.

Monitoring methods

Monitoring of the wildlife populations (e.g., freshwater fish, fish found in brackish waters, eel, shrimp, mangrove crab) would be carried out both upstream and downstream of the weir. The African crocodile will be specifically monitored. The monitoring methods and parameters of the proposed programme cannot be specified at this stage of the project. The aim of the research that is actually being carried out, and that will continue for the next several years, is an increase in knowledge on the aquatic freshwater and estuarine ecosystems. The results of this work will make it possible to provide more specific information on the requirements of the monitoring programme. More specifically, the studies will make it possible to:

- Determine locations for establishing sampling stations that would be representative of the impacted environments (Lake Lanirano, the rivière à méandres, Lake Besaroy, Lake Ambavarano, the Mandromodromotra River and the Anony River);
- Identify bio indicators: priority species and species typical of the environment;
- Identify the monitoring indicators: physicochemical parameters (temperature, dissolved oxygen, pH, etc.);

The parameters of the monitoring programme could include, among other, the following data and observations:

- An assessment of the productivity of zooplankton, phytoplankton and benthos in the freshwater and estuarine systems;
- The state of the fish populations (age of specimens, length, weight, state of maturity of the gonads, fertility rate, etc.);
- Assessment of the quantitative abundance of the fish populations;
- Specific diversity Index: number of species observed;
- Diet of the target species;
- Displacement of specimens during the construction phase (early physicochemical changes in the waters);
- Assessment of the development activities carried out (e.g., spawning grounds);
- Extent of the crocodile population, habitats, etc.

MARINE ENVIRONMENT

4.2.4 Marine flora and fauna

Background

The aquatic species found in the zone where the breakwater will be built are all found elsewhere in the waters surrounding the island of Madagascar and, in the majority of cases, elsewhere in Africa. Therefore, marine life in the Ehoala sector can be characterised as being neither overly diversified nor abundant. Moreover, the marine zone is not characterised by an aquatic flora or fauna any different that of the Evatraha and Fort-Dauphin promontories. Furthermore, the results of various studies conducted in the study zone (***CSSA, 2001) revealed the presence of one species classified as vulnerable, *Megaptera novaeangliae* (UNEP-WCMC, 2000), and five highly migratory species. These species are covered by Section 64 of the United Nations Convention on the Law of the Sea (1982).

On the basis of the various studies conducted, it is highly unlikely that the changes in the marine environment will be detrimental to the Fort-Dauphin region flora and fauna. Moreover, once the breakwater has been erected, QMM feels that this structure will constitute a potential habitat for marine wildlife in the Ehoala sector. This could apply, in particular, to the rock lobster, a marine species with a high commercial value for the region.

Whales, porpoises and dolphins have also been observed in the waters off the eastern coast of Madagascar. The sector identified for construction of the proposed port infrastructure is not known to be a vulnerable zone or a particular habitat where whales breed or one where females give birth. The construction work on the breakwater could, however, disrupt the humpback whales, and other marine mammals. Moreover, during the construction phase, marine mammals will most likely move towards zones, better suited to their activities, farther away from the sector where various development work is being carried out. The increase in marine traffic, in the open seas near Fort-Dauphin Bay and Fausse Baie des Galions, could also disturb whales present in the zone being used for shipping as a result of activities at the ports of Ehoala and Fort-Dauphin.

Monitoring methods

The monitoring programme would begin two years prior to the construction of the breakwater. Stations for sampling of species chosen as indicators (e.g., certain species of fish, rock lobster, coral, and algae, especially the red *Gelidium* species, etc.) would be identified. A complete inventory of the marine species and their complements will be carried out on the region's beaches, so as to enable development of an appropriate monitoring programme regarding impacts of the project on marine biodiversity. Particular emphasis will be placed on those species addressed by Section 64 of the United Nations Convention on the Law of the Sea (1982), namely the humpback whale (*Megaptera novaeangliae*), the dolphin or mahi-mahi (*Coryphaena hippurus*), the bonito (*Euthynnus affi nis*), the skipjack tuna (*Katsuwonus pelamis*), the common tiger shark (*Galeocerdo cuvier*) and the blue marlin of the IndoPacific zone (*Makaira mazara*).

Also, particular attention will be given to the presence of marine turtles in the sector being proposed for the port. Monitoring of the use of the beaches will be carried out on a periodic basis, especially when the turtles' presence is noted. When there is such a presence, a conservation programme will be implemented with the authorities concerned.

Control sampling locations (stations with features similar to those of the Ehoala peninsula, but not disturbed by the works) would also be chosen, in order to compare results and be able to assess the anticipated changes.

The sampling techniques and frequency, as well as the season during which sampling is conducted, will vary according to the species being monitored. Among the various information that will be collected, there is:

- The extent of the species found in the breakwater construction zone;
- The characteristics of the identified species;
- The medium or substrate (habitats) used;
- The variation in the populations over years;
- The zones where various species are concentrated;

- The collection of data as regards the activities related to the construction and operations phases (number of boats, periods when rocks are dumped, etc.).

4.3 Health

4.3.1 Noise environment

Background

World Bank guidelines regarding the noise environment recommend a maximum noise level of 55 dBA during the day and 45 dBA at night. We have thus, as part of this impact study, chosen to use the World Bank recommended levels in analysing the noise environment resulting from project activities.

The construction work at various infrastructure sites, the operations of the port, separation plant and related infrastructures, as well as transport of materials and equipment on the road linking the plant and the port will all cause modifications to the noise environments of the various built-up areas.

Monitoring methods

A programme for measuring noise will be developed. Prior to construction, the initial state of the noise environment in the project area and surrounding zones will be established. For the major construction sites (unloading dock, port, quarry, plant, weir), ongoing measures will be carried out over a 24-hour period once every three months, or as often as needed, if complaints are voiced. As for minor construction sites that will only be in operation for a short while, measures will only be taken should complaints be voiced; in such a case, the situation will be assessed and the necessary corrective measures implemented. During the operations phase, and most particularly when the plant is running at full capacity, measures will be taken in the entire area surrounding the project, including at the Ehoala port (when ships are loaded), at the plant site and along the road linking the plant to the port.

The following frequency is recommended:

- Three reports during the course of the first year (or more, if problems are identified or complaints voiced);
- Once over the course of the next three years (or more often, if problems are identified or complaints voiced); in theory, the plant will operate and run according to plans, and repetitive activities will result in the noise generated being consistent in nature;
- Once every five years thereafter.

4.3.2 Air-borne emissions

Background

QMM's activities could result in changes in air quality in the sector where facilities will be built and operate. This is primarily the case for the mining site, the separation plant complex and along the road linking the plant to the Ehoala port. The air quality at the Mandena mining site will be affected due to the presence of air-borne particles following stripping of the mining surfaces. Some one hundred hectares will be cleared each year. We therefore anticipate that sand particles will be dispersed mostly during dry, windy periods. The bare surfaces, not yet restored, and the mineral piles on the sides of the extraction basin will also be subject to wind erosion.

The impact of the separation plant complex operations on air quality will be linked to emissions from the power plant and the dryer, as well as the exhaust systems of the motor vehicles and equipment (trucks, loader, etc.). The air quality will also be slightly modified by the dispersion of sand particles in the air, caused by truck traffic, and further exacerbated by blowing winds.

At this project definition phase, the type of liquid fuel that will be used for the power plant and the dryer has yet to be determined. However, QMM will incorporate, in the design of these facilities, all of the equipment required (e.g., dust extractors, air purifying equipment, etc.) to ensure that air emissions from the power plant and dryer remain within the applicable international standards, and this regardless of the fuel selected. The same will apply for emission levels resulting from the exhaust systems of motor vehicles and equipment.

Thus, the set up of equipment for capturing air emissions from the power plant and the dryer, the installation of anti-pollution devices on motor vehicles and equipment and the spreading or spraying of dust-control liquid are all measures for decreasing the quantity of sand particles dispersed in the area, thereby minimising the impact on air quality.

Monitoring methods

In order to ensure that QMM's equipment meets the air emission standards adopted, a programme for the management of emissions will be developed. The programme will be designed taking into consideration the various fuel options and the technologies for controlling air emissions.

The monitoring programme will include, among others, the following activities:

- Measurement of the air-borne emissions from the power plant and dryer on two occasions during the first year of operations and once every two years thereafter (measurements taken in the area and at the source);
- Measurement of particles dispersed in the air, on two occasions during the first year of operations and once every two years thereafter; these measurements will be taken at the mining complex (inside and outdoors), port installations, mining site and along the stretch of road linking the plant to the port and the villages surrounding the mining site;
- Meteorological data will be recorded at stations that will be set up at the project site. This data will be used to monitor and eventually create a new model of the anticipated dispersion of pollutants in the atmosphere;
- Development of the sampling plan, at the start of the construction phase (determination of sites, using preferred criteria);

- The frequency of sampling and the choice of sites of interest can be modified on the basis of problems encountered, the advancement of the project or other needs jointly identified by the promoter and the monitoring committee;
- Use of mathematical models, with regard to air quality and dispersion of particles, as monitoring and inspection tools, if judged necessary;
- ***IEC programme.

A report will be prepared on data collection in order to verify that equipment is compliant.

4.3.3 Quality of the water used for domestic purposes

Background

At present, there are no standards from the government of Madagascar for determining the quality of potable water. Thus, the guidelines for potable water issued by the Canadian government, along with those of the World Health Organization (WHO), will be used. A sampling of the water was carried out in 2001. Results showed that chemically, the overall water quality was good. All of the samplings, except for the one involving turbidity, were conducted according to the guidelines used for parameters related to human health. The guidelines for aesthetic parameters (colour, pH, iron, turbidity) were all exceeded.

In the Mandena sector, the waters of Lake Lanirano will be used to supply the community of Fort-Dauphin. The villages surrounding the mining sector use water from nearby watercourses or from wells supplied from the aquifer. Conflicts with regards to the use of water from Lake Lanirano with the community of Fort-Dauphin or the villages surrounding the mining site, whose water comes from watercourses or the water-table, will be generated as a result of the operations of the dredge. The presence of the weir will also help to ensure that the community has access to a sufficient quantity of water; furthermore, this structure will not cause deterioration in the quality of the water from the natural potable water reservoir.

Monitoring methods

Water samplings will be taken every month in Lake Lanirano and in the wells that provide water for domestic uses. The monitoring parameters and frequency will need to be determined following a discussion with stakeholders from the area. The preliminary programme of proposed measures will be as follows:

- Measurement of the water level, temperature, conductivity, salinity and pH, as well as bacteriological analyses of water samples, will be carried out every month in those wells chosen from among existing wells;
- Measurement of the water level, temperature, conductivity, salinity and pH, as well as bacteriological analyses of water samples, will be carried out every month at four sampling stations in Lake Lanirano (at the mouth of the Lanirano River, at the spot where JIRAMA pumps its water, at the centre of the lake, and at the mouth of the lake);
- Collection of a complete series of water samples from selected wells and from Lake Lanirano, once every quarter, for physicochemical and microbiological analyses by laboratories certified as competent by the Madagascar authorities;

- The determination of the presence of schistosomes in the molluscs of the stagnant waters of the mining sector, twice per year.

4.3.4 Road safety

Background

Road traffic between the Ehoala port and the separation plant will constitute a potential risk of accidents during the operations phase of the Mandena mining sector. In total, an average of 20 trucks per hour (320 per day) will travel between the Mandena plant site and the Ehoala port.

Even though the road will be built with a surface that is wide enough to ensure the security of all types of traffic, both motor vehicle and pedestrian, road traffic will nonetheless become a significant issue during the operations phase. To reach the objective of road traffic safety, QMM proposes developing appropriate measures. The implementation of these measures, however, will require the collaboration of all of the roads' users as well as that of the authorities responsible for enforcing traffic regulations.

Monitoring methods

A monitoring programme will be developed, in collaboration with government stakeholders and representatives from the communities concerned. The monitoring programme will include, while not being limited to, the following:

- The establishment and creation of a road safety committee that includes representatives from QMM, villagers, authorities and other economic agents that will use the roads. The committee's mandate will be to monitor the situation and to make recommendations with regard to improving road safety;
- Medical monitoring of the employees, to check the state of health of QMM drivers and ensure that they respect the safety regulations;
- Recording of all incidents and accidents involving QMM vehicles;
- The development of an emergency plan for accidents involving a QMM vehicle.

4.3.5 Radioactivity

Background

Monazite and zircon both contain only very low concentrations of radioactive elements. Furthermore, these two minerals only represent a very tiny portion of the deposit, namely 0.1% in the case of monazite and 0.2% in the case of zircon. Nevertheless, their presence requires that precautions be taken to minimise the risks associated with accidental exposure. The SEIA concludes, in fact, that a responsible management of these sands will ensure that all potential risk to QMM workers is eliminated.

A study (SENES, 2001) on radioactivity, as related to the various activities involved in the mining of mineralised sands, was conducted in 2001. The yearly dose to which workers could be subjected was calculated using regulation in force in Madagascar, which is in turn based

on the international recommendations of the ICRP (International Commission on Radiological Protection). This regulation establishes the maximum dose, for a worker, at 50 mSv for any given year, and the maximum cumulative dose over 5 years at 100 mSv. These standards are similar to those of the ICRP. With regard to the public, the maximum recommended yearly dose is set at 1 mSv in excess of the natural ambient radiation. By contrast, the average yearly radiation level for the public in general is estimated at 2.6 mSv, 75 % of which originates from natural causes (cosmic rays, earth radiation, radon, etc.), with the balance associated with human activity (medical x-rays, for example). In the Mandena sector, the SENES study estimated the yearly dose of terrestrial radiation to which a villager would be subjected, were he to spend all of his time on the mining site as it stands today, prior to operations, as being 3.2 mSv. The SENES study demonstrates that construction sites are a potential source of exposure to ionising radiation, as is the case of laterite with high concentrations of uranium or thorium.

Accidental spills of heavy minerals will represent a source of contamination of the soil at the sites of the various infrastructures (mines, port, roads) during the operations phase.

In point of fact, the sands that contain monazite will be returned from the mineral separation plant (MSP) to the mining site, where they will then be mixed with the light sands produced by the floating separator. This will ensure that the radiation level after operations is the same as that which existed prior to the beginning of mining activities. Sands that contain monazite will be trucked, on the roads developed within the mining site. Given that the trucks will not be travelling on the public roads, there will be no contact with the local population travelling in motor vehicles or on foot. The SENES study concludes, in fact, that the general population will not be exposed to any radiation levels greater than those existing under natural conditions.

On the other hand, QMM employees assigned to work at the MSP and its related facilities, as well as at the mining site, could come into contact, in varying degrees, with sands containing monazite. Risks associated with monazite sands include inhaling, over the long term, of dust, or a prolonged exposure to certain quantities of monazite in the worker's immediate vicinity.

The SENES study has established 2.8 mSv/a as being the maximum possible dose for workers assigned to dredging or separation activities at the mining site. For those workers involved with the loading and transport of residual sands containing monazite, we forecast that they could respectively be subjected to doses of 4.6 and 4 mSv/a. On the other hand, the QMM employees assigned to the MSP and its related facilities could, if appropriate protection measures are not applied, be subject to doses exceeding the recommended standards. Risks associated to monazite sands include inhaling, over the long term, of dust, or a prolonged exposure to certain quantities of monazite in the worker's immediate vicinity.

These measures were established on the basis of the "ALARA" approach ("as low as reasonably achievable"). They will be favoured by QMM as a means of preventing and minimising the risks associated with radiation exposure. These measures include:

- The design and implementation of covered transport equipment (conveyor belts) and separation equipment (magnetic and electrostatic separators);
- The requirement for workers assigned to risk sectors to wear individual protective gear;

- The use of screens, set up between the workers and the monazite sands;
- The establishment and strict application of working methods for all operations being carried out in risk sectors;
- The identification of those sectors where recorded radiation levels justify protective measures;
- The establishment of administrative practices with regard to the movement of personnel in the risk sectors and concerning the management of the exposure level and exposure time of the employees assigned to these sectors;
- Keeping monazite sands wet;
- The use of tarpaulins to cover sands during trucking;
- The use of laterite in works so as to respect applicable radiation protection standards;
- The efficient homogenizing of sand with monazite;
- The establishment and application of a clean up plan.

These measures must comply with the regulations regarding radiation protection in force in Madagascar.

Monitoring methods

Also, a programme for monitoring the exposure of workers as well as the level of radiation resulting from QMM's operations and activities will be developed, in partnership with the concerned authorities, over the course of the next few years. The monitoring programme, while not being limited to, could include:

- Monitoring of the cumulative radiation dose to which each employee has been subjected;
- Medical monitoring of all employees assigned to these sectors (including a requirement that all workers undergo periodic medical check-ups, whose frequency remains to be determined);
- A periodic verification that all workers assigned to the sectors in question are properly trained in this regard and understand the precautions to be taken;
- Regular measurements of the radiation levels at the various sites (e.g., port, road linking the plant to the port, within the villages surrounding the mining site) and recording of all data in a log book;
- Regular inspection of the sites and verification that working methods are adhered to, that individual protective equipment is being worn and that the equipment is in good condition;
- Measurement of radiation, according to a grid established during preparation of the detailed mining plan, will be carried out prior to and following the mining of sands, and this throughout the period of operations, in order to verify the changes in radiation levels;
- Independent verifications of the management of radioactive sands will be carried out;
- Measurement of the works containing laterite, to establish uranium and thorium contents;
- Measurement of uranium and thorium contents in the sand-monazite mixture, each time an adjustment is made to the mixer;
- Measurement of the ambient dose, at the site of accidental heavy mineral spills, once decontamination activities have been carried out.

4.4 Use of the territory

4.4.1 Tourism

Background

One of the dilemmas associated with this project is its compatibility with the region's tourism activities. The tourism sector in Madagascar is experiencing significant growth, with the Fort-Dauphin region considered a preferred destination, and it is expected that this growth will continue in the foreseeable future. Various interested parties have expressed a fear that mining operations would be detrimental for the region's tourism industry. Aware of tourism's positive impact on the local economy, QMM believes that the mining project should, in as much as possible, be compatible with the development of the area's tourism resources and even, if possible, represent a positive contribution.

In this regard, construction of the port will be significant for the development of tourism activities, as it will allow for the regular arrival of cruise ships. QMM's decision to ensure that the Anony remains navigable demonstrates its desire to contribute to the growth of the tourism industry. The construction of new stretches of road and the improvement of certain existing sections will also prove to be important contributions to the continued development of the region's tourism potential.

Also, the conservation zone proposed by QMM also represents an interesting potential for the development of ecotourism. The forest offers many interesting elements, both in terms of plant life and wildlife. There exists an ecological research centre, where the work being carried out can be observed. QMM has already launched a process, in conjunction with various partners, to develop a tour and botanical interpretation trails, and to offer tourists an overview of some of the products that local villagers produce from the country's natural resources. To this end, special guides have been trained. Furthermore, tour operators have been approached, and those interested in possibly offering such a tour of the conservation zone to their customers have been identified.

However, a number of project activities could be viewed negatively by area visitors. These include the movement of trucks, the stripping of the soil in the mining zone, the creation of muddy waters in the dredging basin, the ongoing commercial and industrial activities on the Ehoala peninsula and in nearby areas, the activities related to development of the port on the Ehoala peninsula and the development of the weir at the mouth of Lake Ambavarano. A series of mitigation measures will be implemented in order to minimise the impacts of these factors on the region's tourism activities.

As part of the detailed engineering studies of the various project components, QMM will consult the operators and public utilities concerned, in order to design and implement the very best possible solutions. These discussions will notably address the general design of the port (landscaping), the optimisation of its multifunctional character (within the context of an appropriate public funding), the choice of a method for boat transfer at the weir, the facilities required for accommodating tourists in the conservation zone (e.g., kiosk at the zone's entrance, sanitary facilities) and, the possibility of using of a section of the rehabilitated mining sector, once following closure, for leisure or tourism purposes (example: the area surrounding Lake Ambavarano).

QMM, well aware of the importance of tourism to the Fort-Dauphin region, will ensure, throughout its stay in the region, that its mining activities are as compatible as possible with the area's tourism development.

Monitoring methods

A programme for monitoring the project's spin-offs will be developed so as to assess the project's effects on tourism, as well as evaluate the effectiveness of the measures favoured by the promoter to foster the development of tourism in the Fort-Dauphin region.

However, these monitoring activities will need to be carried out in close collaboration with the relevant public and private bodies. Together, the parties will determine the parameters of the monitoring programme they wish to see implemented.

4.4.2 Exploitation of the plant resources in the mining sector, prior to the operations phase

Background

During the mining of the Mandena sector (about 25 years), an area yet to be determined (around 100 ha) will, at any given time, be in use for mining operations. The rest of the territory, i.e., the land that is not being exploited and that is not part of the mining plan for that year, will be available for the villagers' other uses, even while mining activities are underway elsewhere in the sector.

QMM is committed to setting up a programme for the management and equitable distribution of resources prior to the start of mining activities. The natural resources upstream of the dredge planned route will be developed according to a plan for the exploitation of resources previously prepared by the State, stakeholders from the area, villagers concerned and QMM. Given the populations' high level of dependency on these resources, QMM favours a rational use, one that will foster the development of the benefits of exploitation.

Development of natural resources upstream of the mining activities will be carried out throughout the project's operations phase. The development these activities has already been examined, within the framework of the project's actual preliminary phase, in collaboration with villagers. This examination is taking place as part of the implementation of a plan for the sustainable management of resources in the Mandena zone. The implementation of such a development plan is a corollary to the creation of the Mandena conservation zone, a move that will have an impact on the villagers' needs for resources. In this regard, QMM is committed to supporting the training of operators in improved techniques, aimed at decreasing forest losses and enhancing the available resources. These improved techniques are part of the methods recommended for using wood from rehabilitated areas, once it has attained maturity. QMM agrees to collaborate with the ***Centre de Formation Professionnelle Forestière de Morondava so that operators can receive training in improved forestry production methods.

Development of wood

Clearing that will take place prior to the start of mining operations will enable the recuperation of valuable wood, or the enhancement of wood residues, via their transformation into charcoal or fuel. Preferably, the wood with no commercial value will be used by the villagers for construction, or as fuel.

QMM proposes that villagers be responsible for recuperating wood with a commercial value as well as wood residues, and this according to the method that will be jointly established with the owner of the land, namely the Forests and Water Department.

Gathering medicinal plants

In the various sectors, medicinal plants will be gathered prior to the start of deforestation activities, in collaboration with the users and taking their knowledge into consideration. The replanting and conservation programme will include the replanting and conservation of these species, with the community, in order to ensure their reestablishment. The programme for the development of Mandena's resources upstream of the mining activities presented in Chapter 7 of the SEIA provides more specific information on the methods to be used for harvesting and managing the plant resources of the mined sectors.

Gathering plants for essential oils

The species that can be transformed into essential oils will first be gathered, upstream of the mining area, by the villagers, and then developed. The replanting and conservation programme will include the replanting and conservation of these species, with the community, in order to ensure their reestablishment. The programme for the development of Mandena's resources upstream of the mining activities presented in Chapter 7 of the SEIA provides more specific information on the methods to be used for harvesting and managing the plant resources of the mined sectors.

Development of the wetlands

The wetland resources to be used, prior to the passage of the dredge, include *mahampy* (*Lepironia mucronata*), ravinala (*Ravinala madagascariensis*) and niaouli (*Melaleuca quinquenervia*). These species will be harvested according to a predetermined plan. The Company agrees to ensure the availability of sufficient quantities of quality resources, such as *mahampy*, through the progressive restoration of the wetlands, as the mining activities advances.

The programme for the development of Mandena's resources upstream of the mining activities presented in Chapter 7 of the SEIA provides more specific information on the methods to be used for harvesting and managing the wetland resources of the mined sectors.

Monitoring methods

Data with regard to the plant life that is typical of the forest, the wetlands and the open environments has been collected for a few years already. The same is true with regard to the various uses that the villagers make of these plant resources. The additional studies that will be conducted prior to the construction phase will make it possible to document the relationship that exists between villagers and the ecosystems, as well as the ecological processes that govern the latter.

As of the start of the construction phase, those sectors (mine, weir, quarry, access roads, temporary camps, etc.) where plants will need to be removed will be carefully delineated. An inventory of the resources will be carried out, in order to determine how these same resources can be developed. The available quantities will be evaluated, thereby allowing the "managing body" to dispose of these plant resources according to a pre-determined plan.

A monitoring programme addressing the process for the management of natural resources along with certain aspects of the programme for the development of resources will need to be jointly developed by QMM, the State, stakeholders from the region and the villagers concerned. Together, the parties will determine the parameters of the monitoring programme that they would like to establish.

4.4.3 Agricultural plots and grazing land

The implementation of the various project components will result in the loss of agricultural plots and grazing land and damage to some crops. These inconveniences may be temporary or, in some cases, permanent. QMM is committed to optimising the detailed design of the facilities and monitoring the implementation of the works in order that losses and damages be kept to a minimum. Whenever the project operations require activities to cease in a particular area and be carried out elsewhere, QMM will hold discussions with the relevant communities and public utilities regarding the use of the territory and how to best support the activities thus relocated. Similar discussions will need to be held to address the issue of compensation of owners or operators or yet still, supporting them in carrying out other revenue-generating activities.

The monitoring programme concerning the use of the territory as regards agricultural plots and grazing land will be further developed during the detailed engineering phase of the project components and, following discussions with communities and government stakeholders concerned.

4.4.4 Exploitation of aquatic resources upstream and downstream of the weir and in the marine environment (Ehoala peninsula)

Context

Catches in the lacustrine and estuarine system are weak and continuing to decrease. Despite the actual state of deterioration of fishing conditions in the sector impacted by the weir, we expect a change in the lifestyle of the fishermen affected, in light of modifications to the distribution of the brackish environment's halieutic resources.

Despite the design of the weir so as to allow the passage of fishermen, it should be expected that they will nevertheless view the presence of this structure as hindering their movement between Lake Lanirano and the mouth of the Anony River. The inconveniences involved in crossing the weir will modify the habits of fishermen.

The coastal sector of Fausse Baie des Galions, close to the permanent port infrastructure, actually harbours very few halieutic resources of interest and is not extensively used for traditional fishing. The primary areas, where catches include ocean fish, oysters, mussels and

octopus as well as rock lobster and shark, are located on the south and southwest coasts of the site proposed for construction of the breakwater (CSSA, 2000). Studies have also demonstrated that rock lobster is presently being overexploited.

Construction of the breakwater will bring about the loss of sites for the harvest of marine resources located north of the Ehoala peninsula. Modification of the local hydrodynamic conditions will, for their part, result in the relocation of mobile species and the loss of attached organisms (crustaceans and molluscs). QMM nevertheless believes that the infrastructure will represent a potential habitat for marine wildlife that will contribute, over the medium term, to improving fishing conditions for these same villagers.

As regards halieutic resources, QMM recommends an approach that focuses on the conservation and sustainable management of freshwater and brackish water species, as well as the sustainable management of the coastal zone. To this end, an analysis of the potential market for enhanced freshwater aquatic resources will be conducted and the feeding habits of these same resources will be monitored; both of these activities will be carried out in collaboration with the relevant technical departments. Other measures proposed for promoting the sustainable management of resources include increasing fishermen's awareness with regard to the authorised number of catches, the selective use of fishing boats and the forming of marine and freshwater fishermen organizations. Alongside these modifications, various other measures will promote an increase in the species being exploited.

Monitoring measures

The monitoring programme will be further developed following discussions with fishermen and government stakeholders. The parties will jointly determine the parameters of the monitoring programme that they want to implement.

4.5 Culture and heritage

4.5.1 Traditions and sacred sites

Background

During the course of local consultations, people emphasized the importance of having their traditions, sacred sites and taboos respected. Traditions, considered herewith in the widest sense, include ways and customs, nature, etc. Villagers were specifically emphasizing on respect for sacred sites, which include historical sites, tombs and standing stones. These sacred sites are extremely important to the population and villagers insisted that the project not impact any of these sites during the course of mining activities. This deeply entrenched tradition is derived from a strong attachment to ancestors and to the cult of the dead.

Consequently, project planning took sacred sites into consideration, and was carried out in compliance with the standards established under the Mining Code (Madagascar, 1999c) to this effect. A dozen plots of varying sizes, tombs and funeral sites, were identified near the zones where project activities would be carried out, and will be the object of special consideration by QMM, the residents and the authorities. The activity zones in question include the port storage area at the Ehoala peninsula, the Fort-Dauphin bypass, the sector

under consideration as a location for the pumping station (on the border of Lake Ambavarano) and the Mandena mining sector.

Beyond the sacred dimension, there also exist areas whose character is subtly, yet firmly, affirmed. In such cases, there is a reference to "spirit of the place".

QMM undertook an ongoing dialogue with the populations, and has transmitted its intention to respect local traditions: the protocol of the consultations, the concrete collaboration between QMM and the populations concerned, regarding the "*Mahampy* project", the rehabilitation work and the search for solutions to the coalers' problems are all examples of the Company's commitment, which will remain firm for as long as it is active in the region.

QMM also formally undertakes to respect the sacred sites located in the mining sector and to seek out, in collaboration with the populations, the best means of minimising any negative impacts from the project. Various mitigation measures have been proposed to ensure the protection of the sacred sites. The Company's commitment to restoring the mining sector to its original condition will make it possible to recreate a topography and hydrography very similar to what originally existed. However, use of the sites will be changed, to the extent that, with the agreement of authorities and the villagers, the regeneration of the natural forest and the creation of sources of supply of fast-growing wood are favoured.

Monitoring methods

A monitoring programme will be implemented in order to evaluate the effectiveness of the promoter's actions with regard to the traditions and sacred sites in the urban and rural communes of the Fort-Dauphin sector.

This programme will need to be carried out in close collaboration with these organisations of villagers concerned. The parties will jointly determine the parameters of the monitoring programme that they want to implement.

4.6 Economic activities

4.6.1 The migration of individuals

Background

QMM's project, along with the other anticipated economic activities, risks attracting a number of individuals in search of work or looking to offer support services. Given the high rate of population increase, 2.7 % per year, the population of the region could easily double over the next 25 years. It is difficult, even impossible, to predict the number of new migrants that will be successful in finding employment or adopting an economic activity, in the formal or informal sectors, and how the likelihood that they increase the number of underprivileged. However, a certain migration towards the Fort-Dauphin region could prove necessary to fill all of the jobs generated by the region's economic development. In order to limit speculative migration and mitigate its impacts, the Company agrees to set up various measures, applicable to itself and its authorized representatives; these measures should not, however, infringe upon people's rights to relocate.

Proceeding with caution, QMM will work in collaboration with the responsible parties representing villages and communes, the regional and national authorities, the NGOs and other interested bodies, so as to implement a programme seeking to reduce incentives to migration and manage the impacts of that migration which cannot be avoided. As such, it will promote job stability and will offer applicable training programs for the trades that will be in demand, and this so as to allow the greatest possible number of people from the region to have access to the widest possible range of jobs.

Managing migration exceeds QMM's responsibilities. Other than the recommended measures, described above, other actions, primarily from the public authorities, will be necessary for managing migration.

Monitoring methods

A monitoring programme will be developed as of the decision to invest is made, in order to assess the effectiveness of QMM's actions, and those of the public authorities, in managing the migration of people to the Fort-Dauphin region.

This particular aspect of study will need to be carried out in close partnership with the public, community and private bodies concerned.

4.6.2 Development of the territory

Background

Mining projects often create social and economic enclaves: the promoter and other parties, from outside of the country or region, first settle in, and then proceed to export minerals and profits. In compliance with Rio Tinto's policy, QMM, a subsidiary, will attempt to avoid this as much as possible, and to incorporate its project into the region's development process, while remaining aware that the project itself represents a significant factor of change. Both the cause of and a participant in the changes affecting the community, the Company became involved and has participated in the regional development planning process.

The regional planning process, while ongoing, has yet to determine a master plan. The Regional Development Committee (RDC), responsible for carrying out an integrated, participatory planning process prior to the preparation of the Anony Regional Development Plan (ARDP), has already made its views known on the opportunity represented by the mining of mineral sands. However, the participatory planning process has demonstrated that an objective of sustainable development (quality growth capable of reducing poverty in the region) would only be reached under certain conditions: execution of an impact study, under the MECIE, thereby ensuring a "responsible" mining project; the development of a regional plan identifying the key actions necessary for addressing regional issues (institutional capacity, fiscal distribution, urban planning programme, strategy for the management of natural resources, regional strategy for water management).

QMM, in making choices and decisions, has tried to take into consideration the primary growth axes as well as the main concerns of the region, as expressed during the planning process implemented by the RDC. In order that its project contribute to regional development, QMM has chosen to promote the following:

- Promoting the region's opening up, and the strengthening of Fort-Dauphin's role as a growth pole (e.g. construction of an adequate road infrastructure, construction of a conventional sheltered harbour);
- Supporting the implementation of a plan for the development of Fort-Dauphin that would allow the city to acquire a new urban development plan and development regulations adapted to the new reality;
- Promoting the development of a commercial and industrial zone near Fort-Dauphin;
- Promoting the maintenance of a conservation zone in Mandena.

Monitoring methods

Once the investment decision is made, a monitoring programme will be implemented in order to assess the effectiveness of actions regarding the development of the territory recommended by QMM to promote development of the Fort-Dauphin region. This monitoring programme will be carried out in close collaboration with the public and private bodies concerned.

4.6.3 Poverty in the Fort-Dauphin region

Background

The mining project will have a catalyst role in terms of reducing poverty, if it creates new wealth that is not limited only to investors, Rio Tinto, the government of Madagascar (OMNIS), but that also affects the region. The Madagascar strategy for the reduction of poverty, described in the Poverty Reduction Strategy Paper (INSTAT, 2000), ranks private investment, creator of wealth, first. While this is a necessary condition for the reduction of poverty, it is not sufficient in and of itself. Unless specific measures are taken, the benefits of economic activity will not necessarily impact or trickle down to the poorest members of society. QMM, in managing the project, will follow guidelines ensuring that its investments truly contribute to the reduction of poverty.

The project's contribution to reducing poverty in the region will work by means of the following measures:

- Participation in building heavy public infrastructures, recognized as being the growth pole for various economic activities;
- Offering competitive salaries, which will ensure a minimum of well-being for the recipients, men and women;
- Offering competitive fringe benefits, including health care for the employees and the employees' family members;
- Making a significant contribution to the wealth of the region by rehabilitating the mining site and creating and managing renewable resources: fuel wood, building timber, *mahampy*, regeneration of wetlands, development of aquaculture projects. Not only will new sources of wealth be created, but their management by the community could be as important as the resources themselves;
- The training and experience acquired by QMM managers, professionals and specialists will be combined with Malagasy knowledge, thereby creating additional personal and communal wealth.

Support for health improvement programmes

QMM's actions with regard to health will include financial and material support for the programmes addressing fundamental health issues, among others, lack of potable water, the limited access to health care, cholera and sexually transmitted diseases, especially AIDS, which result from the region's widespread poverty.

Support for education improvement programmes

A basic education and access to advanced learning are engines of social development. QMM wants to continue participating in public and community programmes whose goal is to increase, or maintain, the access by children from neighbouring communities to elementary school. QMM's activities will focus in areas such as the renovation of schools, the construction of school benches, the acquisition of teaching material and the further training of teachers. In order to be able to recruit certain of these workers in Fort-Dauphin, QMM will collaborate with these secondary and technical training institutes in order to ensure that programmes and teachers in the fields are appropriate or, in the latter case, equipped with the necessary knowledge, in areas of need.

QMM will offer training programmes that will make it possible for the underprivileged to have access to jobs created by the project. Similarly, it will offer its employees regular training and educational programmes.

Over the past few years, QMM has been carrying out a community programme that supports initiatives related to health, education and sports. As is the case for all activities involving the population, QMM's strategy in terms of the community will first and foremost be based on the Rio Tinto management principles contained in its policy "The Way We Work". The three main factors of this policy are mutual respect, between the communities and the company, an active and reciprocal partnership, and, a commitment to the community for the entire period of operations and beyond.

Monitoring methods

A programme for monitoring the project spin-offs could be implemented by the public, community and private bodies concerned, in conjunction with QMM. Such a programme would monitor the project's contribution to the reduction of poverty in the urban and rural communities of the Fort-Dauphin sector.

4.6.4 Purchasing of goods and services and job creation

Forecasts of regional spin-offs in terms of the purchase of goods and services

The project's economic spin-offs have been felt since 1986, when the preliminary phase began. All current purchases, for approximately $0.7 M USD per year, are carried out on site, in Fort-Dauphin or Antananarivo. The same holds true for services. The total of these expenses, combined with the direct salaries paid, have represented a total project impact on the Fort-Dauphin economy of around $1 M USD per year from 1986 to 2003. The Gross Domestic Product (GDP) of the Anony region was estimated at $56 M in 2000 (Dobbin

International Inc., 2001). The economic contribution of the QMM project during the preliminary phase therefore represents approximately 2% of the yearly regional GDP.

During the construction phase, the Project will generate investments estimated at around $34 M USD. While much of this will be for engineering services, there will also be a portion allocated to imported parts and equipment. Madagascar's weak level of industrialisation at the present time means that few goods and services can be purchased on site. Nevertheless, QMM will work in partnership with local establishments to promote the award of purchases of goods and services to companies from the region. QMM will favour purchasing from local suppliers with competitive prices and competencies equal to those of their competitors. To do so, QMM will support groups of local operators and will collaborate with lending institutions.

During the operations phase, the project will play a major role as an engine for the development of various activity sectors in Madagascar, and more particularly in Fort-Dauphin. (See the SEIA, Chapter 6 – Section 6.3 "***Economic Spin-Offs", for more details)

Forecasts of regional spin-offs in terms of job creation

A number of jobs have been created in the region since the start of the project. In 1988-1989, the labour force assigned to the project totalled 270 people, the majority of them hired locally. At present, the Company employs about 40 people in Antananarivo and 120 in Fort-Dauphin. During this initial period, QMM has evaluated the number of indirect jobs generated by the project to be between 170 and 250, for a total of somewhere between 370 and 500 jobs. QMM estimates that during the construction period some 500 to 1,000 jobs will be created. The Company seeks to hire at least 35% of the labour force required during this period from the population of Madagascar. During this phase, QMM evaluates the number of indirect jobs created at anywhere from 1,700 to 3,400. It thus estimates the total number of new jobs created during the construction phase to be around 4,000.

During the operations phase, when ilmenite production will reach 750,000 t/y, the number of direct permanent jobs linked to the mining activities and the rehabilitation and development of the site after mining activities have ended should be around 600. QMM's objective is to hire nationals for at least 80% of these permanent positions, including managers. Given that mining operations are highly mechanized, a major portion of the labour force will consist of qualified employees. In order to meet its hiring targets as regards personnel from Madagascar, QMM will set up a training programme to increase the level of skills and competencies of the region's population. The experience acquired will make it so that these workers are likely to be able to contribute to other projects involving the development of renewable resources. Taking into account the fact that one direct job generates around 1.86 additional jobs in other economic activity sectors, QMM estimates that approximately 1,700 new jobs will be created during the operations phase.

A study aimed at assessing contribution to the region's economic development will be conducted in close collaboration with the public and private bodies concerned.

The promoter will also adopt an equal opportunity hiring policy, particularly with regard to gender, for all of the project phases.

5 Environmental practices

The project's construction and, especially, operations phases will require environmental management as regards various activities, including those related to the implementation of environmental measures. To this end, standard operating practices will be established and brought into force in a timely fashion. These practices will be developed in a manner so as to meet ISO 14001 standards. Each of these practices will include the following elements among others:

- A clear definition of the standard's objective;
- A detailed description of the actions to be taken and/or the specific guidelines to be followed;
- Identification of those responsible for applying the standard and a description of their respective responsibilities;
- Identification of the follow-up or monitoring parameters and the contents of the reports to be prepared.

Additional elements may be added to these procedures, on the basis of authorisations and discussions with government stakeholders as well as those in charge of the detailed project engineering.

Standardised operational procedures will be applicable with regard to elements such as:

- Water management;
- Forest resources management;
- Domestic waste from temporary camps management;
- Hazardous waste management;
- Rolling stock and road safety management;
- Air borne emissions management;
- Noise management;
- Radioactive sands management;
- Petroleum, oils and lubricants management (fuel oil, lubricants, etc.)
- Port activities management;
- Action programme in the event of environmental emergencies;
- Protection of the health and safety of employees;
- Protection of the safety of villagers using the mining sector;
- Preparation and awarding of contracts and subcontracts;
- Training of employees as regards health, safety and the environment;
- Standardised operational practices management;
- Etc.

For example, QMM's environmental emergency plan, with regard to accidental hydrocarbon spills at the port, will not be a simple written report, but rather, a process. In fact, it will be continually updated so as to improve any or all of its elements and to adhere to QMM and Rio Tinto's commitment to protecting the environment and the marine environment as well as keeping the losses resulting from any accidental spills to a minimum.

The emergency plan that will be set up will include, among others, the following elements:

- A comprehensive list of possible emergency situations (fire, hydrocarbon spill, etc.);

- A well-structured emergency organisation;
- The definition of the adequate number of properly trained and equipped responders;
- The availability of adequate and working emergency equipment and material;
- Adequate means and methods of communication; and
- Clear and appropriate corrective measure procedures.

6 Budgets and schedules for the implementation of environmental measures

There is an important difference between the mining of the Fort-Dauphin mineral sands deposit, when compared to the mining of a conventional deposit, with regard to the implementation of a "budget for carrying out mitigation measures of the project's environmental impacts and for rehabilitation of the mining site". In fact, the rehabilitation of the zone being mined is on an ongoing basis, parallel with the advancement of the work as mining progresses. This practice is an accepted and current one in dredgemining. In fact, QMM is proposing that the closing of activities also be carried out in such a progressive manner, throughout the entire period of mining activities in the Mandena sector, and that the mined territory be thus progressively returned to its owner, the State.

The expenses related to the implementation and or application of mitigation measures will be of three types, namely:

- Capital costs for construction or for modification of the works to meet needs to be related to management of the environment and the mitigation of project impacts;

  No valid estimate of the capital costs associated with the project impact mitigation programme and environmental protection is currently available, given that the project and hence, that of several of the proposed mitigation measures, are still in the design stage. During detailed engineering phase of the project costs and related budgets required will be established.

- Current expenses for application of the proposed mitigation measures, such as rehabilitation of the mined zones, for compensation, etc. and for carrying out the related programmes for monitoring and follow-up of the components of the natural and human environments affected by the project activities.

  The information available regarding current expenses for application of the environment management programme, for mitigation of the project impacts on the natural and human environment and for the ongoing rehabilitation of mined sites is very preliminary. These will only be properly established once mining is underway. However, should it be required, QMM will be able to provide estimates of these costs once the project's detailed engineering phase is completed.

- A significant voluntary decrease in project revenues, resulting from the decision to propose the establishment of conservation zones in significant areas of the Fort-Dauphin deposit.

The end of operations in the Mandena sector does not represent the end of mining of the Fort-Dauphin deposit. Rather, it will be followed by mining in the Petriky and Ste-Luce sectors. Consequently, and considering the present scenario where the MSP is relocated, the end of mining in the Mandena sector will only involve:

- Closing of the MSP site and of the roads and, possibly, dismantling of the weir; and
- Rehabilitation of the zone mined over the final six months, thus about 50 ha.

Given that QMM, at this time, will need to obtain a new environmental permit from the government of Madagascar for the mining of the chosen sector, this obligation that QMM has constitutes the most important guarantee for the State of Madagascar that the final rehabilitation of the Mandena sector will be carried out according to the agreements entered into in this regard.

Nevertheless, QMM wishes to underline its willingness to adhere to the terms of Ministerial Order N° 12032/2000 with regard to its commitment to finance the closing of its activities. In reality, no investment decision has yet been taken, and this closing could only, in any event, take place in about 60 years. Given these circumstances, it is premature, and for all extents and purposes, impossible, to establish an estimate of the expenses that should be anticipated.

7 Conclusion

The PEMP will be a dynamic and flexible plan, in that it will be subject to periodic revisions and updates. Many of the measures included in the SEIA are still in the preliminary phase, such so that in several cases, their exact parameters have not yet been defined. Similarly, certain of the proposed actions or the techniques used will need to first be discussed with the external experts involved, stakeholders from the government of Madagascar and the populations concerned. Moreover, a better knowledge and a more precise assessment of the anticipated impacts will obviously result in adjustments to the environmental measures. QMM's adoption of an environmental management system that meets ISO 14001 standards will force it to continually improve its environmental management programme, and consequently, to reduce the impact of its activities on the natural and human environment.