Chapter 15 | Environmental and Social Management and Monitoring
Chapter 15 | Environmental and Social Management and Monitoring

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15 ENVIRONMENTAL AND SOCIAL MANAGEMENT AND MONITORING

15.1 Overview

This ESIA chapter describes how the Mako Gold Project proposes to manage the social and environmental impacts and risks that will arise during the Construction, Operation and Closure Phases of the Project.

The proposed management and monitoring strategy for the various phases of the Mako Gold Project has been documented in a detailed *Environmental and Social Management and Monitoring Plan (ESMMP, Volume C)*. A stand-alone *ESMMP* is a requirement of Senegalese regulations (*Arrêté n° 9472 du 28 Novembre 2001 portant Contenu du Rapport d'étude d'impact*) as well as IFC Performance Standards on Environmental and Social Sustainability.

Environmental and social management measures covering the following Project components and activities have been incorporated in the ESMMP:

- Project Development Area;
- Open Pit, Mining and Waste Rock;
- Mineral Processing and Tailings Management;
- Water Supply;
- Power Supply;
- Roads and Transport;
- Accommodation Facilities;
- Borrow Areas and Quarries; and
- Land Management and Livelihood Restoration.

In addition, a set of Standard Operating Procedures have been developed to address general environmental and social management measures relevant for multiple Project components. These include procedures for:

- Erosion and Sediment Control;
- Water Quality and Pollution Management;
- Hydrology and Water Management;
- Emission and Dust Control;
- Noise and Vibration Management;
- Waste Management;
- Hazardous Materials Management;
- Blasting Management;
- Land Clearance and Soil Stockpiling;
- Cultural Heritage Management;
- Lighting and Visual Amenity Management; and
- Chance Finds Procedure (Archaeology and Cultural Heritage).
During the Construction and Operation Phases of the Project, it is expected that the ESMMP will be updated as required to incorporate any significant changes or at least at two year intervals during the life of the Project.

The Company is responsible for ensuring that management and monitoring strategies are implemented during the life of the Project as discussed in the ESMMP. Suitable staff, equipment, support systems, and financial resources will be necessary to implement the ESMMP, as will collaboration with relevant governmental agencies.

15.2 Environmental Management Systems

15.2.1 Overview
The Company is committed to establishing an Environmental Management System (EMS) for the Mako Gold Project which is consistent with the Senegalese legislation and aligned with the following guidelines and international standards:

- OHSAS 18001 Occupational health and safety management systems;
- ISO 14001 Environmental management systems;
- IFC Performance Standards; and
- Global Reporting Initiative Sustainability Reporting Guidelines.

This management system provides the Company with a procedural framework for implementing, achieving, reviewing and maintaining its’ environmental and community policies and all environmental and social management targets.

The ESMMP provides a link between policy and implementation, essentially, acting as a planning document, summarising environmental and social commitments (as outlined in this ESIA) and presenting the management measures and monitoring programs to be undertaken to achieve these commitments. The ESMMP provides a framework for developing flexible and readily updateable environmental management procedures within a formal EMS. This function of the ESMMP is represented schematically in Figure 15-1.
15.2.2 Responsibilities

The implementation, day-to-day management and continued improvement of the ESMMP for the Project will be the responsibility of the Company OHS&E Manager. The OHS&E Manager will report directly to the Operations Manager.

Under the direction of the OHS&E Manager, the Environment Department will comprise a team of qualified professionals responsible for the day-to-day implementation of rehab activities, compliance monitoring and the Biodiversity Action plan. The Social Department will comprise a team of qualified professionals responsible for the day-to-day implementation of the livelihood programme, community relations activities, and local participation programme. Each department will be led by a coordinator who shall report to the OHS&E Manager on a daily basis or as required for fulfilment of duties. The specific duties of the OHS&E Manager with regard to environmental and social management include:

- Complying with legal obligations and ESIA commitments by establishing and maintaining appropriate management and monitoring systems;
- Ensuring the environmental and social management and monitoring described in the ESMMP are implemented effectively;
• Ensuring management measures and commitments contained in the ESMMP are included in Contractor Contracts (as relevant) and that contractors fulfil their contractual environmental and social obligations;

• Reviewing and approving the Construction Environmental Management Plan (CEMP) to ensure it is adequate, complies with the ESMMP and the Mining Permit, and up-to-date with any changes in Project scope, legislation, or policies;

• Proactively engaging and liaising with relevant Government Authorities, communities and other stakeholders - including dissemination of Project updates and regular, meaningful, inclusive and participatory consultations with affected communities;

• Preparing and submitting reports regarding progress of implementation, performance of environmental management measures and monitoring data, and relevant environmental information and data required by regulators;

• Ensuring the Company personnel and contractors receive appropriate training and awareness regarding their environmental and social responsibilities; and

• Monitoring the performance of the environmental and social management measures in the ESMMP.

It is the responsibility of all Company staff and contractors to comply with the regulations and procedures set out in the ESMMP, and to carry out their work in such a manner as to minimise the social and environmental impacts.

15.2.3 General Environmental and Social Management Budget

The Company is committed to providing sufficient resources to ensure the successful implementation of the environmental and social management and monitoring of the Mako Gold Project as identified in the ESMMP. The Company will also ensure that, where applicable, contractors also include sufficient resources for the environmental management of their activities.

The Company has made significant expenditure on environmental and social management and monitoring for their Mako exploration activities. The development of the Mako Gold Project will lead to a significant increase in the overall environmental and social management operating budget.

A preliminary analysis of environmental and social management costs associated with the construction, operation and closure of the Mako Gold Project has been undertaken.

Table 15-1 displays a conceptual Environmental and Social Management and Monitoring Budget. The proposed budget includes capital cost, annual operating costs, and a closure cost (over five years). The closure budget will need to be refined based on the result of closure investigations.
Table 15-1 Conceptual budget for social and environmental management and monitoring for the Mako Project during pre-construction, construction, operation, and decommissioning / closure phases (FCFA ±20%) (converted from USD: 1USD = 587.706 FCFA, 9/9/2015)

<table>
<thead>
<tr>
<th>Item</th>
<th>Pre-construction</th>
<th>Construction</th>
<th>Operations</th>
<th>Decommissioning and Closure</th>
<th>Total</th>
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<tr>
<td></td>
<td>Year 0</td>
<td>Year 1</td>
<td>Year 2</td>
<td>Year 3</td>
<td>Year 4</td>
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<tr>
<td><strong>Staffing Costs</strong></td>
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<td></td>
<td></td>
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<tr>
<td>Human Resources (Environment and Social Dept.)</td>
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<td>323,238,300</td>
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<td>Sub-total</td>
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<td>323,238,300</td>
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<tr>
<td><strong>Capital Costs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Installation of groundwater monitoring bores</td>
<td>-</td>
<td>158,680,620</td>
<td>-</td>
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<tr>
<td>Establishment of environmental monitoring and laboratory equipment</td>
<td>-</td>
<td>88,155,900</td>
<td>-</td>
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<td>-</td>
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<tr>
<td>Maintenance of environmental monitoring and laboratory equipment (10% capital)</td>
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<td>-</td>
<td>8,815,590</td>
<td>8,815,590</td>
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<tr>
<td>Sediment control infrastructure / materials</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td>TMF control measures for fauna (e.g. fencing)</td>
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<td>-</td>
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## Environmental and Social Impact Assessment

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</tr>
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<tbody>
<tr>
<td></td>
<td>Year 0</td>
<td>Year 1</td>
<td>Year 2</td>
<td>Year 3</td>
<td>Year 4</td>
</tr>
<tr>
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<td>8,815,590</td>
<td>8,815,590</td>
<td>8,815,590</td>
<td>8,815,590</td>
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### Environmental and Social Management Systems

- **Environmental and social monitoring protocols:**
  - Year 0: 23,508,240
  - Year 1: 11,754,120
  - Year 12: 17,631,180

- **Preparation / Update of Monitoring Manual, CEMPs and Operations ESMMP:**
  - Year 0: 14,692,650
  - Year 1: 14,692,650

- **Regular updates of environmental and social management plans:**
  - Year 0: 17,631,180
  - Year 1: 17,631,180
  - Year 12: 17,631,180

- **Internal audits / performance review:**
  - Year 0: 5,877,060
  - Year 11: 5,877,060

- **External audits:**
  - Year 0: 23,508,240
  - Year 12: 23,508,240

- **Annual Sustainability Report:**
  - Year 0: 5,877,060

- **Capacity building for local authorities, including Regional Environmental Monitoring Committee:**
  - Year 0: 17,631,180

**Refer Closure Costs:**
- Year 12: 141,049,440
- Year 13: 58,770,000
- Year 14: 141,049,440

**Total:**
- Year 1: 29,385,300
- Year 12: 246,836,520
- Year 13: 246,836,520
## Mako Gold Project
### Environmental and Social Impact Assessment

#### Tabular Data

<table>
<thead>
<tr>
<th>Item</th>
<th>Pre-construction</th>
<th>Construction</th>
<th>Operations</th>
<th>Decommissioning and Closure</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Year 0</td>
<td>Year 1</td>
<td>Year 2</td>
<td>Year 3</td>
<td>Year 4</td>
</tr>
</tbody>
</table>

#### Environmental Management and Mitigation

- **Hazardous Facility Registration (ICPE) and Emergency Response Plan (POI)**
  - Year 0: 11,754,120
  - Year 1: 11,754,120
  - Total: 35,262,360

- **Environmental monitoring, laboratory analysis and consumables**
  - Year 0: -
  - Year 1: 117,541,200
  - Total: 1,219,489,950

- **Finalisation of Biodiversity Action Plan (BAP)**
  - Year 0: 14,692,650
  - Year 1: 29,385,300
  - Year 2: 117,541,200
  - Total: 58,770,600

- **Supplementary pre-construction baseline surveys**
  - Year 0: 20,569,710
  - Year 1: 11,754,120
  - Total: 32,323,830

- **General Biodiversity Monitoring including targeted fauna surveys**
  - Year 0: 8,815,590
  - Year 1: 17,631,180
  - Total: 193,942,980

- **Preparation and implementation of Cultural Heritage/Archeology Management Plan**
  - Year 0: -
  - Year 1: 8,815,590
  - Year 2: 17,631,180
  - Total: 47,016,480
## Mako Gold Project
### Environmental and Social Impact Assessment

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<th>Item</th>
<th>Pre-construction</th>
<th>Construction</th>
<th>Operations</th>
<th>Decommissioning and Closure</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Year 0</td>
<td>Year 1</td>
<td>Year 2</td>
<td>Year 3</td>
<td>Year 4</td>
</tr>
<tr>
<td>Major Update of Rehabilitation and Closure Plan Prior to Decommissioning</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Preparation of Blasting Management Plan by blasting contractor</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Implementation of other aspects of ESMMP and BAP</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Biodiversity Offset Programme</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Preparation of Biodiversity Offset Plan</td>
<td>29,385,300</td>
<td>29,385,300</td>
<td>29,385,300</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Biodiversity Offset Programme implementation</td>
<td>-</td>
<td>14,692,650</td>
<td>88,155,900</td>
<td>88,155,900</td>
<td>88,155,900</td>
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<tr>
<td>Biodiversity Offset Fund</td>
<td>-</td>
<td>-</td>
<td>88,155,900</td>
<td>88,155,900</td>
<td>88,155,900</td>
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<tr>
<td>Biodiversity Offsets Monitoring (including detailed monitoring protocol development, satellite imagery analysis and ground-truthing)</td>
<td>17,631,180</td>
<td>11,754,120</td>
<td>11,754,120</td>
<td>11,754,120</td>
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<tr>
<td>Item</td>
<td>Pre-construction</td>
<td>Construction</td>
<td>Operations</td>
<td>Decommissioning and Closure</td>
<td>Total</td>
</tr>
<tr>
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<td>-----------------------------</td>
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</tr>
<tr>
<td></td>
<td>Year 0</td>
<td>Year 1</td>
<td>Year 2</td>
<td>Year 3</td>
<td>Year 4</td>
</tr>
<tr>
<td>Supporting Biodiversity Conservation Actions</td>
<td>-</td>
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<td>Social Management / Stakeholder Consultation Costs</td>
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<td>29,385,30</td>
<td>0</td>
<td>29,385,30</td>
<td>0</td>
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<tr>
<td>Stakeholder and Government consultation / Community relations</td>
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<td>29,385,30</td>
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<td>Design and planning for Livelihood Restoration Program</td>
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<td>-</td>
<td>-</td>
<td>105,787,080</td>
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<td>14,692,650</td>
<td>0</td>
<td>14,692,650</td>
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<td>Community Infrastructure Mitigation Program (water, health and sanitation facilities)</td>
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<td>58,770,600</td>
<td>0</td>
<td>29,385,30</td>
</tr>
<tr>
<td>Item</td>
<td>Pre-construction</td>
<td>Construction</td>
<td>Operations</td>
<td>Decommissioning and Closure</td>
<td>Total</td>
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<tr>
<td></td>
<td>Year 0</td>
<td>Year 1</td>
<td>Year 2</td>
<td>Year 3</td>
<td>Year 4</td>
</tr>
<tr>
<td>Local Economic Participation Plan (including local content initiatives and capacity building)</td>
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<td>29,385,300</td>
<td>29,385,300</td>
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<td>299,730,000</td>
<td>293,853,000</td>
<td>238,020,900</td>
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Environmental and Social Impact Assessment

| Environmental and Social Investment Fund | - | 117,541,200 | 264,467,700 | 264,467,700 | 264,467,700 | 264,467,700 | 264,467,700 | 264,467,700 | 264,467,700 | 264,467,700 | - | - | - | - | - | 2,233,282,800 |
| Sub-total | - | 117,541,200 | 264,467,700 | 264,467,700 | 264,467,700 | 264,467,700 | 264,467,700 | 264,467,700 | 264,467,700 | 264,467,700 | - | - | - | - | - | 2,233,282,800 |

Rehabilitation and Closure Costs

<p>| Physical Closure Costs | - | - | 39854608 | 4 | 39854608 | 4 | 39854608 | 4 | 39854608 | 4 | 39854608 | 4 | 39854608 | 4 | 75158427 | 7 | 1337257 27 | 1131731 58 | 103097 674 | 103097 674 | 4,393,047,17 9 |
| Closure Investigations and Methodology | - | - | 58035968 | 58035968 | 58035968 | 58035968 | 58035968 | 58035968 | 58035968 | 58035968 | 0 | 0 | 0 | 0 | 0 | 464,287,740 |
| Socio-economic Closure | - | - | 45914531 | 45914531 | 45914531 | 45914531 | 45914531 | 45914531 | 45914531 | 45914531 | 0 | 0 | 0 | 0 | 0 | 367,316,250 |
| Stakeholder Consultation | - | - | 11754120 | - | 11754120 | - | 11754120 | - | 11754120 | - | - | 11754120 | 0 | 1175412 0 | 0 | 1175412 0 | 82,278,840 |
| Purchase/Hire Specialised Equipment | - | - | 29385300 | 29385300 | 29385300 | 29385300 | 29385300 | 29385300 | 29385300 | 29385300 | 0 | 0 | 0 | 5877060 | 0 | 0 | 0 | 293,853,000 |</p>
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<th>Operations</th>
<th>Decommissioning and Closure</th>
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<td>19688151</td>
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<td>17631180</td>
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<td>19,730,410,57</td>
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</table>

**Environmental and Social Impact Assessment**

**Mako Gold Project**

**FINAL**

**15-11**
15.2.4 Regional Environmental Monitoring Committee

The Company will support the Government of Senegal to conduct independent monitoring through the Regional Environmental and Social Monitoring Committee (Comité Régional de Suivi Environnemental et social, CRSE). It is expected that the CRSE will conduct an annual, independent audit of Project activities.

The Company proposes the following support to the CRSE:

1. Annual operating costs for the CRSE to conduct independent monitoring and compliance activities of the Project in accordance with the approved ESMMP and ESIA;
2. Capacity building for CRSE staff employed in monitoring and compliance functions associated with the Company activities, including training and skills development;
3. Financial contributions to the CRSE in the Kedougou Region will cease once the Company no longer has operating projects and is no longer actively undertaking mineral exploration in the Kedougou Region. Contributions will however extend over a period of three years during the closure phase of the Mako Gold Project. In consultation with the CRSE the Company will agree on the requirement for support and review the support program on an annual basis.

15.2.5 Reporting Systems

Incident Reporting

An incident is defined as any event that impacts on, or may potentially impact on safety, health, environment or community, or any activity resulting in regulatory non-compliance or the breach of company policies, standards or commitments.

To assist with the management and reporting of environmental and community incidents, the Company will utilise a computer-based event management system (such as INX InControl). These systems are designed for the efficient and effective management and reporting of environmental and social-related incidents. The system will also allow a reporting scheme that includes:

- Description of the incident and its causes;
- Risk rating of the incident;
- Description of corrective & preventative actions;
- Description of repairs, clean-up or other remedial measures; and
- Actual or estimated costs of repair, clean-up or other remedial measures.

The following situations will constitute an incident:

- Injury or property damage;
- Near miss or hazard;
- Cyanide and other chemical spills;
- Spills of fuel or oil outside of primary containment areas greater than 50 litres (environment event);
- Non-contained fires within operational areas;
- Uncontrolled gas emissions;
- Biodiversity incidents - e.g. unauthorised vegetation, clearance injured or dead animals within the PDA; and
- Community incidents - primarily related to community grievances, uncontrolled access within exclusion zones.
Incidents will be classified according to their actual and potential safety, environmental or social impact using a standard consequence matrix to ensure consistency. Incidents and significant near misses will be reported to the Company’s OHS&E Manager within 24 hours of the occurrence of the incident, and presented at the first management meeting following the incident, unless the severity of the incident (dependent on the risk ranking of the event) requires immediate notification.

**Quarterly Reporting**

A summary of activities, incidents and events is provided in a quarterly operations report, including required key tasks for the following quarter. The following illustrate the contents of a quarterly report:

- Brief presentation of the Company’s environmental and social management systems;
- Discussion of the Company’s environmental and social management and monitoring programs;
- Discussion of ongoing Environmental and Social Investment Program;
- Discussion of environmental and social performance relative to commitments and guidelines against continuous improvement targets and KPIs (with opportunities for improvement identified), non-compliance issues and corrective actions (or lack thereof);
- Progress against planned tasks and key highlights (e.g. targets achieved, preventative measures implemented or processes changed);
- Any significant incidents that have occurred including cause of incident and corrective actions;
- Results of ongoing stakeholder engagement;
- A summary of water quality monitoring data; and
- Any significant grievances.

Formal reporting to the Government of Senegal will also occur on a quarterly basis.

**Annual Reporting**

The Company will prepare an Annual Sustainability Report to summarise environmental and social performance for each calendar year. The report will include:

- Collation and evaluation of quarterly reports;
- Detailed discussion of performance relative to licensing commitments with focus on:
  - Longer lead indicators;
  - Improvement projects; and
- Overview of significant findings of audits and facility inspections.

The Global Reporting Initiative (GRI) Sustainability Reporting Guidelines will be used to guide the preparation of the report to the extent possible. The Annual Sustainability Report will be submitted to the Board of Directors, made available on the Company website, and copied to the DEEC in Dakar as part of the annual reporting commitments.

If required, the ESMMP will be updated according to the recommended improvements identified in the Annual Sustainability Report.
15.3 Monitoring

15.3.1 Overview

The implementation of an appropriate monitoring strategy as part of the ESMMP is important to ensure that existing management measures are effective, and to identify the need for improved or additional measures. The objectives of the Project environmental and social monitoring program are to:

- Detect and analyse environmental and social trends or changes to develop an appropriate response, where required;
- Ensure relevant environmental legislation and licensing commitments of the Project are complied with;
- Measure the performance of environmental and social management measures to ensure impacts remain at an acceptable level and there is ongoing improvement of Project’s operation; and
- Provide early warning of potential impacts, determine the extent of anticipated impacts and identify any unforeseen impacts associated with Project activities;

The environmental and social monitoring program for the Construction and Operation Phases includes the following main categories of monitoring:

- **Construction monitoring**: Routine construction monitoring including visual inspections and ‘toolbox’ meetings with Project personnel to ensure management measures are employed adequately during construction works.

- **Operations monitoring**: Routine operations monitoring including visual inspections, ‘toolbox’ meetings with Project personnel. Monitoring is for operations and process control, cost control, technical efficiency and safety reasons, as well as for environmental purposes. This will be primarily the responsibility of the Mine and Process Department personnel.

- **Discharge (emission) monitoring**: The monitoring of potential contaminants discharged or emitted from the Project to the environment, measured at or near the point of discharge (e.g. discharge from sewage treatment plant at the accommodation camp).

- **Ambient monitoring**: The monitoring of background conditions and the receiving environments that may be affected by Project activities. Ambient monitoring will be undertaken in upstream and downstream surface waters, along with ambient dust and noise monitoring at nearby villages. While operational and discharge monitoring will determine if environmentally significant releases have occurred, effects on sensitive receptors within the receiving environment can only be determined by ambient monitoring.

- **Social monitoring**: The monitoring of socio-economic indicators and feedback from Project affected communities, to identify and quantify the direct and indirect impacts of the Project on the surrounding community.

A fourth category, **investigation monitoring**, will also be carried out when necessary, to determine the occurrence, nature and extent of impacts following an environmental incident (oil leakage, etc.) from the Project, or to verify/refute third-party claims of environmental / social impact.

During the closure phase, **post-closure monitoring** will be undertaken to assess progress in achieving closure completion criteria as specified in the *Rehabilitation and Conceptual Mine Closure Plan* (Volume E).

All relevant employees involved in monitoring activities (particularly for field monitoring) will be given appropriate training by a competent person in the use of:

- Monitoring techniques, including: use, calibration and maintenance of field monitoring equipment, sample collection, labelling and transport;

- Review and interpretation of field and laboratory monitoring results; and
• Record keeping and reporting procedures, including using standard forms and databases.

Relevant environmental and social monitoring programs summarised for each Project component are provided in Sections 4 – 16 of the ESMMP (Volume C). These monitoring programs will be revised as appropriate when Project activities or conditions change significantly.

15.3.2 Operations Monitoring

All departments will perform routine monitoring of appropriate parameters during operation in relation to their specific objectives.

The following operations monitoring is relevant to environmental and social management, but will primarily be the responsibility of mine and process personnel, who will require the information for process and operations control:

- Ore and waste rock chemistry, production, classification and disposal location;
- Milling and tailing production;
- Tailings water quality, densities, tailings beach slopes and tailing geochemistry;
- Detoxification and water treatment efficiency;
- Pump flow rates and site water balance;
- Diesel and other consumable usage rates;
- Groundwater levels;
- Routine safety inspections of facilities to identify potential hazards (e.g. TMF embankment, leakage, etc.);
- Energy use;
- Local employment, training and skills development;
- Local procurement;
- Land disturbance and soil stockpiles; and
- Workforce health (Malaria, STDs).

15.3.3 Discharge Monitoring

Discharge monitoring is generally conducted at the point of discharge or within the local catchment area, and provides direct information regarding the contaminants (concentrations and loads of contaminants) being discharged from the operation. Furthermore, it also acts as a link between ambient monitoring results and the operation itself.

The quantity and the concentrations of contaminants being discharged from the Project to the environment will be routinely monitored. Liquid will only be discharged from site when the water quality is of adequate quality (in accordance with the relevant discharge and ambient (downstream) water quality criteria). During operation, the Company intends to operate the Project as a ‘zero discharge operations’, with no planned discharges into the environment envisaged for the mine operations.

The discharge monitoring program will include:

- Installation of dust gauges at the Mine Pit and Process Plant for dust monitoring on a monthly basis;
- During pre-construction and construction, water quality monitoring, at least of a monthly basis of major construction worksites discharge points for Turbidity, TSS, DO, temperature, electrical conductivity (EC), pH, and oils and grease contamination;
- Water quality monitoring of treated effluent and wastewater from water treatment plants during discharge for key parameters such as Total and faecal coliform, Total nitrogen, Total Phosphorous, COD, and BOD;
● Periodic monitoring of noise, airblast, ground vibration and fly rock once blasting has commenced or whenever there is a significant change in operating procedures, e.g. such as blasting location; and

● Upon mine closure, water quality monitoring of the Mine Pit, WRD, WSD discharge points and TMF spillway. Parameters to be monitored will include pH, EC, ORP, acidity/alkalinity, sulfate, metals (to be determined by waste rock characterisation) and cyanide (i.e. free, WAD and total) and related breakdown products of cyanide (e.g. ammonia, nitrate, thiocyanate). Multi-element testing using ICP-MS will be undertaken from time to time to fully characterise the discharge.

15.3.4 Ambient Environment Monitoring

Ambient monitoring is defined as the monitoring of background conditions and the receiving environments that could be affected by Project activities. It is useful in determining the effects of releases or discharges from the Project on the receiving environment, in contrast to operational and discharge monitoring which determine the occurrence of these releases. Typical monitoring points for ambient monitoring include upstream and downstream surface waters, as well as at nearby villages for ambient dust and noise monitoring. Monitoring of aquatic/terrestrial biodiversity, meteorology and rehabilitation activities will also be conducted.

Surface Water Quality

Ambient monitoring of surface water quality will be conducted as per the Company’s existing water monitoring program which includes a network of monitoring locations as described in the Surface Water and Groundwater Baseline Report (Volume A, Appendix 6).

Field parameters monitored on a monthly basis will include:

- pH;
- Redox potential (ORP);
- Dissolved Oxygen (DO);
- Electrical conductivity (EC);
- Total Dissolved Solids (TDS);
- Turbidity; and
- Water temperature.

Water quality samples will be obtained for laboratory analysis on a monthly basis during the wet season and quarterly during the dry season. Laboratory parameters will include:

- pH;
- EC;
- Total Dissolved Solids (TDS) and Total Suspended Solids (TSS);
- Cyanide (WAD CN and Free CN);
- Total alkalinity (or acidity), bicarbonate alkalinity, carbonate alkalinity and total hardness as CaCO3;
- Nutrients (ammonia as N, nitrate as N, total Kjeldahl nitrogen and total phosphorous);
- Cations and anions (Cl, SO\textsubscript{4}, Ca, Mg, Na, K), total cations and total anions; and
- Total and dissolved metals (Ag, Al, As, Au, Ba, Be, Cd, Co, Cr, Cu, Fe, Hg, Li, Mo, Mn, Ni, Pb, Sb, Se, Sn and Zn).

The Company has committed to ensuring that ambient and discharge water quality for the Project will be measured for compliance against Government of Senegal guidelines, WHO guidelines, as well as IFC/World Bank standards (Environmental Health and Safety Guidelines for Mining, 2007).
**Groundwater**

Groundwater quality monitoring for the Project will include ongoing monitoring at the Company’s existing monitoring program locations as described in the *Surface and Groundwater Baseline Report* (Volume A, Appendix 6). The groundwater quality parameters will be the same as for surface water field monitoring and laboratory parameters described above.

During construction, a number of additional groundwater bores will be installed both up-gradient and down-gradient of the TMF, Mine Pit and WRD. Bores will be monitored monthly during the wet season and quarterly during the dry season.

**Aquatic Fauna and Habitat**

The Company will develop and implement an ongoing aquatic fauna and habitat monitoring programme for areas upstream, within and downstream of the PDA using standardised monitoring techniques (e.g. surveys and bio-indicator analysis, drift net surveys for fish), particularly for the presence of the restricted range fish species *Barbus dialonensis* (a priority species).

The program will use the sample sites established in the baseline studies.

**Hydrology**

The Company has established a number of hydrology monitoring stations around and within the PDA which are monitored on a continuous basis. Installation of additional stream gauges on waterways downstream of the Project may be required. Stream gauges are used to measure surface flow and stream height. Implementation and management of a hydrological monitoring program will be the responsibility of the Environmental Department.

**Meteorology**

Meteorological data will continue to be collected from two Automatic Weather Stations (AWS) established in 2012 by the Company for the Mako Gold Project (refer Meteorological Baseline Study, Volume A). The AWS automatically logs measurements of rainfall, wind speed and direction, temperature, and relative humidity. Data will be downloaded on a monthly basis. Evaporation readings from an evaporation pan will also be recorded manually on a daily basis.

Meteorological data is also recorded by the Government of Senegal at Kédougou Airport (Meteorology Station No. 61699). As per the AWS, data recorded includes daily rainfall, wind speed and direction, temperature, evaporation, and relative humidity.

These existing meteorology monitoring sites established are sufficient for the requirements of the Mako Gold Project.

**Terrestrial Biodiversity**

Bird and animal activity near the TMF, Process Plant, WSD and haul roads will be monitored. Monitoring will include camera trapping, transect surveys, and species-specific monitoring, as appropriate. All reports of Project-related animal mortalities or injuries will be reported by the Company in accordance with the incident reporting system.

The Company’s land clearance activities will be carefully controlled and monitored through the implementation of the Company’s land disturbance procedure.

Additional terrestrial flora and/or fauna monitoring is identified as part of the established Project-specific *Biodiversity Action Plan* (Volume C).

**Rehabilitation/Revegetation**

Rehabilitated/revegetated areas should be monitored regularly as per the *Rehabilitation and Conceptual Mine Closure Plan* (Volume E). Monitoring records should include the following, as a minimum:

- Area revegetated/rehabilitated;
• Number of type of seeds/seedlings planted;
• Source of seeds/seedlings;
• Number germinated and rate of growth and spread; and
• Photographs.

**Dust and Noise**

Four existing dust and noise monitoring points in the Project area have been established by the Company (refer Air Quality, Noise and Vibration Assessment, Volume A). Dust deposition collectors have been installed and dust samples are collected on a monthly basis during the dry season. Dust monitoring of both PM10 and PM2.5 will continue to be undertaken at these sites, with ten (10) days continuous monitoring undertaken at each site on a rotational basis. Additional monthly monitoring of TSP at each site will also be required to allow comparison to IFC standards.

Noise logger monitoring (10 days continuous) will also continue to be undertaken at these sites on a rotational basis.

The locations of the dust and noise monitoring points will need to be reassessed to ensure impacts on potential sensitive receptors (such as nearby villages and schools) are adequately captured by the monitoring program.

**15.3.5 Social Monitoring**

Social impact monitoring is required to identify and quantify the direct and indirect impacts of the Project on the surrounding community. Social monitoring will also ensure that existing management measures are effective, and will identify the need for improved or additional measures.

The social monitoring will include:

• Local workforce statistics (including employment by contractors);
• Local procurement of goods and services;
• Livelihood restoration and improvement measures for Project affected villages and individuals;
• General socio-economic parameters in Project affected villages including livelihood, income, cost of living, access to infrastructure and services, demographic trends and access to land and water;
• Grievance resolutions;
• Disbursement and effectiveness of the Social Investment Fund.
• In partnership with the relevant technical agencies, periodic (every two years) monitoring of:
  » Health indicators (e.g. malaria, sexually transmissible infections, etc.) in Project affected villages; and
  » Local attitudes toward the Project Operation.

**15.4 Management and Mitigation Program**

The proposed management and monitoring strategy for the Mako Gold Project has been documented in the detailed ESMMP (Volume C). This plan will be updated regularly to incorporate any significant changes during the life of the Project.

Other key plans produced as part of the ESIA which will form part of the management system for the Project include the:

• *Biodiversity Action Plan* (Volume C);
• *Local Economic Participation Plan* (Volume D);
Livelihood Restoration Plan (Volume D);
Stakeholder Engagement Plan (Volume C); and
Rehabilitation and Conceptual Mine Closure Plan (Volume E).

Project-specific Emergency Preparedness and Response Plans (including a POI) will also be developed for the Project, prior to construction (see below for further details).

Avoidance measures that have already been incorporated into the planning and Project design are outlined in Chapter 5.

The effective implementation and regular updating of these plans in response to changing needs will ensure that environmental and social impacts attributable to the Project are minimised and potential environmental and social benefits are maximised. Ongoing consultation with the Government of Senegal, local communities and other stakeholders will also be important to ensure consideration of stakeholder interests in the planning and development of the Project.

15.5 Emergency Response

15.5.1 Overview

Where an event takes place that impacts on or may potentially impact on the environment, or triggers the specific conditions or limitations of a license or permit to be exceeded, the event is classified as an environmental incident.

A Risk Assessment has been established for the Mako Gold Project based on the guidelines of the ‘Risk Assessment Guide’, published by DEEC (2007) is presented in Volume B of the ESIA. The Project risk assessment will be reviewed on an annual basis to identify potential environmental emergency situations that may arise.

The following situations are environmental incidents which require an emergency response:

- All hazardous chemical spills;
- Uncontrolled release from TMF;
- Breach of WSD;
- All spills of fuel or oil greater than 500 litres within workshop areas and pits;
- All spills of fuel or oil outside of primary containment areas greater than 500 litres;
- All non-contained fires within operational areas; and
- All uncontrolled gas emissions.

The risk assessment will form the basis for the preparation of Emergency Preparedness and Response Plans for the Project. The Plans will meet Senegalese legislative requirements and will be prepared prior to Project construction and will comprise internal plans (Plan d’Opération Interne and Cyanide Spill Contingency Plan) and practices for alerting the relevant authorities and surrounding populations in the case of an accident or threat, evacuating personnel and the means for identifying and controlling the cause of the accident. Key elements of the Plans will include:

- Emergency response procedures:
  » Informing the public and emergency response agencies;
  » Taking emergency response actions; and
  » Reviewing and updating the emergency response plan to reflect changes, and ensuring that employees are informed of such changes.
- Communication procedure;
Functions and responsibilities;
Evacuation and shutdown procedures;
Risk management;
Emergency response equipment – procedures should be prepared for using, inspecting, testing and maintaining the emergency response equipment; and
Emergency response training – employees and contractors should be trained on emergency response procedures.

15.5.2 Assessment of Risk and Priority
Emergency response to an incident will prioritise the actions to be undertaken according to the following sequence:

1. Protection and rescue of human life;
2. Minimisation of the area impacted by the incident;
3. Protection of the environment, plant and property;
4. Rendering the area safe in which the emergency has occurred;
5. Restoration of all disrupted services; and
6. Decontamination and rehabilitation of the incident scene and surrounding area.

The Company will undertake routine environmental and social risk assessments on a regular basis to review potential emergency situations that may arise from the Project. The methodology to be used for the periodic risk assessments will be consistent with that outlined in the Detailed Risk Assessment (Volume C).

Depending on the severity and nature of an incident, emergency response may also involve using or notifying external agencies and groups, including the police, ambulances and medical clinics, government authorities, and nominated representatives within the local community.

Notification procedures are outlined in the ESMMP (Volume C) and will be further described in the Company’s Emergency Preparedness and Response Plans to be produced prior to operation.

15.5.3 Spill Management
Spills may pose environmental risk depending on the chemical constituents of the spill, the size of the spill and the location of the spill. Spill management broadly covers the management of a range of liquids including fuel, oil, process water, wastewater and chemical reagents. Spill ratings definitions fall within the following categories:

- Contained within primary protection system (i.e. spills contained within first bund);
- Contained within secondary protection area (i.e. spills contained by second bund or drainage control);
- Contained within operational area (i.e. spills that occur away from fixed spill containment structures such as bunds but within the operational area. Examples include the haul road and pit);
- Contained within non-operational area (i.e. spills that occur away from fixed spill containment structures such as bunds but not within the normal operational areas);
- Off-site spill (i.e. spills that originate from activities not within the Project Area. Example includes container transport to site); and
- Non-compliance discharge (i.e. all spills that originate from within the Project Area and escape this area. Examples include spills that affect the river environment or flow down creeks beyond the Project Area).

Response to spills will be further specified in the Emergency Preparedness and Response Plans for the Project (to be developed).
15.6 Auditing and Review

Regular audits of the Project ESMMP and associated management systems will be undertaken internally and externally. The audits will assess:

- Adequacy of the ESMMP and associated plans with respect to the scale and nature of anticipated impacts and current development stage of the Project;
- Workforce awareness, competence and compliance with the ESMMP and associated plans and procedures;
- Performance of managers and operators in implementing, maintaining and enforcing the ESMMP and associated plans; and
- Suitability of allocated resources, equipment and budget for implementation of the ESMMP.

All audit recommendations will be discussed with the relevant departmental managers, including the Company's Operations Manager, OHS&E Manager, and Security Manager, where appropriate. Corrective actions will be documented and progress towards resolution reported.

Independent external audits will be conducted during the Construction Phase and on an annual basis for the first two years of operation. The frequency of subsequent audits will be based on the recommendations from the initial audits.

In addition, the Environment Department will undertake a site inspection of all Project facilities on a routine basis using a visual inspection form to record observations onsite. The frequency of inspection will be informed by the risk level, but will typically be on a monthly basis. KPIs will be developed to enable environmental performance to be assessed objectively and quantitatively across the operation.

If required, independent external audit reports will be submitted to the Ministry of Environment and Sustainable Development (Ministère de l'Environnement et du Développement Durable) via the DEEC, as well as relevant authorities in the Kedougou Region (including DREEC).