Social and Environmental Impact Assessment (SEIA) Addendum for GAC's Bauxite Export Project, Guinea

Volume 3

- Social and Environmental Management Plan
- Monitoring Plan

Guinea Alumina Corporation S.A. (GAC)

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18.1 INTRODUCTION

This Social and environmental Management Plan (SEMP) was prepared as an outcome of the social and environmental impact assessment (SEIA) Addendum specifically developed for GAC's bauxite export project ("the Project"). It is designed to be consistent with the integrated SEIA issued in 2008 by GAC (*Knight Piésold, 2008*) and approved by Guinean national environmental authorities. This SEMP integrates and supersedes the 2008 SEMP for all aspects relevant to the bauxite export mining project.

The SEMP was developed with a view to aligning with the requirements of applicable Guinean regulations, in particular the Environment Code (*Ordinance No. 045/PRG/87 of 28 May 1987, as amended by Ordinance No. 022/PRG/89 of 10 March 1989 on the code of protection and enhancement of the environment)* and related regulations on social and environmental impact assessments in Guinea (as described in *Chapter 2, Institutional and Regulatory Framework*). It has also been developed in consideration of international good practices applicable to social and environmental management, in particular the requirements of the IFC's Environmental and Social Performance Standards (2012) and the Policy Statement and Operational Safeguards (2013) from the African Development Bank's operational safeguards.

The SEMP provides a framework for the social and environmental management of the Project, compiling the mitigation measures specified in the 2015 SEIA Addendum and 2008 integrated SEIA into a plan for implementation of GAC bauxite export project. Consequently, the SEMP:

- lists mitigation measures and social and environmental plans and procedures to be implemented by the Project, with the aim of complying with Guinean regulations and international standards and good practices;

- provides a framework for monitoring or even auditing project compliance with these standards and good practices.

18.2 SEMP STRUCTURE

The SEMP sets out the general principles and framework for managing the Project social and environmental impacts. Therefore, the SEMP:

- sets out the legal and regulatory procedures, international standards and company policies it is based on (*Section 18.3, Standards and procedures*);
- provides a list of mitigation measures to reduce or optimize the Project social and environmental impacts (*Section 18.4, Impacts reduction and enhancement plan*);

- defines and commits to general principles and procedures of Discipline Specific Management Plans (*Section 18.5*);

- sets the basis of Sites closure and restoration plans which will be developed and updated before the closure of operations in order to take into account the evolution of environmental, social, technological and real operational conditions that prevail at the time (*Section 18.6*); and

- develops an Implementation Plan including the roles & responsibilities, timing & budget, training & capacity development, auditing & updating and reporting & transparency prerequisites which will ensure a fully effective implementation of the SEMP.

Topic-specific management plans will be developed by GAC based on its existing plans and procedures, in line with GAC's 2015 and 2008 SEIA documentation. GAC will have the responsibility to develop and implement operational procedures for their own areas of operation and in line with the SEMP and topic-specific management plans. This will also be a requirement for GAC's contractors involved on each stage of the Project.

18.3 APPLICABLE STANDARDS, PROCEDURES AND VALUES

18.3.1 Applicable social and environmental standards

The social and environmental standards applicable to the Project are those described in Chapter 2 *Institutional and Regulatory Framework* of the 2015 SEIA Addendum. These include:

- the laws and regulations of the Republic of Guinea;
- the IFC's social and environmental performance standards (2012);
- the IFC's and World Bank's EHS guidelines (2007):
  - General EHS Guidelines (2007);
  - EHS Guidelines for Mining (2007);
  - EHS Guidelines for Ports, Harbors and Terminals (2007);
  - EHS Guidelines for Railways (2007); and
  - EHS Guidelines for Wind Energy (2015).
- the AfDB's Integrated Safeguards System (2013) and Sector Key sheets;
- Equator Principles;
- where relevant, reference is made to other international guidelines such as from the WHO, ICMM, UNEP and OECD, in the absence or lack of relevant national legislation;
- internationally accepted Good International Industry Practice (GIIP);
- requirements of the Extractive Industries Transparency Initiative; and
- international conventions and treaties ratified or accessed by Guinea.

18.3.2 Project performance targets, mission & values and policies

As stated in GAC's 2008 SEIA:

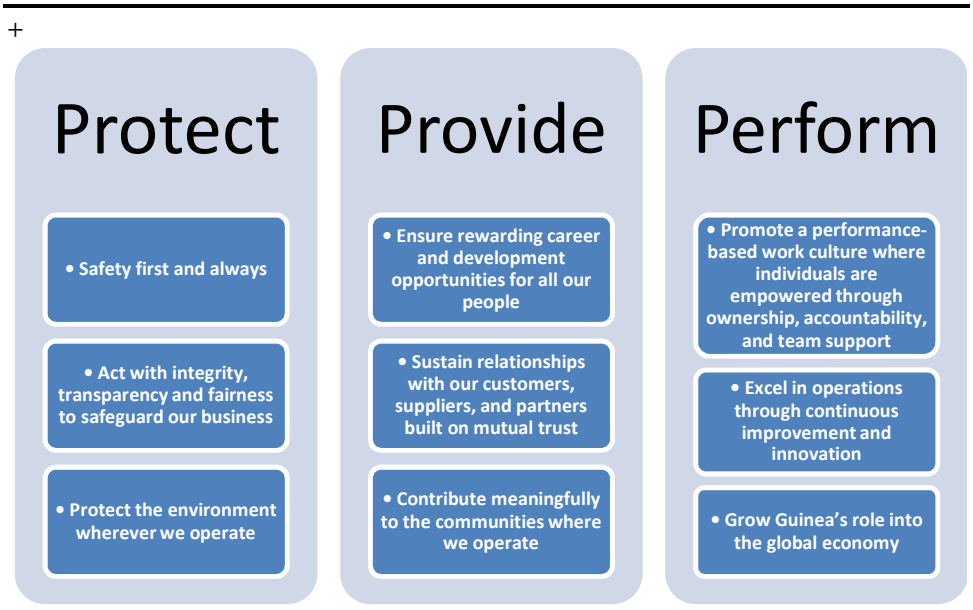
"GAC's commitment for this SEMP is to apply technologies and practices that avoid or minimize adverse impacts through the diligent respect of norms and procedures listed in section 18.3.1 and by adopting a « Zero Harm » approach to human health and safety, local communities and the environment.

GAC is committed to the long-term involvement of protecting the environmental quality and human interests in Guinea, including the health and safety of its people. GAC's social and environmental programs aim to continually improve environmental and safety performance in the workplace, maintain multi-directional communication among the Company, local communities, and interested stakeholders, and to limit local community dependence on the Project.

Therefore, it is part of GAC Mission to "operate with a deep commitment to sustainability and to the well-being and development of its people" with the Purpose to "construct a future made of hope, opportunities and pride for Guinea".

GAC Core Values are aligned to its shareholder Emirates Global Aluminium's (EGA) Vision which are encapsulated in three words, protect, provide and perform as showed in Figure 18.1.

Figure 18.1 GAC Core Values



In addition, the Project commits to comply with GAC policies, procedures and requirements[1], among which the following that directly influence the Project's social and environmental performance:

(1) A full list of GAC's policies, procedures and requirements at the time of writing as well as most relevant policies and procedures to this SEMP can be found in Appendix A of the SEMP. Policies, requirements and procedures are evolving along with the Project and are subject to updates depending on Project changes, feedback from operations and management decisions.

- Environment Policy;
- Health & Safety Policy;
- Environment Performance Requirements;
- Health Performance Requirements;
- Procurement policy;
- Code of Business Conduct;
- Supplier Code of Conduct;
- Recruitment procedure; and
- Health, Safety and Security operational procedures as listed in *Section 18.6.9.*

18.3.3 GAC's environmental policy and performance requirements

The SEMP and ensuring Project specific environmental management plans (DSMP) developed in accordance with GAC Environmental Policy as presented in *Figure 18.2* and the Project Environmental Performance Requirements document which set out the Project minimum requirements in terms of:

- land management;
- hydrocarbon management;
- water management;
- air emission management;
- energy and greenhouse gas management; and
- waste management.

Where relevant, these minimum requirements are referred to in the theme specific management plans hereafter.

Figure 18.2 GAC Environmental Policy

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ENVIRONMENTAL POLICY OF GUINEA ALUMINA CORPORATION (GAC)

Guinea Alumina Corporation (GAC) recognizes that responsible environmental management and leading environmental performance is essential to its business success. We are committed to promote the efficient use of resources, the reduction and prevention of pollution and the enhancement of biodiversity protection through the life cycle of the project to prevent harmful effects on the biophysical environment and natural resources as well as to secure a sustainable environmental future for communities surrounding our sites. This will be achieved through leadership and the use of reliable formal management systems that support effective decision making, manage environmental risks and impacts, and promote continuous improvement.

GAC is committed to achieving environmental performance and sustainable development through the implementation of an effective Environmental Management System and more specifically by:

- Complying with all applicable environmental laws, regulations and other commitments to which GAC subscribe;
- Identifying and assessing all environmental risks and impacts of our activities through Environmental Impact Assessment;
- Developing and implementing an Environmental Management System addressing responsibly environmental risks and impacts of our activities in accordance with the best environmental practices;
- Establishing measurable objectives and targets for environmental performance and regularly review performance to ensure compliance with applicable legislation, policies and standards;
- Allocating the appropriate resources and accountability to implement the Environmental Management System and providing training and skills development to fulfill their environmental obligations;
- Ensuring appropriate communication of this Policy and the Environmental Management System and promoting environmental awareness amongst employees, contractors, suppliers and consultants;
- Engaging and consulting with communities and other stakeholders to understand their environmental concerns and implement community development initiatives;
- Promoting active partnerships at international, national and local levels to identify opportunities to improve environmental management;
- Conducting monitoring and audit on a regular basis to assess effectiveness and performance of the Environmental Management System for continual review and improvement;
- Communicating openly with all stakeholders about our Environmental Management System and our performance in an accurate, transparent and timely manner.

GAC intend to create a workplace culture where the protection of the environment is everyone's business and integrate environmental management into all facets of our business. To do so, GAC requires all its employees and contractors to behave consistently with the requirements of this Environmental Policy.

The GAC Environmental Policy is aligned with the Emirates Global Aluminium (EGA) Environmental Policy. This policy will be reviewed annually to ensure relevant alignment with EGA Policy.

William Morrell
Chief Executive Officer - GAC
August 2014

Doc. No. 9000-S-CPC-00016

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18.4 IMPACTS MITIGATION AND ENHANCEMENT PLAN

18.4.1 Approach to developing mitigation & enhancement plan

The impacts mitigation and enhancement plan is a compilation of the relevant mitigation and enhancement measures identified in the 2008 SEIA (*Knight Piésold, 2008*), applicable to the bauxite export project, complemented with mitigation measures specifically defined in the 2015 SEIA Addendum for the bauxite export project. Where mitigation measures defined in the SEIA Addendum are comparable with, or more stringent than measures from the 2008 SEIA, only the former are incorporated here.

References to the source chapters and sections from which mitigation measures have been extracted are given in *Table 18.1*, *Table 18.2*, *Table 18.3* and *Table 18.4*. Mitigation measures have been grouped in accordance to the impact evaluation themes and chapters sequences of the SEIA Addendum.

18.4.2 Monitoring indicators

For each measure, monitoring indicators, the person in charge of implementing the measure and the budget involved is suggested. The responsibilities and costs of the surveillance that will be implemented by GAC are also specified. Details on monitoring means, frequency and responsibilities are developed further in *Chapter 19, Social and environmental Monitoring Plan.*

18.4.3 Impact mitigation and enhancement measures for closure phase

Impacts mitigation and enhancement measures in relation with the Project closure phase will be developed and updated before the Project closure to take into account the evolution of the socio-economic context, environmental conditions, Project impacts, and available techniques and technology. Closure and rehabilitation measures are being separately compiled by GAC into a Mine Closure Plan and a Port Closure Plan in accordance with the general principles and Project commitments set out in *Section 18.8*, *Closure and restoration after operations*.

18.4.4 Presentation per Project area and phase

In order to allow sites managers to ensure Project compliance with regard to their areas of responsibilities, the social and environmental impacts mitigation and enhancement measures are presented per Project component and phase in the following tables:

- *Table 18.1 Environmental impacts mitigation and enhancement plan – Port area;*
- *Table 18.2 Environmental impacts mitigation an enhancement plan – Mine area;*
- *Table 18.3 Social impacts mitigation and enhancement plan – Port area; and*
- *Table 18.4 Social mitigation and enhancement plan – Mine area.*

Table 18.1 Environmental impacts mitigation and enhancement plan – Port area

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation and enhancement measures	Monitoring indicators	Timeline for implementation	Implementation: Person responsible
Air quality									
IP2008, p189	Emissions of air pollutants, NOx, SOx and particulates	Power generation	X	X	Residents and employees. Vegetation and agricultural land.	• Air quality management plan. • Power generation equipment complying with Guinean standards and IFC EHS guidelines. • Appropriate equipment and vehicles maintenance. • Trip management to reduce vehicle movement. • Enforce appropriate vehicle speed limitations.	Particulates concentration in µg/m³, and levels of SOx, NOx, etc.	Start of construction until site closure	HSSEC Manager Maintenance Superintendent
		Vehicles and equipment used on site, transport of employees	X	X					HSSEC Manager Maintenance Superintendent
		Train locomotive accessing and entering the Site		X				During operation	HSSEC Manager Maintenance Superintendent
IP2008, p189	Dust	Vehicle and equipment used on site, transport of employees	X	X	Residents and employees. Flora and fauna (health and growth potential).	• Air quality management plan. • Dust management plan. • Travel management and use of busses to reduce number of vehicle movements. • Project routes and transport procedures to avoid dust emissions. • Access road, site surface watering and/or chemical dust control. • Appropriate equipment maintenance and washing. • Speed control and proper vehicle maintenance. • Monitoring of dust deposition. • Community grievance monitoring through Grievance Procedure.	Daily dust deposition in mg/m², Particulates concentration in µg/m³ Number and resolution rates of grievances	Start of construction until site closure	HSSEC Manager Maintenance Superintendent
		Land disturbances during construction	X					Start to end construction activities	HSSEC Manager Construction Site Manager
		Transfer, handling and stockpiling of minerals (incl. site access, stackers,		X				During operations	HSSEC Manager Operations Manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation and enhancement measures	Monitoring indicators	Timeline for implementation	Implementation: Person responsible
		stockpiles, conveyors and other transfer points)				• Water sprays at transfer and stockpiling points. • Personnel Protective Equipment. • Occupational Health and Safety trainings.			

IP2008, p.30	Release of greenhouse gases (GHG).	Housing and vehicle air-conditioning and energy consumption	X	X	Biosphere	• Air quality management plan and site specific management plan will include:
						  • GHG accounting and target setting;
						  • actions to energy consumption and greenhouse gas emissions on site; and
						  • investments and designs during construction for energy efficient installations and buildings.
							Number of measures and investments to reduce GHG emissions	Start of construction until site closure	HSSEC Manager

Noise & vibration (terrestrial, marine)									
IP2008, p189	Terrestrial noise	Project site activities	X	X	Residents and employees	• Ensuring noise levels meet IFC EHS Guidelines • High noise equipment to be equipped with sound control/noise enclosures. • Install mufflers on noisy vehicles. • Install additional noise attenuation barriers where needed. • Maintain vehicles and equipment in good state of repair. • Limit noisy activities near residences during night and quiet times (e.g. heavy vehicle movement, train transport and unloading). • Provide training to Project employees on noise and vibration reduction procedures and use of PPE. • Periodic monitoring of ambient noise levels at receptor points.	Ambient noise levels at receptor points, in dBA Workplace noise levels, in dBA Number and resolution rates of noise grievances	Start of construction until site closure	HSSEC Manager
		Mobile equipment and vehicles on Site	X	X					
		Road access to the Site (commuters and supply vehicles)	X	X					
		Rail access to the Site		X				During operation	

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation and enhancement measures	Monitoring indicators	Timeline for implementation	Implementation: Person responsible
						• Community grievance monitoring through Grievance Procedure. • Limit traffic speed on site and on all roads and define Project routes and transport procedures to avoid excessive noise in sensitive areas. • For rail access, limit train speed in sensitive populated areas. • Trip management and bussing of employees to reduce Project traffic.			
IP2008, p136 & 189	Terrestrial vibrations	Road access to the Site (commuters and transport of equipment and materials) Site equipment (e.g. stackers, feeders)	X	X	Buildings and structures, owners and residents	• Limit traffic speed and loaded vehicle weights on all roads. • Define Project routes and transport procedures to avoid excessive vibration in sensitive populated areas. • Design for appropriate vibrating loads with adequate safety factors. • Appropriate equipment, vehicles and train locomotive maintenance. • Limit train speed in sensitive populated areas.	Number and resolution rates of vibration grievances Vibration levels in m/s^2		HSSEC Manager
IP2008, p189		Rail access to the Site		X				During operation	HSSEC Manager

IP2008, p190	Underwater noise and vibration affecting marine fauna behavior	Marine construction works including marine trestle and quay construction and dredging	X		Fish community, marine mammals and reptiles	• Adoption of international good practice e.g. Joint Nature Conservation Committee (JNCC), IFH EHS:
						  • Minimization of noise generation through appropriate equipment selection.
						  • Pre noise source observation.
						  • Soft start/ ramp up procedures.
						  • Ongoing protected species observation during piling.
							None required (impact is deemed to be of low significance)	During offshore construction and dredging works (including maintenance)	HSSEC Manager

		Maintenance dredging and regular		X					HSSEC Manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation and enhancement measures	Monitoring indicators	Timeline for implementation	Implementation: Person responsible
		passage of cargo vessels transporting minerals				• Maintenance of noise source. • Use of well-maintained equipment designed to eliminate unnecessary noise generation.			
Surface water									
IP2008, p189	Increased erosion	Storm water runoff from Port areas	X	X	Tidal banks Surface water	• Good International Industry Practices (GIIP) for sediment and erosion control on all facilities. • 50 m mangrove buffer. • Project design measures for scour/erosion control. • Emergency Prevention, Preparedness and Response Plan. • SWQ Monitoring Plan. • Standard engineering drainage design measures, including careful siting (design) and routine maintenance of all cross drainage structures.	Inspection of soils on site Surface water turbidity	Start of construction until site closure	Construction Site Manager
IP2008, p140, 189, 190	Degradation of quality of surface water	Sewage treatment and discharge	X	X	Surface water habitats and species, local communities	• Port sewage treatment system tailored to the Project needs. • Respect maximum sewage pollutant contents (BOD, etc.) before discharge. • Oil/ water separator for abatement of hydrocarbons.	Discharge and surface water monitoring results		HSSEC Manager
Groundwater & Soils									
IP2008, p189	Soil & groundwater contamination	Storage, handling, and use of chemicals	X	X	Soil, groundwater and residents	• Containment of areas where hydrocarbons and chemicals are stored and handled (e.g. secondary containment, liner or concrete, etc.).	Number of findings during Environmental and H&S audits	Start of construction until site closure	HSSEC Manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation and enhancement measures	Monitoring indicators	Timeline for implementation	Implementation: Person responsible
						• Regular inspections, maintenance, emptying and cleaning of containment areas.			
		Accidental spill of chemicals	X	X	Soil, groundwater, habitats, communities	• Training on hazardous materials management plan including on spill prevention and response. • Availability and use of spill clean-up materials.			HSSEC Manager
		Mobilization of bauxite ore-containing materials from the proposed stockpile		X		• Implementation mitigations similar to the overburden management in mining areas. • Bunded or contained area with hardstanding to prevent leaching into the ground.	None required (impact is deemed to be of negligible significance)	During operation	

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation and enhancement measures	Monitoring indicators	Timeline for implementation	Implementation: Person responsible
Seawater									
IP2008, p145	Increased water turbidity from suspension of particles. Impacts to Sediment Physico-chemistry from Dredging Impacts to seabed footprint, hydrodynamics and geomorphology from dredging	Dredging of Kamsar channel, including maintenance dredging, disposal of dredge spoil and marine disposal areas	X	X	Rio Nuñez bay and downstream marine water habitats and species	Development of and implementation Dredging Social and environmental Management Plan to include: • findings of fully hydrodynamic and dredge plume modeling • contractor method statements • dredging procedures • water quality monitoring to limit the suspension of solid particles • placement procedures for dredged materials and disposal in low current areas to limit remobilization of spoil; • the process, frequency and timing of maintenance dredging; • controls for limiting suspended solids in the river to the extent practical; a detailed water quality and habitat preservation monitoring (1) plan; and • management of change procedure in case of excessive impacts to water quality and estuary biota and habitats.	Seawater quality at selected locations during dredging and dredge spoil disposal (focus on TSS concentration of seawater)	Start of construction until site closure	HSSEC Manager
	Estuarine water pollution	Accidental spill of chemicals from dredging vessels	X	X	Estuarine ecosystems	• Implement marine specific measures from emergency prevention and response plan. • Train people for emergency response. • Ensure emergency response material is readily available.	NA	Start of construction until site closure	HSSEC Manager

(1) The IP2008 refers to follow on biological studies that will inform the choice of dredged soil disposal area.

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation and enhancement measures	Monitoring indicators	Timeline for implementation	Implementation: Person responsible
Topography and visual resources									
IP2008, p189	Night light pollution	Lights at Port area	X	X	Marine fauna Residents	• Use directional lights pointing inwards and downwards. • Use of lights with reduced glare. • Install light barriers (e.g. barriers, vegetation).	Number and resolution rates of grievances Visual observation	Start of construction until site closure	HSSEC Manager
	Visual impact	Worksite installation, machinery, presence of the worksite	X	X	Residents	• Store equipment and materials in an orderly manner during the works. • High machinery, including cranes, will be demobilized from site as soon as they are not needed anymore for construction work.		Start of construction until site closure	Construction Site Manager
	Change in landscape	Mining activities		X		• Use of barriers and vegetation to lower visual effects of port infrastructures. • Dismantling and decommissioning of Port equipment and infrastructure except for those handed-over 'as they are' to the Government of Guinea • Rehabilitate temporary work areas		During operation	Operation Manager
Flora and vegetation (terrestrial, marine)									
IP2008, p189	Introduction of exotic / invasive species	Ballast water discharge of construction, mineral transport and dredging vessels	X	X	Mangrove and estuarine ecosystems	• Apply effective ballast release management and monitoring program. • Forbid ballast in coastal waters for boats related to GAC's operations • Invasive plant species control program.	Number of reported breaches to the ballast release procedures	Start of construction until site closure	HSSEC Manager
IP2008, p189	Loss of vegetated and mangrove habitats	Land reclamation in port terminal and along conveyor	X	X	Mangrove and vegetated wet habitats	• Optimize design of facilities to reduce loss of terrestrial vegetated habitats. • Implement an effective Biodiversity Management Plan (BMP).	Cleared and revegetated hectares BMP monitoring		HSSEC Manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation and enhancement measures	Monitoring indicators	Timeline for implementation	Implementation Person responsible
						• Plan for restoration of vegetated areas after project closure where possible.	results		
	Dust deposition on plants resulting in reduced evapotranspiration	Site activities generating dust (construction, minerals loading and stockpiling, mobile equipment, etc.)	X	X	Mangroves, natural and agricultural vegetation	• Application of dust control and reduction measures as developed in Air Quality section	Air quality monitoring results (dust deposition)		HSSEC Manager
IP2008, p130	Loss of aquatic flora and reduction in primary trophic production	Dredging of Kamsar Channel	X	X	Aquatic flora and aquatic primary consumers	• Optimize the design of channel widths and depths and dredging frequencies. • Effective sediment and erosion control of unconsolidated material. • Reclamation of unused areas.	BMP monitoring results		HSSEC Manager
Fauna (terrestrial, marine)									
IP2008, p189	Mangrove dependent species	Loss of mangrove habitats	X	X	Estuarine habitats, species and local communities	• Implement GAC's Biodiversity Management Plan (BMP). • Plan for restoration of vegetated areas after Project closure where possible.	Marine fauna monitoring results	During construction and operation	HSSEC Manager
IP2008, p189	Noise and presence affecting terrestrial fauna behavior	Noise, vibration, human presence form site activities	X	X	Terrestrial fauna	• Noise and vibration controls and reduction measures. • Education programs for staff and contractors regarding wildlife importance.	Number of staff trained Regular audit of the good implementation of the mitigation measures	During construction and operation	HSSEC Manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation and enhancement measures	Monitoring indicators	Timeline for implementation	Implementation: Person responsible
IP2008, p189	Collisions with animals	Vehicles and road transport entering the site	X	X	Terrestrial fauna incl. mammals, birds, reptiles and amphibians	• Training vehicle operators on importance of wildlife. • Implement speed controls.	Number of reported accidents	During construction and operation	Operation Manager
IP2008, p190	Loss of habitat and benthic communities	Project marine footprint (marine trestle, quay, maintenance dredging and dredge spoil disposal)	X	X	Benthic communities, invertebrates and demersal fish	• Optimize borrow pits requirements and prioritize onshore sources. • Optimize location for dredge spoil disposal to areas with lower density of benthic communities and in low current areas to limit remobilization and sedimentation of spoil. • Optimize the frequency and timing of maintenance dredging events. • Develop a detailed water quality and habitat preservation monitoring plan (1). • Define a management of change procedure in case of excessive impacts to water quality and estuary biota and habitats.	Water and benthic quality monitoring results	Prior and during construction and operation	HSSEC Manager
IP2008, p189	Introduction of exotic / invasive fauna species	Ballast water discharge of construction and dredging vessels	X	X	Local fauna	• Apply effective ballast release management and monitoring program. • Forbid ballast in coastal waters for boats related to GAC's operations • Invasive fauna species control program	Number of reported breaches to the ballast release procedures	During construction and operation	

(1) The IP2008 refers to follow on biological studies that will inform the choice of dredged soil disposal area.

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation and enhancement measures	Monitoring indicators	Timeline for implementation	Implementation: Person responsible
IP2008, p190	Underwater noise and vibration affecting fish behavior or causing injury	Dredging and transport of minerals via cargo vessels	X	X	Fish community, marine mammals and reptiles	• Use of well-maintained equipment designed to eliminate unnecessary noise generation.	None required (impact is deemed to be of negligible to minor significance)	During construction and operation	HSSEC Manager
Freshwater ecosystems									
IP2008, p189	Risk of pollution	Sewage water treatment discharge	X	X	Surface water and groundwater	• Maintain in good working condition	Water quality	Start of construction until site closure	HSSEC Manager
IP2008, p189	Risk of pollution	Project' activities and discharges	X	X	Surface water and groundwater	• Maintain water discharge controls within guideline limits.	Water quality		
IP2008, p189	Risk of pollution	Changes to surface water quality from storm water pond discharge	X	X	Surface water and groundwater	• Stilling basins • Proper vehicle maintenance, • Monitoring of discharge, • Sediment control structure	Water quality		HSSEC Manager Maintenance Superintendent
IP2008, p189	Risk of pollution	Accidental spills	X	X	Surface water and groundwater	• Spill prevention plan • Employees' training • Clean-up materials in inventory	Water quality Number of trained employee		HSSEC Manager
Wastes									
IP2008, p189	Risk of pollution	General and domestic waste generation	X	X	Soil, ground- and surface-water	• Develop waste management plan prior to construction. • Collection, storage and disposal or treatment of waste by qualified personal or service provider.	Waste register	Start of construction until site closure	HSSEC Manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation and enhancement measures	Monitoring indicators	Timeline for implementation	Implementation Person responsible
						• For waste landfilled or treated on site ensure infrastructures meet GIIP standards. • Waste register and traceability. • Waste stocks inventory.			
Hazardous materials									
	Hydrocarbons and chemicals products use	Storage, handling, use and disposal of hydrocarbons and other chemicals	X	X	Employees	• Use of hazardous materials by qualified trained personnel only. • Training on and use of Personnel Protective Equipment. • Availability of eye-rinse liquid and medical support. • Training on Hazardous materials management plan including on spill prevention and response. • Availability and use of spill clean-up materials. • Where appropriate, waste oil will be recycled on site and returned to suppliers for recycling. • Solvents will be sent to off-site recycling or disposal.	Hazardous materials register	Start of construction until site closure	HSSEC Manager Procurement Supervisor
	Health & Safety risk	Medical waste generation and storage	X	X	Employees	• All medical waste, including human tissue, will be transported to the proposed facilities for incineration.	Hazardous materials register	Start of construction until site closure	HSSEC Manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation and enhancement measures	Monitoring indicators	Timeline for implementation	Implementation: Person responsible
	Waste incineration	Ash from the incinerator	X	X	Employees	• Incinerator ash will be treated as a hazardous material and is stored in drums until a suitable disposal option can be identified for them.	Hazardous materials register	Start of construction until site closure	HSSEC Manager
	Sewage treatment	Bio-solids from the sewage treatment plant	X	X	Employees Soil, ground- and surface-water	• Given the absence of a municipal sludge treatment plant, project-specific sludge treatment options will be investigated (e.g. drying beds, compost production for agricultural, natural biodegradation by spreading on a dedicated managed surface).	Hazardous materials register	Start of construction until site closure	HSSEC Manager
	Project' activities	Other hazardous materials	X	X	Employees Soil, ground- and surface-water	• All chemicals will be managed according to a chemical management plan.	Hazardous materials register	Start of construction until site closure	HSSEC Manager

Table 18.2 Environmental impacts mitigation an enhancement plan – Mine area

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation and enhancement measures	Monitoring indicators	Timeline for implementation	Implementation: Person responsible
Air quality									
IP2008,p186	Emissions of air pollutants, NOx, SOx and particulates	Power generation	X	X	Residents and employees. Vegetation and agricultural land.	• Air quality management plan. • Power generation equipment complying with Guinean standards IFC EHS guidelines. • Appropriate equipment and vehicles maintenance Trip management to reduce vehicle movement. • Speed control. • Implement displacements and resettlements of the affected populations in case the inhabited areas are significantly impacted by the Project's activities.	Particulates concentration in µg/m³, and levels of SOx, NOx, etc.	Start of construction until site closure	HSSEC Manager
		Vehicles and equipment used on site, transport of employees	X	X					HSSEC Manager
		Train locomotive accessing and entering the Site		X				During operation	HSSEC Manager
IP2008,p186	Dust emissions	Mobile equipment, vehicles, and transport of employees, transport of materials on Site access roads and haul roads	X	X	Residents and employees Flora and fauna	• Dust management plan. • Trip management to reduce vehicle movement. • Project routes and transport procedures (e.g. cover trucks) to avoid dust emissions. • Access road, site surface watering and/or chemical dust control. • Proper equipment maintenance and washing. • Speed control. • Air quality and grievance monitoring. • Dust barriers to protect sensitive areas. • Restrict land clearance and/or blasting at specific hours and during particular meteorological conditions (e.g. strong winds heading towards nearest communities). • Limit dust arising Site surface being cleared by	Daily dust deposition in mg/m₂, Particulates concentration in µg/m³ Number and resolution rates of grievances	Start of construction until site closure	HSSEC Manager
		Mine pits and haul roads land clearance activities, pits excavation and blasting		X				During operation	Operation Manager HSSEC Manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation and enhancement measures	Monitoring indicators	Timeline for implementation	Implementation Person responsible
		Minerals unloading, crushing, stockpiling and loading		X		applying gravel, water, or stabilizing agent. • Water spays at transfer points. • Surface stabilization as needed on dumps and stockpiles and revegetation as needed. • Personnel Protective Equipment such as hearing protection. • Occupational Health and Safety trainings • Restrict blasting at specific hours (quite time) and during particular meteorological conditions. • Implement displacements and resettlements of the affected populations in case the inhabited areas are significantly impacted by the Project's activities.			HSSEC Manager
IP2008,p189	Nuisance odors	Sorting and temporary storing of wastes, waste treatment and landfilling	X	X	Residents and employees.	• Organize regular collection of wastes for their subsequent treatment. • Cover landfilled waste regularly.	Number and resolution rates of grievances Odor inspection	From start of landfilling until site closure	HSSEC Manager
IP2008,p189		Wastewater sewage treatment	X	X		• Maintain sewage treatment system in good order.		From start of operating sewage treatment plant until site closure	HSSEC Manager
IP2008, p.30	Release of greenhouse gases (GHG)	Refrigerants and energy consumption	X	X	Biosphere	Air quality management plan will include: • design of construction and infrastructure to lower GHG emissions; • actions to energy consumption and greenhouse gas emissions on sites and in operations; • investments to seek building GHG emissions abatement; • GHG management and monitoring process including reporting and target setting;	Number of designs, investments and measures to reduce GHG emissions	Start of construction until site closure	HSSEC Manager Procurement

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation and enhancement measures	Monitoring indicators	Timeline for implementation	Implementation Person responsible
						• considerations of energy saving into the business decision-making processes.			Supervisor
Noise & vibration									
IP2008,p131 & 186	Noise	Project' activities at mine infrastructure area (e.g. land clearance, piling, access road construction, etc.)	X	X	Residents and employees	• Meet IFC EHS Guidelines for noise generation • High noise equipment to be equipped with sound control/noise enclosures. • Install noise barriers such as berms, tire rows, tree lines, etc.). • Install mufflers on noisy vehicles • Maintain equipment in good state of repair. • Limit noisy activities near residences during night and quiet times (e.g. heavy vehicle movement). • Provide training to Project employees on noise and vibration reduction procedures and use of PPE. • Periodic monitoring of ambient noise levels at receptor points. • Limit traffic speed on all roads and define Project routes and transport procedures to avoid excessive noise in sensitive areas. • Trip management and bussing of employees to reduce Project traffic. • Community grievance monitoring through Grievance Procedure. • Limit train speed in sensitive populated areas.	Noise levels in dBA Number and resolution rates of noise grievances	Start of construction until site closure	HSSEC Manager Construction Site Manager Maintenance Manager
		Mobile equipment and vehicles on Site (including minerals transport, land clearance and road maintenance works)	X	X					
		Road access to the Site (commuters and supply vehicles)	X	X					
		Rail access to the Site (transport of minerals)		X				During operation	

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation and enhancement measures	Monitoring indicators	Timeline for implementation	Implementation Person responsible
		Blasting at mining pits areas		X		• Blasting to occur during daylight hours only. • Blasting controls.			Operation Manager
IP2008,p136, 186 and 189	Vibration	Road access to the Site (commuters and transport of construction equipment and materials) Site equipment (e.g. stackers, feeders)	X	X	Buildings and structures, owners and residents	• Limit traffic speed • Limit loaded vehicle weights • Define additional Project routes and transport procedures to avoid excessive vibration in sensitive populated areas. • Design for appropriate vibrating loads with adequate safety factors. • Limit train speed in populated areas. • Appropriate equipment and train locomotive maintenance.	Number and resolution rates of vibration grievances Vibration levels in m/s^2 Site inspection	Start of construction until site closure	HSSEC Manager
		Rail access to the site during construction and during transport of minerals	X	X					
		Heavy trucks supply on public road		X				During operation	Operation Manager
		Mining activities including blasting		X		• Restrict blasting during day-time only. • Blasting controls to limit the vibrations to acceptable levels (e.g. multiple-row blasting with short-delay ignition, decoupled blasting, pre-splits).			
Surface water									
IP2008, p140,	Degradation of quality of surface water	Storm water runoff from mine	X	X	Surface water Freshwater	• GIIPs for sediment and erosion control on all facilities, including first flush 56,000 m^3 settling pond for abatement of suspended solids.	Inspection of soils on site	Start of construction until site closure	Construction Site Manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation and enhancement measures	Monitoring indicators	Timeline for implementation	Implementation Person responsible
189		infrastructure areas			habitats Fish species and other species sensitive to surface water quality Local communities	• Revegetation of unused surfaces and slopes in both short and long term.	Surface water turbidity		
IP2008, p.140 SEIA Addendum, Ch3, Section 1.2.5.6	Degradation of quality of surface water	Storm water runoff from contaminate areas (e.g. fuel loading/unloading areas, maintenance yard, washbay, parking areas, etc.)	X	X		• First flush 56,000 m^3 settling ponds (sediment basins) on each plateau (provisionally 2 per plateau) for abatement of suspended solids. Settling tank for primary abatement of suspended solids, followed by oil/water separator for abatement of hydrocarbons, followed by 56,000 m^3 settling pond for final settling (or 'polishing') of effluent. • Standard construction environmental management procedures, including site-specific Erosion, Dust Management and Sediment Control Plans. • Particle size distribution analysis and detailed design of sediment/ wastewater controls for runoff from all mine terraces (including waste rock and material stockpile areas), operational sites, fuel storage and plant areas, based upon results of ongoing sediment/ARD testing. • Application of project-specific discharge and water quality standards, based upon SEIA recommendations and further ecological field survey. • Bio-composting of sludge including water runoff controls. • Mine sewage treatment system will be appropriately sized for abatement of COD and BOD • Oil/ water separator for abatement of hydrocarbons.	Surface water monitoring results Discharge water monitoring results		HSSEC Manager
		Storm water runoff from mine terraces, mine backfill and other disturbed areas		X				During operation	HSSEC Manager
	Degradation of quality of surface water	Sewage treatment and discharge	X	X				Start of construction until site closure	HSSEC Manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation and enhancement measures	Monitoring indicators	Timeline for implementation	Implementation Person responsible
						• Water settling tank will be appropriately sized for abatement of suspended solids. • Treatment and reuse of sludge to avoid contamination of surface water (e.g. drying beds, compost production for agricultural or mine rehabilitation use, natural biodegradation by spreading on a dedicated managed surface). • Standard construction environmental management procedures, including site-specific Erosion, Dust Management and Sediment Control Plans. • Particle size distribution analysis and detailed design of sediment/ wastewater controls for runoff from all mine terraces (including waste rock and material stockpile areas), operational sites, fuel storage and plant areas, based upon results of ongoing sediment/ARD testing. • Application of project-specific discharge and ambient water quality standards, based upon SEIA recommendations and further ecological field survey. • Long-term surface water quality monitoring campaign to identify/ remedy impacts and refine site-specific water quality standards.			
IP2008, p189	Degradation of quality of surface water	Accidental spill of chemicals	X	X		• Training on Hazardous materials management plan including on spill prevention and response. • Availability and use of spill clean-up materials.	Number of findings during Environmental and H&S audits	Start of construction until site closure	HSSEC Manager
	Impact to water quantity and Tinguilinta	Water supply for Project construction	X	X	Surface water Freshwater	• Raw water supply will be designed by combination of different sources. These sources options will be used as complementary solutions	Tinguilinta flow monitoring		HSSEC Manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation and enhancement measures	Monitoring indicators	Timeline for implementation	Implementation Person responsible
	flow	and operation			habitats Fish species and other species sensitive to surface water quality Tinguilinta river Local communities	to provide operational flexibility to the Project at the mine area, and assist in minimizing the potential impact of the Project on water availability and quality during wet and dry season: • no abstractions will occur from the river during the dry season if the river flows at the abstraction point fall below 90% of the estimated minimum average monthly flow, i.e. 0.62 m^3/s (or 620 l/s). • a water dam and associated reservoir dedicated to Project will be developed in the north of the concession (dam construction was already authorized by Guinean authorities in 2006). • the possibility of building and operating a bore field is under investigation. Potential water volume to be pumped will be based on the groundwater conditions. • clean runoff water from undisturbed areas will be partially stored during wet season to be used during dry season. • dirty runoff water from pits will be stored during wet season for use in dry season • Development and implementation of Mine Water Management Plan (MWMP) for all raw water sources	Ratio between volume pumped and seasonal flow conditions		
	Impacts on surface water drainage and flow conditions in Tinguilinta	Mine excavation and operation		X		• Standard engineering drainage design measures, including careful siting (design) and routine maintenance of all cross drainage structures. • Development and implementation of Mine Water Management Plan (MWMP) for all surface	Surface water monitoring results Discharge water	During operation	HSSEC Manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation and enhancement measures	Monitoring indicators	Timeline for implementation	Implementation Person responsible
	and affected tributaries mine					water discharges. • Sensitivity testing and the development of bespoke mitigation to minimize potential impacts upon high value tributary headwaters. • Flood management plan together with the integration of protective resistance and resilience measures within detailed Project design. • Surface water flow monitoring campaign. • Mine Closure and Reclamation Plan.	monitoring results		
Groundwater & Soils									
IP2008, p189	Soil & groundwater contamination	Storage, handling, and use of chemicals	X	X	Soil, groundwater and residents	• Containment of areas where hydrocarbons and chemicals are stored and handled (e.g. secondary containment, liner or concrete, etc.). • Regular inspections, maintenance, emptying and cleaning of containment areas.	Number of findings during Environmental and H&S audits	Start of construction until site closure	HSSEC Manager Construction Site Manager
		Accidental spill of chemicals	X	X		• Training on hazardous materials management plan including on spill prevention and response. • Availability and use of spill clean-up materials.			HSSEC Manager
IP2008, p187	Reduced groundwater levels	Reduced soil permeability at mine infrastructure area	X	X	Residents and employees Shallow ground water reserve	• Monitor aquifer supply interruption. • Monitor through stakeholder engagement.	Groundwater monitoring levels		HSSEC Manager
	Reduced soil permeability at mine plateaus and disruption of shallow groundwater	Extraction of bauxite layer and soil compaction/Stockpiling/ Dewatering		X		• Continual monitoring of spring outputs and groundwater quality (up gradient and down gradient) in the region. • Implementation of the Mine Water Management Plan.		During operation	HSSEC Manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation and enhancement measures	Monitoring indicators	Timeline for implementation	Implementation Person responsible
	recharge.					• Implementation of the Overburden management Plan.			

EP2008, p.140
 	
SEIA Addendum, Ch3, Section 1.2.5.6
	Water drainage into groundwater
	
	Change to water quality
		Mine terraces, mine backfill and other disturbed areas/ Stockpiling/ Dewatering		X		• Monitor through stakeholder engagement.
						• Provide alternative water supply if necessary by:
						  • drilling and completing new individual or community wells in deeper aquifer;
						  • supplying community water abstraction points
						  • providing alternative compensation for interrupted water supplies.
						• Progressive rehabilitation plan to be designed to slow the run-off of surface water from the mined plateau in the wet season to maximize recharge.
						• Mining drainage controls as necessary.
						• Regular consultation with nearby communities.
							Groundwater monitoring results (incl. pH and mineral composition)		HSSEC Manager

	Soil & groundwater contamination	Construction of the processing facility north of Plateau 26	X		Residents and employees Shallow ground water reserve	• Construction during the dry season • Appropriately compacted fill • Continual monitoring of water quality, water table levels and spring sources • Appropriately lined and bunded storage areas will be used for all fuel, lubricant or other chemical stockpiles • Pollution Prevention Control Measures and Emergency Response Procedures	Groundwater monitoring levels	During construction	HSSEC Manager Construction Site Manager
Topography and visual resources									
NEW	Night light pollution	Lights from mobile equipment and temporary lighting during	X	X	Terrestrial fauna Residents	• Training and awareness of employees. • Use the lowest possible level of lighting as long as it is; it will be sufficient to enhance the night time visibility required for safety and security	Number and resolution rates of grievances Visual	Start of construction until site closure	HSSEC Manager Construction Site Manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation and enhancement measures	Monitoring indicators	Timeline for implementation	Implementation Person responsible
		construction at infrastructure area				• Use directional lights pointing inwards and downwards. • Use of lights with reduced glare. • Install light barriers (e.g. barriers, vegetation). • Worksites will only be temporary as machinery and construction equipment will be dismantled and removed.	observation		
NEW	Change in landscape	Worksite installation, machinery, presence of the worksite Mining mobile equipment	X	X	Residents	• Store equipment and materials in an orderly manner during the works. • High machinery, including cranes, will be demobilized from site as soon as they are not needed anymore for construction work.			Maintenance Superintendent
NEW		Infrastructure area	X	X	Residents	• Installation of barriers and vegetation to lower visual effects of mine infrastructures. • Rehabilitation of infrastructure upon closure including ground leveling, and revegetation.	Number and resolution rates of grievances Visual observation	Start of construction until site closure	Construction Site Manager
	Change in landscape and topography	Mining of plateaus		X		• Possible use of barriers or vegetation to lower visual effects of mining pits exploitation. • Progressive rehabilitation of mining pits as they close including land grading and shaping, ground leveling, and revegetation.		During operation	Construction Site Manager
Flora and vegetation									
IP2008, p187	Loss of natural vegetation	Project footprint on natural habitats	X	X	Natural habitats	• Optimize design of Mine infrastructure (mining pits, haul roads, etc.) area and access road to reduce loss of natural vegetated areas, fallow land and cultivated areas.	Hectares of natural and agricultural land reclaimed and	Start of construction until site closure	Operation Manager HSSEC Manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation and enhancement measures	Monitoring indicators	Timeline for implementation	Implementation Person responsible
						• Development and implementation of a Biodiversity Management Plan which seeks to limit adverse impacts to flora and fauna species to the extent practical, and that avoid adverse impacts to populations. • Tailor Project Closure and Restoration Plan to achieve BMP conservation goals. • Creation of local herbarium, seed bank and nursery of native species of plants as needed to support rehabilitation efforts. • Replant as much of the original species diversity as possible as part of the restoration, with a view to enhancing connection of habitats reinstated through the closure .and rehabilitation phase. • As part of progressive closure and rehabilitation, give consideration of the order in which pits are opened and rehabilitated to support reinstatement of interconnected habitats. • Providing education and awareness training in local communities on the importance of protecting critical and natural habitat and recommended actions; • Providing education and awareness training to Project employees regarding protected areas and species including recommendations and restrictions on behaviors to support or limit degradation of habitats and wildlife.	restored Number of people that have participated to awareness training BMP monitoring results		
IP2008, p187	Loss of agricultural and fallow vegetation	Project footprint on agricultural habitats	X	X	Flora community	• Optimize design of Mine infrastructure (including mining pits areas and haul roads) area and access road to reduce in priority loss of gallery forest, natural vegetated areas where	BMP monitoring results	Before construction until site closure	Construction Site Manager HSSEC Manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation and enhancement measures	Monitoring indicators	Timeline for implementation	Implementation Person responsible
						endangered and threatened species have been identified and other natural vegetation areas, fallow land and cultivated areas. • During mining pits restoration and at Project closure, prioritize rehabilitation of previously cultivated areas into areas suitable for agriculture or into natural vegetated areas in consultation with local communities.			
IP2008, p108-117	Loss of critical habitats and population reduction of species for which it is deemed critical	Project footprint on critical habitats	X	X	Critical habitats and species	• In addition to the BMP, GAC will develop a dedicated plan for the management of the concession as critical habitats for chimpanzee with the aim to achieve no net loss to critical habitats through an offset program if deemed necessary.	BMP monitoring results	Before construction until site closure	HSSEC Manager
IP2008,p187	Invasive plant species threatening existing natural habitats	Introduction of exotic plant species	X	X	Flora community, threatened and endangered species and agricultural vegetation	• Invasive plant species control program • Training and awareness program on invasive weed species and Project procedures and rules.	Number of employees trained	Start of construction until site closure	HSSEC Manager
Fauna (terrestrial, surface water)									
IP2008,p187	Loss of natural habitats including l critical habitats and loss of breeding and nesting resources	Mine infrastructure (including mining pits and haul roads) and access road footprint on natural habitats	X	X	Natural habitats and critical habitats dependent species	• Delineation and removal of features critical to the protection of the gallery forest (such as headwaters) from development plans. • Optimize design of facilities, mining pits and haul roads to reduce loss of breeding/nesting resources and loss of natural habitats • Ecological surveillance brief and species relocation during land clearance process. • Implement an effective Biodiversity Management Plan (BMP) including species	Surface of Critical Habitats within development areas BMP monitoring results CMP	Start of construction until site closure	Construction Site Manager HSSEC Manager
IP2008,p18	Habitat fragmentation		X	X	Large natural habitats				HSSEC Manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation and enhancement measures	Monitoring indicators	Timeline for implementation	Implementation Person responsible
7					dependent species	specific management programs such as chimpanzees. • Progressive rehabilitate of mining plateaus with natural vegetation as they close following the process of Mine closure plan. • When necessary, create wildlife passage across linear infrastructures such as haul roads. • When necessary, create corridors along watercourse to allow chimpanzees displacements between plateaus	monitoring results		
IP2008,p187	Noise and presence affecting fauna behavior	Noise, vibration, human presence from construction and operation activities	X	X	Mammals, birds and reptiles, including Chimpanzees and other potential threatened and endangered species.	• Delineation and removal of features critical to the protection of the gallery forest (such as headwaters) from development plans. Noise and vibration controls and reduction measures. • Develop guidelines and rules to avoid Project employees' interaction with wildlife. • Education programs for staff and contractors regarding wildlife importance. • Implement an effective Biodiversity Management Plan (BMP) including species specific management programs such as chimpanzees.	NA	Start of construction until site closure	Construction Site Manager HSSEC Manager
	Accidents and death of sensitive species	Land clearance on Plateau 34		X	Herpetofauna	• Prior to the vegetation clearance phase in Plateau 34, where *Hemidactylus kundaensis* may be found, a pre-stripping monitoring of herpetofauna will be undertaken. This will allow to avoid killing species and to potentially acquire knowledge on *Hemidactylus kundaensis* distribution area. A "catch-release" protocol will be made by local herpetofauna experts as follows:	Number of man-days of herpetofauna survey and geographical survey coverage Number of herpetofauna	During operation	HSSEC Manager Construction Site Manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation and enhancement measures	Monitoring indicators	Timeline for implementation	Implementation Person responsible
						• Collection of all sensitive herpetofauna species encountered. • Release in designated area outside the direct Project footprint (e.g. along watercourse between plateaus). • Areas to be cleared will be clearly delineated. Their extent will be minimized where possible. • Vegetation clearance will be undertaken on a single front, to prevent herpetofauna species from being trapped.	individuals recorded, with particular attention to number of *Hemidactylus kundaensis* individuals recorded		
IP2008,p187	Accidents and death of animals	Vehicles and road transport entering the Site and moving within the Site.	X	X	Terrestrial fauna incl. mammals, birds, reptiles and amphibians	• Training vehicle operators on importance of wildlife. • Implement appropriate vehicle speed limitations. • Install signage in important wildlife areas. • When necessary, create wildlife passage across linear infrastructures such as roads or rails. • Bushmeat hunting by Project workforce will be forbidden. The killing of snakes or other reptiles will also be forbidden. GAC's Code of Conduct will limit the purchase of bushmeat by Project employees. • Awareness on biodiversity sensitivity and conservation will be included within environmental induction training for all Project staff, and periodic refreshers will be provided.	Number of reported accidents Number of people that have participated to awareness training	Start of construction until site closure	HSSEC Manager
IP2008,p187	Increase in hunting pressure for bush meat	Increase in local population due to Project induced in-migration.	X	X					HSSEC Manager
IP2008, p108-117	Loss of critical habitats and/or wildlife population reduction of species for	Project impacts on critical habitats (incl. footprint on habitats, fragmentation	X	X	Critical habitats and species	• In addition to the BMP, GAC will develop a separate and detailed plan for the management of the concession as critical habitats for chimpanzee with the aim to achieve no net loss to critical habitats through an offset program if	BMP monitoring results CMP monitoring results		HSSEC Manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation and enhancement measures	Monitoring indicators	Timeline for implementation	Implementation Person responsible
	which it is deemed critical	of habitats and others impacts such as noise, vibration and human presence.)				deemed necessary. • Delineation and removal of features critical to the protection of the gallery forest (such as headwaters) from development plans. • Implement the Chimpanzee Management Plan • Bushmeat hunting by Project workforce will be forbidden. The killing of snakes or other reptiles will also be forbidden. GAC's Code of Conduct will ban the purchase of bushmeat by Project employees. • Awareness on biodiversity sensitivity and conservation will be included within environmental induction training for all Project staff, and periodic refreshers will be provided.	Number of people that have participated to awareness training		
IP2008, p187	Impact on fish and other vertebrates behavior	Presence of workers and vibration caused by Project vehicles and construction works	X	X	Fish community and other vertebrates	• Provide community sensitization on importance of wildlife.	BMP monitoring results	Start of construction until site closure	HSSEC Manager
IP2008, p187	Increase in fishing pressure	Increase in local population due to Project induced in-migration.	X	X		• Provide community sensitization on importance of wildlife.	BMP monitoring results		HSSEC Manager
Freshwater ecosystems									
	Deterioration of freshwater habitats	Increased erosion on catchments		X	Freshwater habitats	• Implementation of good practices to prevent erosion and suspended matters input to headwaters.	Suspended matters monitoring	During operations	HSSEC Manager Construction Site Manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation and enhancement measures	Monitoring indicators	Timeline for implementation	Implementation
									Person responsible
						• Spatial planning of construction/development/operation activities in order to mitigate social and environmental damages.	results Water quality monitoring results Results of fish biodiversity monitoring		
		Increased activities along water-courses Hydrological changes in the operation areas		X	Fish communities	• Implementation of good practices to prevent erosion and suspended matters input to headwaters. • Implementation of good practices to prevent/mitigate quantitative and qualitative degradation of watercourses. • Spatial planning of development/operation activities in order to mitigate social and environmental damages.			HSSEC Manager
	Changes in fish biodiversity							During operations	HSSEC Manager Operation Manager
	Impact on fish species of conservation interest *Paramphilius teugelsi*	Increased activities along watercourses and hydrological changes in the operation areas		X	*Paramphilius teugelsi*	• Additional study on *Paramphilius teugelsi*. • Spatial planning of development/operation activities in order to mitigate social and environmental damages.			HSSEC Manager Operation Manager
	Decrease of fish stock due to overfishing	In-migration and pressure and fish resource	X	X	Freshwater fauna	• Collaboration with local authorities in charge of natural resources management.	Results of fish biodiversity monitoring	Start of construction until site closure	HSSEC Manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation and enhancement measures	Monitoring indicators	Timeline for implementation	Implementation Person responsible
Wastes									
	Risk of pollution	General and domestic waste generation	X	X	Soil, ground- and surface-water pollution	• Develop waste management plan prior to construction. • Collection, storage and disposal or treatment of waste by qualified personal or service provider. • For waste landfilled or treated on site ensure infrastructures meet GIIP standards. • Waste register and traceability. • Waste stocks inventory.	Waste register Results of water quality monitoring	Prior to construction until site closure	HSSEC Manager
	Risk of pollution	Inert materials waste generation	X	X	Soil, ground- and surface-water pollution	• Inert material such as overburden, rock, gravel and/or organic material will be stockpiled for future re-use onsite. • Stockpiles will be implemented in a way to minimize generation and or loss of sediment by wind, rain or surface water. • Strict rules regarding access to the site will be enforced.	Waste register Results of water quality monitoring	Prior to construction until site closure	Construction Site Manager HSSEC Manager
		Timber waste generation	X	X	Soil, ground- and surface-water pollution	• Where practical, the timber will be cut to size and stacked or stored awaiting re-use as formwork, structural timber or for processing. • Where feasible, timber may be either sold or given to the local population or to local Enterprises. Alternatively, it could also be used as composting generating material			Construction Site Manager HSSEC Manager
	Degradation of soils and water quality	Impacts generated by overburden – physical footprint and erosion and	X	X	Soils, water and groundwater	• Inert material such as overburden, rock, and gravel will be stockpiled for future re-use onsite, in a way to minimize generation and or loss of sediment by wind, rain or surface water. • Appropriate erosion controls and (if necessary)	Waste register Results of water quality and suspended matters		Construction Site Manager HSSEC Manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation and enhancement measures	Monitoring indicators	Timeline for implementation	Implementation Person responsible
		turbid runoff				drainage water retention for TSS abatement. • Below-grade bauxite formations that may have been moved to access higher-grade material will be stockpiled in-pit or at a maximal distance of 2 to 5 km from the pit, for potential use during subsequent phases of the concession (e.g. for use as refinery feed).	monitoring		
Hazardous materials									
	Health & Safety risk	Storage, handling, use and disposal of hydrocarbons and other chemicals	X	X	Employees	• Use of hazardous materials by qualified trained personnel only. • Training on and use of Personnel Protective Equipment. • Availability of eye-rinse liquid and medical support. • Training on Hazardous materials management plan including on spill prevention and response. • Availability and use of spill clean-up materials. • Where appropriate, waste oil will be recycled on site, returned to suppliers for recycling or burned using appropriate methods. • Solvents will be sent to off-site recycling or disposal.	Hazardous materials register	Start of construction until site closure	HSSEC Manager
	Health & Safety risk	Medical waste generation and storage	X	X	Employees	• All medical waste, including human tissue, will be transported to the proposed facilities for incineration.	Hazardous materials register	Start of construction until site closure	HSSEC Manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation and enhancement measures	Monitoring indicators	Timeline for implementation	Implementation Person responsible
	Health & Safety risk	Ash from the incinerator	X	X		• Incinerator ash will be treated as a hazardous material and is stored in drums until a suitable disposal option can be identified for them.			HSSEC Manager
	Health & Safety risk Risk of contamination and pollution	Bio-solids from the sewage treatment plant	X	X	Employees Soil, ground- and surface-water	• Given the absence of a municipal sludge treatment plant, project-specific sludge treatment options will be investigated (e.g. drying beds, compost production for agricultural, natural biodegradation by spreading on a dedicated managed surface).			HSSEC Manager
	Health & Safety risk Risk of contamination and pollution	Other hazardous materials	X	X		• All chemicals will be managed according to a chemical management plan.	Hazardous materials register	Start of construction until site closure	HSSEC Manager
	Health & Safety risk	ANFO explosive mixture		X	Employees and communities	• The explosives and detonators will be stored and transported separately in line with best practice and will, when required, be mixed together at the drill site, and used as explosive. • In addition, General Hazardous Material Management measures will be implemented	ANFO explosive mixture register	During operation	HSSEC Manager

Table 18.3 Social impacts mitigation and enhancement plan – Port area

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation measures	Monitoring Indicators	Timeline for implementation	Implementation Manager
Demographics and social dynamics									
	Increase in social tensions	In-migration	X		Communities Communities	• Support competent local authorities in establish an influx management plan for the city of Kamsar to limit the demographic pressure on the central sections of Kamsar, due to the migrations related to the Project.	Number of people that have participated to awareness training	During construction	HSSEC Manager
			X	X		• Implement and fund development projects as part of the Local Development Plan, in particular by: • implement awareness programs by the specialized local or national NGOs to the community regarding the following subjects: dangers associated with prostitution and other risky behavior (STDs), teenage and/or unwanted pregnancies, consumption of drugs, etc.; • implement an updated SEP for regular consultation and information policy of the communities potentially affected by the Project. • continue using Project and / or donor funds,for public infrastructure projects within the framework of the signature of the Local Development Agreement with the impacted communes and local authorities.		During construction and operation	HSSEC Manager
	Increase in social tensions	Recruitment	X	X	Communities	• Communicate and apply a clear and transparent recruitment policy:	Percentage of local employees	During construction and operation	HR Director

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation measures	Monitoring Indicators	Timeline for implementation	Implementation Manager
						• clearly and widely communicated hiring procedures at national, regional and local level that emphasizes the preferential recruitment of local indigenous people based on an already developed database, employment opportunities and requirements, application procedures and location for application including in the capital Conakry and Kamsar city and Sangarédi, and providing a clear process for soliciting and processing applications for employment from populations located in proximity to the Project site • set up a database of workers available and their level of skills, that has to be consulted as a priority for recruitment by the mining company or its subcontractors.	vs. total		
Power, governance and civil society									
	Strengthening of civil society	Project development In-migration	X	X	Communities	• Implement and fund development projects as part of the Local Development Plan with the objective to improve access and quality of education in the area • Engage regularly with the associations and organizations of citizens as part of the Project Stakeholder Engagement Plan		During construction and operation	HSSEC Manager
	Risks of tension between communities and local administrative	Project development In-migration	X	X	Communities and local authorities	• continue implementation of an effective and transparent grievance mechanism and to report on this mechanism to the authorities in Kamsar and in the villages impacted by the Project's activities. • inform the administrative authorities regarding	Amount of community investment Number and type of	During construction and operation	HSSEC Manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation measures	Monitoring Indicators	Timeline for implementation	Implementation Manager
	authorities					the progress of the Project's activities; • Develop a local development agreement (LDA) and community development plan in collaboration with other local project developers with the competent authorities and widely circulate information on this tool; • Gather information on the possible factors of tensions and conflicts in the port area • identifying and implementing development projects (particularly the basic infrastructures) supported by GAC using their own funds; • Ensure the transparency of the Project's participation in financing development activities, when using own funds or via the contribution to the public budgets as determined by the Basic Agreement and its Amendments between GAC and the GoG; • Participate in the meetings organized by the Prefecture Development Committee (PDC) on mining stakes; and	development projects supported Number and resolution rates of grievances		

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation measures	Monitoring Indicators	Timeline for implementation	Implementation Manager
	Increase in risks of corruption	Project development In-migration	X	X	Communities and local authorities	• Support the local authorities in their communication steps related to expenses in relation to LDA. • To rely on the LDA that would involve a principle of transparency and consultation associated with it and made accessible to the local community (Article 130 of the Mining Code -2011). • Apply a transparent hiring policy. • Update the SEP on a regular basis taking into account project phases. • Favor methods of communication that can reach the majority of the stakeholders (radiophonic broadcasting for example). • Comply with the legal obligation of putting in place a corruption monitoring plan.	Amount of community investment Number and type of development projects supported	During construction and operation	HSSEC Manager HR Director Legal and compliance manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation measures	Monitoring Indicators	Timeline for implementation	Implementation Manager
Land use									
	Increase in land prices	In-migration Physical displacement and re-installation	X		Communities and local authorities	• Assist as feasible displayed persons in securing land rights in their place of resettlement in collaboration with local authorities. • Finalize the future construction plans in order to minimize the coverage on the residential sites (particularly, the rail spur area).	Number and resolution rates of grievances	During construction	HSSEC Manager Construction Site Manager

	Increase in tensions on the land resource		X	X		• Assist local authorities in the development of an Influx Management Plan as an overarching mitigation measures to attenuate this impact, in particular by:
						  • guiding displaced persons in the case of re-installation towards welcome centers that offer the same opportunities as the land requisitioned by the Project, especially in terms of accessibility to basic public infrastructures; and
						  • working with the local authorities to adequately prepare facilities for new migrants.
						• Continue implementation of a grievance mechanism as an overarching mitigation measure that is widely known by the local authorities and runs effectively and transparently.
								During construction and operation	HSSEC Manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation measures	Monitoring Indicators	Timeline for implementation	Implementation Manager
Agriculture									

	Fall in household income	Project footprint and construction activities	X		Communities	• Implement the Local Development Plan as an overarching mitigation measures is expected to attenuate this impact, in particular by:
						  • Allowing for financial compensation for possible interruption of activities during the work phase as part of the RAP;
						  • Implementing programs in support of agricultural development (technical courses, provision of equipment and inputs, etc.) for the affected populations; and
						  • Implementing economic diversification projects and favor the development of alternative income-generating activities, particularly for women (support to the transformation and selling of farm produce, specifically).
							Number of agricultural development programs implemented	Prior and during construction	HSSEC Manager

	Reduction of agricultural yields	Project footprint and operation activities		X		• Adopt anti-dust measures (truck traffic, bauxite handling) in the port terminal. • Undertake measures to prevent accidents and the risk of discharging effluents in the environment and minimize as much as possible the cause of these dangers.		During operation	Governance and Compliance Manager HSSEC Manager
Fishing and access to the natural resources									
	Degradation of the quality of surface water and pressure on the resource	In-migration Accidental spills	X	X	Communities	• To construct improved water sources (type, location, number of works, functioning conditions, and undertake to choose them in conjunction with local populations); • To limit to the maximum amount possible the sources of atmospheric pollution.		During construction and operation	HSSEC Manager Construction Site Manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation measures	Monitoring Indicators	Timeline for implementation	Implementation Manager
						• To undertake, monitor and update measures to prevent accidents and the risk of discharging effluents in the natural setting and minimize as much as possible the cause of these dangers.			

	Reduction in fishing	Dredging activities and infrastructure construction operations	X	X	Communities	• Adopting measures within the framework of the Stakeholder Engagement plan (SEP) as an overarching mitigation measures is expected to attenuate this impact, in particular by:
						  • informing the fishermen of the area upstream of operations in order to limit the impact of the Project on the mobility of fishermen in the estuary;
						  • work with Harbor Master to develop and implement a boat traffic plan for construction and dredging work in the estuary, and to share with the authorities and the affected populations;
						  • compensate for losses of revenues if fishing activity is compromised during dredging activities
						• Undertake measures to prevent accidents and the risk of discharging effluents in the natural setting and minimize as much as possible the cause of these dangers
						• Apply the mitigation measures proposed in the environmental impact study (the biological part regarding fish stocks).
								During construction and operation	HSSEC Manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation measures	Monitoring Indicators	Timeline for implementation	Implementation Manager
Local socio-economic context									
	Improvement in the economic situation of recruited persons and of their households	Recruitment	X	X	Communities	• The overarching mitigation measures of local preferential hiring will be implemented to attenuate the impact by: • Pursuing a local recruitment policy. • Favoring the sustainability of the job. • Assuring decent salary conditions for the employees; and • Ensuring, both under agreements signed with subcontracting companies and in practices in the field, that the commitments GAC has made in favor of employees and the communities impacted are respected by all Project's stakeholders (random checks might be put in place to check the working conditions in the subcontracting companies of the Project).	Percentage of local employees vs. total	Prior and during construction	HR Director
	Increase in demand, economic diversification and reinforcement of local entrepreneurship	Procurement	X	X	Communities	• Communicate regularly on the contract offers for goods and services offered by the Project at local and national level, and on the requirements and standards to be satisfied to obtain these contracts. • Favor procurement with local or national companies when the goods and services sought are available at comparable prices, quantities, qualities, service, support and delivery lead-times. • Set up a database of local companies and their area of competence, to be consulted as a priority when the Project or its subcontractors award a new contract. • Support the development of local	Expenses in for local supply *vs.* total Number and percentage of local subcontractors *vs.* total Number and type of training provided	Prior and during construction During operation	Procurement Supervisor HSSEC Manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation measures	Monitoring Indicators	Timeline for implementation	Implementation Manager
						entrepreneurship through training courses, particularly in terms of compliance with the quality, health and safety standards - this measure could be included in the Support Plan to Guinean companies whose implementation is imposed by the Mining Code (Article 30-II).			
	Capacity-building and professional expertise in a globalised context	Capacity building	X	X	Communities	• Support continuous training for the employees of the Project and their subcontractors. • Anticipate the short-term retraining for employees (professional training, training on job-seeking). • Open up training opportunities to persons who were not able to be recruited, in order to support the development of their professional potential.	Number and type of training provided	During construction and operation	HR Director HSSEC Manager
	Increase in local development initiatives	Local development	X	X	Communities	• Involve the communities and local authorities during the construction of basic infrastructures or the implementation of development projects, in order to find out their specific needs (recording of investments within the framework of the Local Development Plan of the communes). • Develop and respect a local development agreement (LDA) and a community development plan on a collaborative basis with the competent authorities and widely circulate information on this tool. • As part of the SEP, establish and respect a framework of collaboration with quarterly meetings (sub-prefectoral, communal and	Amount of community investment Number and type of development projects supported Amount of tax paid to the local government	During construction and operation	HSSEC Manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation measures	Monitoring Indicators	Timeline for implementation	Implementation Manager
						district authorities, GAC and representatives of the subcontracting companies). • As part of the SEP, participate in the meetings organized by the Prefecture Development Committee (PDC) on mining stakes. • Support the local authorities in their communication steps related to expenses related to the Local Development Fund.			
Health and safety									
	General health and safety	Project' activities	X	X	Communities and employees	The following measures apply to all potential impact on health and safety: • Evaluate the risks and the impacts on health and safety to which the affected communities are exposed and to take the appropriate prevention measures. • Use work techniques and methods adapted to protect the environment, the safety of workers and the population living near the rivers. • Develop a "Health, Safety and Hygiene Plan" in accordance with the Mining Code. • Design and construct the structural elements of the Project by taking account of the risks to which the workers and the affected communities are exposed. • Reduce the potential exposure of the community to hazardous materials and substances. • Consider physical resettlement when the technical measures available may not lower the level of impact to an acceptable level.		During construction and operation	HSSEC Manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation measures	Monitoring Indicators	Timeline for implementation	Implementation Manager
						• Inform the populations on location and duration of construction activities and the risks associated with the activities • As part of the Local Development Fund, financially support the construction of the healthcare infrastructures in the impacted settlements, in partnership with the government and the competent authorities. • Support campaigns raising the awareness of the Project's workers and communities on health problems, in collaboration with national and/or international NGOs. • Continue implementation of a grievance mechanism as an overarching mitigation measure that is widely known by the local authorities and runs effectively and transparently. •			Operation Manager HSSEC Manager
	Diseases related to water and sanitation	In-migration	X	X	Communities and employees	• Support local authorities in development of an influx management plan. • Support the local authorities in managing migration flows and in the associated urban planning: definition of a waste management system, installation of hygiene infrastructures (particularly latrines) in public places, installation of improved water bodies (via investments using own funds or support to the competent authorities). • Support the authorities and civil society to implement awareness-raising campaigns on hygiene. • Reduce the production of hazardous and non-		During construction and operation	HSSEC Manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation measures	Monitoring Indicators	Timeline for implementation	Implementation Manager
						hazardous waste and eliminate it appropriately (residue, waste and hazardous materials' management strategy). • Avoid or reduce and control the discharge of effluents in the environment (evaluate their production, transport, handling, stockpile and use). • Adopt anti-dust measures (truck traffic, scouring of land, sweeping and backfilling operations).			
	Diseases	Physical displacement of populations	X	X	Communities and employees	• Support local authorities in development of an influx management plan. • Support the local authorities in the management of migration flows and urban planning (housing in particular). • Initiate measures that would avoid too concentrated of a population - the Project will operate, for example, bus services to access the work sites in order to thin out the lodging areas for temporary workers; • Implement existing Code of conduct for workers applicable to all of the Project's personnel, that will include guidelines on workers-communities and workers-workers interactions, on the development of personal relationships with members of the local communities, on the consumption of alcohol, risky behavior, etc. • Explicitly prohibit any illegal activity carried out by all of the Project's personnel, including the use of sex workers, the sex trade and the	Number of people that have participated to awareness training	Prior and during construction During operation	HSSEC Manager HR Director

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation measures	Monitoring Indicators	Timeline for implementation	Implementation Manager
						consumption and/or the traffic of illegal substances. • Establish a systematic medical inspection and a screening of workers at least once a year and to develop a healthcare adjustment plan (Article 143 of the Mining Code, 2011). • Promote, as part of the initial training, the raising of the awareness of the Project's personnel on transmitted diseases (for example, tuberculosis) and sexually transmitted diseases (for example, HIV/AIDS), vector-borne diseases (for example, malaria) and other diseases as appropriate. • Design and administer the accommodation camps in accordance with international best practices on the accommodation of workers, particularly the criteria of the IFC PS 2 as well as AfDB OS 5. • Organize awareness-raising campaigns on public health problems with the communities in collaboration with national and international NGOs. • Support the development of the healthcare infrastructures of the region through investment using own and / or third party funds, by providing specific structures for viral diseases.			Studies Manager Operation Manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation measures	Monitoring Indicators	Timeline for implementation	Implementation Manager
	Risks to the safety of populations	Project' construction and operation activities	X	X	Communities	• Carry out awareness-raising actions with GAC workers and its subcontractors on risky practices and the GAC policy on relations between workers and with the communities. • Support the public authorities for the implementation of awareness-raising campaigns on risky behavior, in collaboration with the national and international NGOs.		During construction and operation	HSSEC Manager
	Risks for the security of workers	Project' construction and operation activities	X	X	Employees	• Establish a worker protection system against occupational diseases (screening of factors of harm, regular medical visits of the workers, etc.). • Identify the potential dangers for the workers, particularly likely to constitute a threat for their lives. • Initiate measures designed to prevent accidents, injuries and diseases resulting from the work by minimizing, as much as possible, the cause of such dangers. • Safeguard the safety of the machines and equipment. • Assure the ability to work of the workers (physical conditions). • Develop a training program for the Project's workers (direct and indirect jobs) in order to ensure that these employees have the skills, information and capacities required to manage the risks associated with the job to which they are assigned. • Provide the workers with all the protection equipment necessary to minimize the risks	Number and type of training provided	During construction and operation	HSSEC Manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation measures	Monitoring Indicators	Timeline for implementation	Implementation Manager
						associated with the tasks carried out as part of the job. • Check compliance with the application of the aforementioned standards by the subcontractors of the Project, particularly by conducting regular audits and taking corrective measures if need be.			
	Improvement of health care services in accordance with priorities as determined by local authorities	Project' development	X	X	Communities and employees	• Maximize the positive impacts of investment and assist in funding in collaboration with third parties in the healthcare sector in accordance with priorities as determined by local authorities. • Involve the communities and local authorities during the construction of basic infrastructures or the implementation of development projects, in order to find out their specific needs (recording of investments within the framework of the Local Development Plan of the communes). • Develop a local development agreement (LDA) and a community development plan on a collaborative basis with the competent authorities.		During construction and operation	HSSEC Manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation measures	Monitoring Indicators	Timeline for implementation	Implementation Manager
	Access to healthcare	Project' development	X	X	Communities and employees	• Develop a Local Development Plan • Support local authorities in the development of an influx management plan • Participate, in collaboration with the local administrative authorities (within the framework of a Local Development Plan), in the renovation of public health infrastructures in the southern islands). • Anticipate the reinforcement of Kamsar's healthcare infrastructures in collaboration with competent authorities in relation to the arrival of migrants. • Provide for financial in kind compensation for the displaced households through the transition period to enable them to maintain the same financial capacity of access to healthcare. • Put in place alternative solutions so as to not block the flow of locals from Taïgbé and the southern islands between the Dougoufissa River and the city of Kamsar. • Request from ANAIM/CBG a crossing point above the railway track, so as not to hinder the movement of inhabitants living south of the future connection and particularly users of Salamaya port.		During construction and operation	HSSEC Manager HSSEC Manager
	Road and maritime security	Terrestrial and maritime traffic increase	X	X	Communities and employees	• Adopt a traffic management plan that minimizes traffic during rush hour. • Adopt a road traffic code (speed limits, signs, signals at the entrance of sites, etc.). • Put a campaign in place to raise the awareness of the population on road and maritime safety	Number of incidents reported Number of people that have	During construction and operation	Studies Manager HSSEC Manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation measures	Monitoring Indicators	Timeline for implementation	Implementation Manager
						issues. • Prohibit the access of non-authorized persons to the project sites.. • Pay for the costs from road traffic accidents for which the Project's vehicles are proven responsible. • Work with Harbor Master to create and apply a maritime traffic code that takes into account the fishermen in the area, in collaboration with the competent local authorities. • Inform the authorities (specifically the port authorities) of the nature and agenda of the business work in the area of the estuary.	participated to awareness training		Operation Manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation measures	Monitoring Indicators	Timeline for implementation	Implementation Manager
Education									
	Improvement of education services	Project' development and in-migration	X	X	Communities and employees	• Develop a Local Development Plan • Optimize the Local Development Plan using Local Development Fund in accordance with local authority priorities in education.. • Develop in collaboration with the competent authorities (prefectoral, sub-prefectoral and local) a strategy for the development of the educational offer in the area in accordance with the needs and capacities of the government • Collaborate in the building of one or more colleges in the area in order to encourage the secondary education of young people (particularly girls whose parents refuse to educate in the town). • Prioritize spend on education facilities as part of the contribution to the LDF. • Favor the construction of new infrastructure in less advantaged sections of the city; • Put in place a study bursary program that would encourage parents to educate their children, particularly girls.		During construction and operation	HSSEC Manager
	Access to education	Project' development and in-migration	X		Communities and employees	• Participate, in collaboration with the local administrative authorities, in the construction of a middle school in the Districts south of the SP (concerted approach within the framework of a Local Development Plan). • As part of the RAP, provide for financial compensation or compensation in kind for the displaced households through the transition		During construction	HSSEC Manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation measures	Monitoring Indicators	Timeline for implementation	Implementation Manager
						period to enable them to maintain the same financial capacity of access to education. • Put in place alternative solutions so as to not block the flow of locals from Taïgbé and the southern islands between the Dougoufissa River and the city of Kamsar. • Put in place a study bursary system for the pupils and students of the poorest households and for those living in particularly isolated affected areas such as Taïgbe.			

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation measures	Monitoring Indicators	Timeline for implementation	Implementation Manager
Mobility, flows and transport									
	Road congestion	Terrestrial traffic increase	X	X	Communities and employees	• As of the RAP, provide financial compensation or compensation in kind during the entire period of construction for people who have been financially impacted. • Develop and update a traffic management plan that minimizes traffic during rush hour. • Establish and maintain a work agenda and a river traffic plan that will be given to the authorities.		Prior and during construction During operation	HSSEC Manager Operation Manager
			X	X		• Implement alternative solutions so as not to block the movement of residents of Taïgbé and of the southern islands between the river Dougoufissa and the town of Kamsar, either during the construction of the conveyor or when the latter is in operation (construction of a secured tunnel under the conveyor for the passage of pedestrians and vehicles). • Request from ANAIM/CBG to organize and maintain a crossing point above the railway track, so as not to hinder the movement of inhabitants living south of the future connection and particularly users of Salamaya port.		Prior and during construction During operation	Studies Manager Operation Manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation measures	Monitoring Indicators	Timeline for implementation	Implementation Manager
Living conditions and landscape									
	Disturbance	Noise and vibrations	X		Communities	• Respect guidelines to ensure quiet times at the building sites, at night in particular. • Implement displacements and resettlements of the affected populations in case the inhabited areas are significantly impacted by the Project's activities. • Consider all technical measures designed to reduce the levels of noise and vibration (plantations, anti-noise walls, etc.). • Continue implementation of a grievance mechanism that will be able to resolve situations on a case-by-case basis.	Number and resolution rates of grievances	During construction	HSSEC Manager Studies Manager HSSEC Manager
				X		• The following overarching mitigation measures will be implemented to attenuate the impact: • implement displacements and resettlements of the affected populations in case the inhabited areas are significantly impacted by the Project's activities; • Continue implementation of a grievance mechanism that will be able to resolve situations on a case-by-case basis; • as part of the Local Development Plan support the competent authorities in improving the public and private transport services.		During operation	HSSEC Manager Studies Manager HSSEC Manager
	Degradation of air quality	Dust emission	X	X	Communities	• Dust management plan • Consider all the technical measures designed to reduce the dust emission levels (sprinkling of the tracks, tarring of the roads, etc.).	Number and resolution rates of grievances	During construction and operation	HSSEC Manager Studies Manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation measures	Monitoring Indicators	Timeline for implementation	Implementation Manager
						• Put in place a transparent and effective grievance mechanism that will be able to resolve situations on a case-by-case basis. • Implement displacements and resettlements of the affected populations in case the inhabited areas are significantly impacted by the Project's activities.			
	Changes to the landscape	Visual effects	X		Communities	• Plan the rapid decommissioning of the temporary infrastructures required for the construction of the permanent infrastructures (cranes, etc.). • Provide for external night-time discreet lighting, pointing at the process facility and other mining infrastructure and the works areas (light beams aimed downward).		Prior and during construction	Construction Site Manager
Cultural heritage									
IP2008, p.32, 100	Physical degradation of sites and reduced access to the sites	Project footprint and earth moving works	X		Local communities	• Implement a procedure for managing incidental findings during the construction phase. • Continue using compensation system already in place for all the damage caused by the building sites. • Ensure these measures are respected by the Project's sub-contracting companies.		Prior and during construction	HSSEC Manager

Table 18.4 Social mitigation and enhancement plan – Mine area

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation measures	Monitoring Indicators	Timeline for implementation	Implementation Manager
Demographics and social dynamics									
	Change in the traditional family structure	Physical and economic displacements of the populations Employment opportunities	X	X	Communities	• Develop a resettlement action plan (RAP) in line with GAC's commitments to Resettlement and livelihood restoration and IFC PS 5 and AfDB OS 2. • Develop and implement a Local Development Plan with the aim to support income-generating activities for the displaced persons. • Implement a preferential hiring and sourcing procedure in favor of people directly affected by the resettlement (subject to availability and skills of the applicants for each job to be filled). • Collaborate with local authorities to influence their use of the LDF in support of the income-generating activities for the most vulnerable persons exposed to this impact.	Number of affected persons recruited Number of grievance and resolution rate	During construction and operation	HSSEC Manager Procurement Supervisor
	Loss of cultural markers and identity	Physical and economic displacements of the populations	X	X		• Develop a resettlement action plan (RAP) in line with GAC's commitments to Resettlement and livelihood restoration and IFC PS 5 and AfDB OS 2 in particular by assisting displaced people to secure land rights and by taking into account dependency relationships between families and community lineages in the selection of displacement areas.			HSSEC Manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation measures	Monitoring Indicators	Timeline for implementation	Implementation Manager
	Increase in social tensions	Population resettlement	X	X	Communities	• To develop a resettlement action plan (RAP) in line with GAC's commitments to Resettlement and livelihood restoration and IFC PS 5 and AfDB OS 2 in particular by developing collective compensation programs in benefits of hosts and displaced households, engaging regularly with local communities and by taking into account dependency relationships between families and community lineages in the selection of displacement areas.	Number of compensation programs developed Number of local development initiatives taken	During construction and operation	HSSEC Manager
		Employment		X	Communities	• Ensure local preferential hiring is implemented so as to benefit to the Project resettled people and local communities in priority. • Implement and fund development projects as part of the Local Development Plan in order to reinforce or create income generating activities especially those performed by women. • Collaborate with local authorities to influence their use of the LDF in support of the income-generating activities for the most vulnerable persons exposed to this impact.	Percentage of local people recruited	During operation	HR Director HSSEC Manager
	Pressure on persons benefiting from a salaried job and increase in social tensions	Employment	X	X		• Implement and fund development projects as part of the Local Development Plan with the objective to enhance economic opportunities and living conditions in the MA, in particular by: • supporting income-generating activities for women and men through the provision of trainings, materials, funding, etc.; and • to fund community development projects to enhance public infrastructure and services.		During construction and operation	HSSEC Manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation measures	Monitoring Indicators	Timeline for implementation	Implementation Manager
				X		• Collaborate with local authorities to influence their use the LDF in support income-generating activities for the most vulnerable persons exposed to this impact.		During operations	HSSEC Manager
Power, governance and civil society									
	Weakening of methods of traditional governance	Land requisitioned by the construction of the processing facility and resettlement Physical footprint of the processing facility and resettlement	X	X	Communities and authorities	Develop a resettlement action plan (RAP) in line with GAC's commitments to Resettlement and livelihood restoration and IFC PS 5 and AfDB OS 2 in particular by involving local authorities in the decision and organization process of the displacements (e.g. selection of areas, organization of displacements, restoration programs, etc.).		During construction and operation	HSSEC Manager
		In-migration	X	X					
	Reinforcement of civil society around intellectuals and workers	Project' activities	X	X	Communities and authorities	• Implement and fund development projects as part of the Local Development Plan with the objective to improve access and quality of education in the area. • Engage regularly with the associations and organizations of citizens as part of the Project Stakeholder Engagement Plan.		During construction and operation	HSSEC Manager
	Increase in the risk of poor financial management and tensions between	Increase in local development budget of the communities	X	X		• Apply a principle of transparency on the contributions paid by the Project to the budget of the local communities and financing of development activities using GAC's own funds. • Support the local authorities in their financial management and communications related to		During construction and operation	Governance and Compliance Manager HSSEC Manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation measures	Monitoring Indicators	Timeline for implementation	Implementation Manager
	communities and local administrative authorities					expenses for the local development. • Involve the sub-prefectoral, communal and district authorities in identifying and implementing development projects (particularly the basic infrastructures) supported by GAC using own funds. • Establish a framework of collaboration with regular meetings (sub-prefectural, communal and district authorities, GAC and representatives of the subcontracting companies). • Participate in the meetings organized by the Prefecture Development Committee (PDC) on mining stakes. • Continue use of effective and transparent grievance mechanism already in place.			
Land use									

	Increase in tensions on the land resource	In-migration
		
		Physical displacement and re-installation
			X	X	Communities and local authorities	• Develop a formal resettlement action plan (RAP) in line with GAC's commitments to Resettlement and livelihood restoration and IFC PS 5 and AfDB OS 2 in particular by:
						  • involving local authorities in charge of land management;
						  • favoring collective compensation measures;
						  • engaging regularly with the local population.
						  • exploring the legal options with regard to a cut-off date and restrictions with regard to newcomers installation;
						  • setting a maximum of two years' time limit for resettlement after a possible construction moratorium.
						• Continue use of grievance mechanism that is
							Number and resolution rates of grievances	During construction and operation	HSSEC Manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation measures	Monitoring Indicators	Timeline for implementation	Implementation Manager
						widely known by the local authorities and runs effectively and transparently			
	Increase in tensions on the land resource	In-migration Physical displacement		X	Communities and local authorities	• Progressively rehabilitate mining plateaus to allow for re-vegetation or preparation of the land for agriculture, depending on stakeholder expectations, to limit the pressure on the resource.	Surface of land rehabilitated during every year in operation	During operation	Construction Site Manager HSSEC Manager
	Inequality of access to land	In-migration Physical displacement and re-installation		X	Communities	• Develop a resettlement action plan (RAP) in line with GAC's commitments to Resettlement and livelihood restoration and IFC PS 5 and AfDB OS 2 in particular by: • compensating both holders of strong rights (rights of administration) and simple use rights • assisting in the selection of resettlement sites for the displaced populations that offer similar economic opportunities in terms of quantity and quality of available land; • assisting displaced people in securing land rights in their place of resettlement; and • supporting projects to develop income-generating activities for displaced persons, and particularly persons displaced for economic reasons.		During operation	HSSEC Manager
	Increase in inequalities of access to land resources	In-migration	X	X	Communities	• Support local authorities in the development of an Influx Management Plan as an overarching mitigation measures is expected to attenuate this impact, in particular by: • support local authorities in undertaking urban planning and development in larger centers to accommodate in-migrants, in complement with planning for Project employee housing and		During construction and operation	HSSEC Manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation measures	Monitoring Indicators	Timeline for implementation	Implementation Manager
						infrastructure; and • supporting development of village zoning plans for settlements at high risk from in-migration, to direct in-migrant related development to defined areas where impacts will be minimized and to encourage local people to remain in their villages.			
Agriculture and cattle herding									
	Fall in the bovine breeding practice	Physical footprint of the Project' infrastructures	X	X	Communities	• Develop a resettlement action plan (RAP) in line with GAC's commitments to Resettlement and livelihood restoration and IFC PS 5 and AfDB OS 2 in particular by developing individual and collective compensations for the displaced cattle herders (e.g. assistance in securing alternative pasture land and water sources, provisioning of technical training courses and support to animal health, etc.) and by securing the mining areas with mounds and fences in order to limit interactions of Project mobile equipment and vehicles with herds and ruminants. • Implement a Local Development Plan and development programs to further support cattle herding in the MA.	Number and type of training provided	During construction and operation	HSSEC Manager
	Fall in the bovine breeding practice	Physical footprint of the Project' infrastructures		X	Communities	• Ensure stakeholder engagement comprise information to the communities on the blasting works timings and carry out temporary evacuations if necessary. • Progressively rehabilitate mining plateaus to allow for re-vegetation for herding, depending on stakeholder expectations.		During operation	HSSEC Manager Construction Site Manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation measures	Monitoring Indicators	Timeline for implementation	Implementation Manager

	Fall in agricultural production	Physical footprint of the Project' infrastructures	X	X	Communities	• To develop a l resettlement action plan (RAP) in line with GAC's commitments to Resettlement and livelihood restoration and IFC PS 5 and AfDB OS 2 in particular by
						  • minimizing the encroachment on the lands with the greatest agricultural potential;
						  • compensating for the loss of agricultural la particularly by the replacement of this land with high farming potential development land when possible;
						  • compensating both holders of strong rights (rights of administration) and simple use rights;
						  • the development of agricultural development projects.
						• Manage the site with respect to best industry practice in particular the management of hazardous substances and spill risks and the impacts related to traffic and dust on site through the development and implementation of a Dust management plan, Traffic management plan and a Hazardous materials management and spill prevention & response plan.
								Prior and during construction
								
								During operation
									HSSEC Manager

	Fall in agricultural production	Physical footprint of the Project' infrastructures		X	Communities	• To progressively rehabilitate mining plateaus to allow for re-vegetation or preparation of the land for agriculture, depending on stakeholder expectations.		During operation	Construction Site Manager
	Increase in food insecurity	Physical footprint of the Project' infrastructures	X	X	Communities	• Develop a resettlement action plan (RAP) in line with GAC's commitments to Resettlement and livelihood restoration and IFC PS 5and AfDB OS 2 in particular by provisioning of financial		During construction and operation	HSSEC Manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation measures	Monitoring Indicators	Timeline for implementation	Implementation Manager
						compensation or compensation in kind throughout the transition period necessary for the displaced households to recover their agricultural production levels.			
	Increase in conflicts between farmers and cattle herders	Physical footprint of the Project' infrastructures	X	X	Communities	• Help villages in securing the crop-growing areas (installation of fencing). • Help affected farmers and herders in finding specific areas for growing crops and others for cattle herding (thus enabling a shared fertility management scheme to be proposed).		During construction and operation	
	Increase in the cost of farm labor	In-migration Project' attractiveness	X	X		• Ensure local preferential hiring is implemented in particular through the wide communication available jobs, required skills and hiring procedures in order to avoid that young people abandon their land in an unfruitful search for work. • Implement and fund development projects as part of the Local Development Plan in order to improve agricultural productivity) resulting in a reinforced attractiveness of agriculture compared to uncertain/temporary jobs at the mine.		During construction and operation	HR Director
Fishing and access conditions to natural resources									
	Deterioration of the access conditions to surface water	Physical footprint of the Project' infrastructures	X		Communities	• Finalize the plans of the process facility and other mining activities and infrastructure so as to minimize their impact on the surface water supply areas of the surrounding populations (buffer zones definition detailed in *section 18.5*). • Develop a resettlement action plan (RAP) in line with GAC's commitments to Resettlement and		During construction	Studies Manager HSSEC Manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation measures	Monitoring Indicators	Timeline for implementation	Implementation Manager
						livelihood restoration and IFC PS 5 and AfDB OS 2 which will result in the relocation of most users of the impacted water sources. • Build improved water bodies (human powered pumps) near affected housing in collaboration with the populations to implement appropriate solutions (type, location and number of structures, operating and maintenance conditions, etc.). • Limit as much as possible the sources of atmospheric pollution by developing a Dust management plan and Traffic management plan including measures to control dust emissions from traffic and earthmoving works (e.g. reduced speed limit, watering of site surfaces, etc.). • Manage hazardous materials and risks of spills by developing a Hazardous materials management and spill prevention & response plan in line with best industry practice. • Treat Project wastewater to limit the risk of untreated discharge into the natural environment.			
	Deterioration of the access conditions to surface water	Physical footprint of the Project' infrastructures		X	Communities	• Develop and implement a Local Development Plan in particular by improving access to water near affected housing areas through stakeholder engagement (population proposed solutions such as types of works, locations, operating and maintenance conditions, etc.).		During operation	HSSEC Manager
	Fall in economic opportunities and income related to consumption of	Physical footprint of the Project' infrastructures	X	X	Communities	• Minimize the Project's coverage area on the surface water used for fishing (buffer zones definition detailed in *section 18.5*). • Develop a resettlement action plan (RAP) in line with GAC's commitments to Resettlement and		During construction and operation	Studies Manager HSSEC Manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation measures	Monitoring Indicators	Timeline for implementation	Implementation Manager

	natural resources					livelihood restoration and IFC PS 5 and AfDB OS 2 which will result in the relocation and livelihood restoration of some users of the natural resources.
						• Develop a Local Development Plan, in particular through programs in support of :
						  • agricultural development;
						  • economic diversification and development of alternative income-generating activities
						• Support the creation of community forests (protected areas, managed collectively by the communities in order to protect the access to various resources).
						• Support at community level, the breeding of rodents (agoutis) and fishing farming projects in order to compensate for the reduction in game and fishing products			

	Increase in food insecurity	Fall in economic opportunities and income related to consumption of natural resources	X	X	Communities	• Implement programs in support of agricultural development (technical courses, provision of equipment and inputs, etc.). • Implement economic diversification projects and favor the development of alternative income-generating activities, particularly for women • Support community development initiatives such as favoring the breeding of rodents (agoutis) and the development of settlement-based fishing farming projects in order to compensate for the reduction in game and fishing products.	Number of agricultural development programs implemented	During construction and operation	HSSEC Manager
Local socio-economic context									
	Fall in income	Physical footprint of	X	X	Communities	• Develop a resettlement action plan (RAP) in line with GAC's commitments to Resettlement and	Number of settlements	Prior and during construction	HSSEC Manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation measures	Monitoring Indicators	Timeline for implementation	Implementation Manager
		the Project' infrastructures				livelihood restoration and IFC PS 5 and AfDB OS 2 in particular by: • developing economic restoration programs and projects promoting income generating activities • support the selection of displacement areas that offer similar economic opportunities; and • the provision of financial compensation or benefits in kind throughout the transition period necessary for the displaced households to resume their economic activities. • Develop a Local Development Plan in particular that promotes alternative income-generating activities (support to the transformation and selling of farm produce). • Build alternative tracks (and crossing points over watercourses) in order to avoid the isolation of settlements.	isolated	During operation	Construction Site Manager
	Fall in income	Physical footprint of the Project' infrastructures		X	Communities	• Build secure crossing points over the haul roads for the local populations.	Number of secure crossing points built	During operation	Construction Site Manager
	Inflation of commodity prices and the price of other local products	Physical footprint of the Project' infrastructures	X	X	Communities	• Develop a Local Development Plan, in particular by implementing projects in relation to the objectives of increase and herding productivity • Support at community level, activities such as the breeding of rodents (agoutis) and fishing farming projects in order to compensate for the reduction in game and fishing products on the market.	Commodity and local products prices Number of agricultural development programs	Prior and during construction During operations	HSSEC Manager
	Increase in economic	Employment	X	X		• Implement and fund development projects as part of the Local Development Plan with the objective		During construction and operation	HSSEC Manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation measures	Monitoring Indicators	Timeline for implementation	Implementation Manager
	inequalities between households					to enhance economic opportunities and living conditions in the MA, in particular by supporting the creation of income-generating activities, agriculture and herding and capacity building in alternative professions.			
	Increase in demand and in outlets for local produce, diversification of economic opportunities and reinforcement of local entrepreneurship	In-migration	X	X		• Ensure local preferential sourcing is implemented so as to benefit to local entrepreneurs and businesses at local, regional and national level, including through a capacity building program aiming at building local business competencies to meet the Project standards including quality, health and safety requirements.		During construction and operation	HR Director HSSEC Manager
	Capacity-building and professional expertise in a globalized context Improvement in the economic situation of recruited persons and of their households	Employment	X	X		• Ensure employees and subcontractors are continuously trained on a series of topic including: • trainings related to the delivery of the work specific to each workstation; • task-specific training for each new job assignment; • knowledge of risks associated with work and applicable health & safety procedures; • understanding of adequate procedures associated with the use and handling of hazardous materials; • awareness of employment conditions and personnel rights; • knowledge of, and training in, emergency procedures; and • knowledge on workers code of conduct.		During construction and operation	HSSEC Manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation measures	Monitoring Indicators	Timeline for implementation	Implementation Manager
						• Promote employment and training including through the replacement of expatriates with Guinean staff where practicable and the development of career advancement measures as foreseen by the Local Development Plan 'Employment and Training' investment category. • Include English language training for non-English-speaking staff making reference to the health and safety programs, trainings and procedures as foreseen in the Employment conditions and awareness management plan for the Project.			HR Director HSSEC Manager
	Increase in local development initiatives	Increase of local authorities public revenue	X	X	Local authorities and communities	• Ensure transparency on the contributions paid by the Project to the budget of the local, regional and national authorities. • Involve the communities and local authorities with the development and implementation of the Project's Local Development Plan so that it is tailored to the population needs. • Establish a framework of collaboration with regular meetings (sub-prefectural, communal and district authorities, GAC and representatives of the subcontracting companies) to discuss public development initiatives. • Participate in the meetings organized by the Prefecture Development Committee (PDC) on mining stakes.		During construction and operation	Governance and Compliance Manager Corporate Communications and Govt. Relations
Health and safety									
	General increase in safety risks and diseases	Project' activities	X	X	Communities and employees	• Evaluate the risks and the impacts on health and safety to which employees and affected communities are exposed and to take the		During construction and operation	HSSEC Manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation measures	Monitoring Indicators	Timeline for implementation	Implementation Manager
	transmission					appropriate prevention measures including by developing a Health, safety and security management plan and a Community health, safety and security plan. • Use appropriate working methods and techniques to protect the environment, the safety of workers and of the surrounding populations. • Design and construct the structural elements of the Project by taking account of the risks to which the workers and the affected communities are exposed. • Reduce the potential exposure of the community to hazardous materials and substances including by developing a Hazardous materials management and spill prevention & response plans. • Select Project security personnel to ensure they are not involved in past human rights abuses. • Train Project security staff and personnel on local cultural practices and expected behaviors when interacting with local communities. • Continue using existing Grievance Mechanism allowing the population to raise safety issues. • Inform the populations of the installation of the building sites and their duration so as to be able to report the risks associated with the activities of the Project. • Develop a Local Development Plan, in particular with regard to the objectives to improve access to and quality of health care infrastructure and services and raise local communities' awareness on hygiene, health and communicable diseases. • Support local authority in developing and			HR Director HSSEC Manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation measures	Monitoring Indicators	Timeline for implementation	Implementation Manager
						implementing an Influx management plan in particular by • supporting the local authorities in managing migration flows and the associated urban planning; and • supporting for upgrading health, education, water and sanitation facilities in settlements affected by in-migration.			
	Increase in safety risks	Project' operations		X	Communities	• Install a temporary buffer zone around the pits to avoid danger from projectiles where workers and population presence will not be allowed during blasting operations.		During operation	Operation Manager
	Diseases related to water and sanitation	Project' activities In-migration	X	X	Communities and employees	• Reduce the production of hazardous and non-hazardous waste and eliminate it appropriately (residue, waste and hazardous materials' management strategy). • Avoid or reduce and control the discharge of effluents in the environment (evaluate their production, transport, handling, stockpile and use). • Adopt dust management measures (truck traffic, scouring of land, sweeping and backfilling operations). • Construct improved water bodies in order to propose alternative solutions to the surface water supply of surrounding populations.		During construction and operation	HSSEC Manager
	Diseases related to the displacement of populations	Displacement of populations	X	X	Communities	• Develop a resettlement action plan (RAP) in line with GAC's commitments to Resettlement and livelihood restoration and IFC PS 5 and AfDB OS 2 which will result in the livelihood restoration of displaced households while taking into account	Number of compensation programs developed	Prior and during construction During operation	HSSEC Manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation measures	Monitoring Indicators	Timeline for implementation	Implementation Manager
						family ties and communities lineage in the resettlement process.			

	Appearance of new diseases related to population movements and migration	In-migration	X	X	Communities	• Support local authority in developing and implementing an Influx management plan in particular by:
						  • supporting regional development planning that encourages distribution of opportunities across a wider area to avoid concentration of population around key Project locations;
						  • support local authorities in undertaking urban planning and development in larger centers to accommodate in-migrants, in complement with planning for Project employee housing and infrastructure;
						  • supporting development of village zoning plans for settlements at high risk from in-migration, to direct in-migrant related development to defined areas where impacts will be minimized; and
						  • supporting for upgrading health, education, water and sanitation facilities in settlements affected by in-migration.
						• Develop a Local Development Plan in particular with regard to the objective to improve local communities' awareness on hygiene, health and communicable diseases.
						• Communicate and enforce the Code of business conduct in particular provisions related to drug and alcohol consumption and interactions with local communities and the prohibition of illegal activities.
								During construction and operation	HSSEC Manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation measures	Monitoring Indicators	Timeline for implementation	Implementation Manager
						• Train employees at their induction and continuously during the Project lifetime on health and safety risks from transmittable diseases and procedures applicable to Project employees. • Establish a systematic medical inspection and a screening of workers at least once a year and to develop a healthcare adjustment plan (Article 143 of the Mining Code).			
	Lack of road safety	Increased traffic	X	X	Communities and employees	• Develop a Traffic and transportation management plan including specific measures to increase safety for the local population (e.g. avoidance or residential areas, reduced speed near populated areas, etc.). • Adopt and install a road traffic code for the entire mine area (speed limits, sign boards, control barriers at the entrance of the settlements, etc.). • Put a campaign in place to raise the awareness of the project affected populations on road safety issues. • Avoid the movement of the populations on the tracks used by construction vehicles by developing alternative, safe paths. • Prohibit the access of non-authorized persons to the building sites. • Pay for the costs from road traffic accidents for which the Project's vehicles are proven responsible.	Number of incidents reported Number of people that have participated to awareness training	During construction and operation	HSSEC Manager
	Lack of road safety	Increased traffic		X		• Avoid the movement of the populations on the tracks used by the mining trucks by developing alternative, safe paths. • Secure the crossing points between haul roads and		During operation	HSSEC Manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation measures	Monitoring Indicators	Timeline for implementation	Implementation Manager
						roads and the settlement tracks. • Prohibit the access of non-authorized persons to the building mining sites. • Fence-off the railway track and the mining sites if possible near to inhabited areas. • Put a bus service in place for the workers to lessen vehicle numbers on the roads.			
	Employee safety	Construction and operation activities	X	X	Employees	• Establish an operational health and safety management system to prevent occupational health and safety risks to workers. • Identify the potential dangers for the workers, particularly likely to constitute a threat for their lives. • Initiate measures designed to prevent accidents, injuries and diseases resulting from the work by minimizing, as much as possible, the cause of such dangers. • Safeguard the safety of the machines and equipment. • Ensure the ability to work of the workers (physical conditions). • Develop a training program for the Project's workers (direct and indirect jobs) in order to ensure that these employees have the skills, information and capacities required to manage the risks associated with the job to which they are assigned. • Provide the workers with all the protection equipment necessary to minimize the risks associated with the tasks carried out as part of the job.	Number and type of training provided	During construction and operation	HSSEC Manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation measures	Monitoring Indicators	Timeline for implementation	Implementation Manager
						• Check compliance with the application of the aforementioned standards by the subcontractors of the Project, particularly by conducting regular audits and taking corrective measures if need be.			

	Decrease of budget allocated to healthcare	Loss of income of certain households at the start of mining construction and operation works	X	X	Communities	• Implement a RAP in accordance with the principles of a LRRF in particular by:
						  • restoring displaced people livelihoods and source of incomes;
						  • support the selection of resettlement sites that offer similar or better access to healthcare services;
						  • developing collective compensations which will benefit to host and displaced households;
						  • providing for financial compensation or compensation in kind for the displaced households through the transition period.
						• Develop and implement a Local Development Plan with the objective to improve access and quality of health services and infrastructures, including by:
						  • participating, in collaboration with the local administrative authorities, in the construction of new healthcare infrastructures and in the renovation of old ones depending on the needs;
						  • providing existing public healthcare services with equipment. .
							Number of healthcare infrastructures access created
							
							Waiting time and prices for healthcare infrastructure access
							
							Number of isolated settlements
								During construction and operation	HSSEC Manager

	Decrease of budget allocated to healthcare	Loss of income of certain households at the start of mining		X	Communities	• To build alternative tracks and crossing points over watercourses and haul roads in order to avoid the isolation of settlements build alternative tracks (and crossing points over watercourses) in order to avoid the isolation of settlements.	Number of isolated settlements	During operation	Studies Manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation measures	Monitoring Indicators	Timeline for implementation	Implementation Manager
		construction and operation works							
Education									
	Decrease of budget allocated to education Limited access to education	Loss of income of certain households at the start of mining construction works	X	X	Communities	• Participate, in collaboration with the local administrative authorities, in the construction of new schools and in the renovation of old ones depending on the new requirements (concerted approach within the framework of a Local Development Plan). • Support selection of resettlement sites for the displaced populations that offer similar or better economic opportunities in terms of access to education infrastructures. • As part of the RAP, provide for financial compensation for the displaced households through the transition period to enable them to maintain the same financial capacity of access to education. • Build alternative tracks (and crossing points of watercourses) in order to avoid the isolation of settlements and propose safe paths so that children can attend school. • Put in place in collaboration with concerned families a study bursary system for the pupils and students of the poorest households and for those living in particularly isolated areas.	Number of isolated settlements	During construction and operation	HSSEC Manager
	Improvement of access to education	Increase in national and local budget	X	X	Communities Local authorities	• Develop and implement a Local Development Plan which one of the objective is to improve access and quality of education, including by: • participating, in collaboration with the local		During construction and operation	HSSEC Manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation measures	Monitoring Indicators	Timeline for implementation	Implementation Manager
						administrative authorities, in the construction of new primary and secondary schools and in the renovation of old ones depending on the needs; • developing a study bursary system for the pupils and students of the poorest households, for those living in particularly isolated areas and to encourage the education of girls. • Collaborate with local authorities towards their use of the LDF in support of the development of public education infrastructures and services in the region.			
Mobility, flows and transport									
	Isolation of settlements	Construction and operation works	X	X	Communities	• Build alternative tracks (and crossing points over watercourses) in order to avoid the isolation of settlements in collaboration with the populations concerned and the local administrative authorities (within the framework of the LDP in particular).	Number of isolated settlements	Prior and during construction During operation	Studies Manager
	Isolation of settlements	Operation works		X	Communities	• Request from ANAIM/CBG the development of crossing points for pedestrians and vehicles (ground crossings) over the railway tracks in the villages of Diarabaka, Tantouloumane and even Filow bowal. • Secure crossing points between haul roads and roads and the settlement tracks. • Clarify the status of the haul roads and other structures (bridges) as regards a possible use by villagers.	Number of isolated settlements	During operation	Studies Manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation measures	Monitoring Indicators	Timeline for implementation	Implementation Manager
	Movement difficulties	Construction works	X		Communities	• Provide an alternative path in order to allow the population to continue to travel throughout the construction phase.		Prior and during construction	Studies Manager
	Improvement of infrastructures related to the displacements	Project's contributions to the local development budgets and investments	X	X		• Support the local authorities in the management of a public transport system and the improvement of the private transport system and the related infrastructure (bus shelters, train station, etc.).		During construction and operation	HSSEC Manager
Landscape and living conditions									
	Disturbance	Noise and vibrations	X		Communities	• Respect guidelines to ensure quiet times during the building sites, at night in particular. • Implement displacements and resettlements of the affected populations in case the inhabited areas are too near to the Project construction activities. • Consider all technical measures designed to reduce the levels of noise and vibration (plantations, anti-noise walls, etc.). • Put in place a transparent and effective grievance mechanism that will be able to resolve situations on a case-by-case basis. • as part of the Local Development Plan support the competent authorities in improving the public and private transport services.	Number and resolution rates of grievances	During construction	HSSEC Manager
	Disturbance	Noise and vibrations	X		Communities	• Respect guidelines to ensure quiet times during the building sites, at night in particular. • Implement displacements and resettlements of the affected populations in case the inhabited areas are too near to the Project construction activities. • Consider all technical measures designed to reduce	Number and resolution rates of grievances	During construction	HSSEC Manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation measures	Monitoring Indicators	Timeline for implementation	Implementation Manager
						the levels of noise and vibration (plantations, anti-noise walls, etc.). • Put in place a transparent and effective grievance mechanism that will be able to resolve situations on a case-by-case basis. • As part of the Local Development Plan support the competent authorities in improving the public and private transport services.			
	Disturbance	Noise and vibrations		X	Communities	• Adopt a traffic management plan that avoids displacements near residential areas. • Provide the populations with information on the blasting works and carry out temporary evacuations if necessary. • Consider all technical measures designed to reduce the levels of noise and vibration (plantations, anti-noise walls, etc.). • Implement displacements and resettlements of the affected populations in case the inhabited areas are too near to the operating areas. • Revegetate (knolls) the surrounding areas of the quarries (and of all work sites) located on the edge of settlements. • Put in place a control of the impacts on the village infrastructures with appropriate compensation measures in case of deteriorations observed following the blasting works. • Adapt the working hours in order to guarantee quiet periods, particularly at night (train traffic). • Aim at the compliance of the noise and vibration levels with the EHS Guidelines (IFC 2007) and adopt appropriate measures to limit them.	Number and resolution rates of grievances	During operation	HSSEC Manager Construction Site Manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation measures	Monitoring Indicators	Timeline for implementation	Implementation Manager
						• Continue use of transparent and effective grievance mechanism that will be able to resolve situations on a case-by-case basis. • as part of the Local Development Plan support the competent authorities in improving the public and private transport services.			
	Degradation of air quality	Dust emission	X	X	Communities	• Traffic, vehicle movement and transportation management plan. • Implement displacements and resettlements of the affected populations in case the inhabited areas are significantly impacted by the Project's activities. • Consider all the technical measures designed to reduce the dust emission levels (sprinkling of the tracks, tarring of the roads, etc.). • Put in place a transparent and effective grievance mechanism that will be able to resolve situations on a case-by-case basis.	Number and resolution rates of grievances	Prior and during construction During operation	HSSEC Manager
	Changes to the landscape	Visual effects	X		Communities	• Plan the rapid decommissioning of the temporary infrastructures required for the construction of the permanent infrastructures (cranes, etc.). • Provide for external night-time discreet lighting, pointing at the process facility and other mining infrastructure and the works areas (light beams aimed below and not at the residential areas).		Prior and during construction	Construction Site Manager
				X		• Revegetate the surrounding areas of the quarries (and of all work sites) located on the edge of settlements. • Provide for reforestation directly near to the quarries during the operational phase in order to		During operation	Construction Site Manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation measures	Monitoring Indicators	Timeline for implementation	Implementation Manager
						limit the impact on the landscape. • Implement progressive rehabilitation and vegetation of the mine pits and waste emplacements as they are developed.			
Cultural heritage									
	Direct Impact to Cemeteries	Ground Disturbing Activities	X	X	Communities	• Update as needed the existing Stakeholder Engagement Plan • Cemetery Relocation in coordination with local population in particular with regard to their preference regarding relocation practices and location • Cultural Heritage Training of Workers	Number and type of training provided Number of cemeteries relocated Number of Djinn location relocated	Prior and during construction During operation	HSSEC Manager
	Direct Impact to Djinn Locations from	Ground Disturbing Activities	X	X		• Regularly update the Stakeholder Engagement Plan • Djinn Relocation in particular with regard to their preference regarding relocation practices and location • Cultural Heritage Training of Workers			HSSEC Manager
	Direct Impact to Archaeological Anomalies that are found not to be archaeological sites, or to be replicable archaeological	Ground Disturbing Activities	X	X		• Field Investigation of Archaeological Anomalies • Development and Implementation of a Chance Finds Procedure • Cultural Heritage Training of Workers			HSSEC Manager

Reference	Potential impact	Activity/ Source	Construction	Operation	Impact receptors	Mitigation measures	Monitoring Indicators	Timeline for implementation	Implementation Manager
	sites								
	Direct Impact to Archaeological Anomalies found to be archaeological sites that are critical or non-replicable	Ground Disturbing Activities	X	X		• Field Investigation of Archaeological Anomalies • Avoidance of critical (high sensitivity) cultural heritage sites • Avoidance or Archaeological Rescue Excavation of non-replicable (medium sensitivity) cultural heritage sites • Development and Implementation of a Chance Finds Procedure • Cultural Heritage Training of Workers			HSSEC Manager
	Indirect Impact to the Cultural Setting of Cemeteries	Ground Disturbing Activities	X	X	Communities	• Develop and implement a Specific Stakeholder Engagement • Cultural Heritage Training of Workers •			HSSEC Manager
	Indirect Impact to the Cultural Setting of Djinn Locations	Ground Disturbing Activities	X	X		• Develop and implement a Specific Stakeholder Engagement • Possible Djinn Relocation • Cultural Heritage Training of Workers •			HSSEC Manager
	Impact to all categories of cultural resources through the increase of non-local workers	Ground Disturbing Activities	X	X		• Develop and implement a Specific Stakeholder Engagement • Cultural Heritage Training of Workers			HSSEC Manager

18.5 BUFFER AREAS

In the mitigation and enhancement measures described in the above tables of the SEMP both for environmental and social aspects, different buffer areas are defined where no operations will be conducted. Extent of these areas depends on the receptors sensitivity to the anticipated potential impact. For example, it is recommended to limit the impact on biodiversity to keep a minimum buffer zone of 20 m at both sides of small rivers to allow access to the river to mammals. It is also recommended to protect water resource for communities to have a buffer zone of 50 m from any water body to limit the potential risk of a surface water contamination by the Project operation.

The size of the buffer zones that will be taken into account by the Project both at design and operational phases as mitigation measures will be the highest size described in the mitigation and enhancement tables.

The sizes of the buffer zones that will be taken into account by the Project are summarized below:

- 50 m from any water body;
- 300 m along headwaters feeding forest galleries ;
- 100 m from Tinguilinta river;
- 250 m from water abstraction/wells
- 100 m from any sensitive ecological site;
- 500 m from the periphery of the plateaus;
- 50 m from mangrove;
- temporary buffer zone of up to 800 m from blasted areas during blasting operations (depending on specific blasting parameters).

18.6 ENVIRONMENTAL SPECIFIC MANAGEMENT PLANS

In addition to the mitigation plan presented above, several specific themed environmental management procedures are to be developed. The essential principles and procedures of these Discipline-Specific Management Plans (DSMP) are defined in the following sections. Environmental specific management plans are:

- air quality and greenhouse gas management plan;
- dust management plan;
- noise and vibration management plan;
- integrated water management plan;
- mine water management plan;
- terrestrial biodiversity management plan;
- marine biodiversity management plan;
- waste management plan;
- hazardous materials management plan;
- overburden management plan;
- risk management plan;

- health, safety and security management plan;
- emergency prevention, preparedness and response plan; and
- traffic, vehicle movement and transportation management plan.

Social specific management plans are covered in *Section 18.7*

These procedures will be integrated by GAC and its contractors into their social and environmental management system. They will be designed to be adaptable to the various Project phases, in order to remain relevant to the specific issues arising in each phase. Eventually GAC and its contractors will have the responsibility to develop and implement operational procedures for their own installations and areas of operation and in line with the previously developed DSMP.

Where appropriate, some existing GAC policies and requirements may as well be presented below as they define the benchmarks and requirements to the Project environmental performances.

18.6.1 Air quality and greenhouse gas management plan

The Air quality and greenhouse gas management plan aims to integrate into the SEMP the management of air-quality that is part of the Guinean regulation, IFC performance standards and AfDB integrated safeguards system; it concerns energy and refrigerant consumption.

The Plan will include the following elements, in particular:

- an inventory of Project's activities and locations where impacts on air quality are foreseen;
- location of sensitive receptors and areas where air quality must be particularly monitored and controlled;
- definition of targets and air-quality objectives depending on Project activities, location and type of air emissions;
- general principles and procedures for reducing particulate matter emissions;
- definition of actions to mitigate, prevent, or avoid to the extent practical nuisances to site personnel and nearby populations; and
- procedures to monitor air-quality and update mitigation measures as necessary; and
- resources and responsibilities to implement these procedures and implement necessary changes based on monitoring results.

The Plan will also address greenhouse gas (GHG) emissions throughout the whole Project life by promoting energy efficiency and by taking proactive actions within its own business and work with governments, industry and other stakeholders to address the global challenge of limiting GHG emissions to the maximum practical extend. It will seek to improve the management of energy and GHG emissions by designing the Project to be among the more fuel-efficient producers relative to the global bauxite mining industries.

Among others, the Plan will include:

- an assessment of the emissions from the full life cycle of the product including public reporting and implementing effective emission mitigation programs, and
- considerations of energy saving into the business decision-making processes.

Site-specific GHG and energy management plan (operational procedure level) will be developed including:

- actions for reducing energy consumption and greenhouse gas emissions on sites and at operations; and
- initiatives to seek GHG emissions abatement where possible.

The Air-quality and greenhouse gas management plan will be developed according to the principles given in *Table 18.5.*

Table 18.5 Principles applicable to the air-quality management plan

Aspect	Management principle
Reduction of GHG emissions	• Systematically implement a substitution principle: use or replace where practicable fuels and refrigerants with a lower global warming potential (GWP). • Enhance energy efficiency by using state of the art technology appropriate for the local conditions for engines, vehicles, pipes exhaust filtration systems, etc. • Abate GHG emissions from building by installing sun protection installations (artificial or natural) and/or by opting for effective insulation. • Manage waste appropriately and avoid incineration when practicable. • Avoid unnecessary transport and use low carbon intensive transportation, develop a travel and transport policy with the objective to reduce GHG emissions. • Provide awareness training and define good practices to limit energy consumptions and building cooling by Project employees at all activities levels (driving behaviors, cooling needs in personal habitations and common living spaces, etc.).
Monitor and manage emissions	• Perform air quality monitoring at emission points and receptors areas. • Adapt and/or update procedures, as necessary. • Define resources and responsibilities to implement these procedures and implement necessary changes based on monitoring results. • Implement a Grievance Mechanism allowing for stakeholders to file air quality related grievances and enabling the Project to identify problematic areas and seek resolution.

18.6.2 Dust management plan

The dust management plan aims to integrate into the SEMP the management of dust that is part of the Guinean regulation, IFC performance standards and AfDB integrated safeguard system. It concerns the release of dust by the Project activities.

The Plan will include the following elements, in particular:

- an inventory of Project's activities and locations where impacts of dust emissions are foreseen;
- location of sensitive receptors and areas where dust emissions must be particularly monitored and controlled;
- definition of targets and dust emissions objectives depending on Project activities and location;
- general principles and procedures for reducing particulate matter emissions;
- definition of actions to mitigate, prevent, or avoid to the extent practical nuisances to site personnel and nearby populations; and
- procedures to monitor dust emissions and update mitigation measures as necessary; and
- resources and responsibilities to implement these procedures and implement necessary changes based on monitoring results.

Specific fugitive emissions suppression programs (operational procedure level) will be developed to limit dust emissions from Project activities such as earth movement during construction, mining and blasting, minerals processing, transport and loading and traffic in general.

The dust management plan will be developed according to the principles given in *Table 18.6*

Table 18.6 Principles applicable to the dust management plan

Aspect	Management principle
Reduction of dust emissions	• Reduce dust from blasting and mining activities including by restricting blasting at specific hours and during particular meteorological conditions (e.g. strong winds heading towards nearest communities). • Utilize efficient equipment management practices to limit the number of trips required. • Limit dust emissions by using appropriate equipment where necessary • Controlling dust at conveyor transfer points, stockpiles and ship loading areas. • Apply gravel, water, or stabilizing agents as appropriate. • Limit traffic speed on un-paved roads, haul roads and restrict off-road travel and define Project routes and transport procedures to avoid dust emissions in sensitive areas.

18.6.3 Noise and vibration management plan

The noise and vibration management plan aims to integrate into the SEMP the management of noise and vibration that is part of the Guinean regulation and IFC EHS Guidelines. It concerns:

- the noise generated by all Project activities in particular construction and mining operation, minerals processing and transport; and
- the vibrations generated by the blasting in particular and to a minor extend the transport by heavy trucks.

People who live in close proximity to the Project, especially those residing near the mine and access roads areas and along the rail siding and loop at the mine and port area respectively are predicted to experience an increase in noise levels which will need to be managed.

The noise and vibration management plan will be developed based on SEIA Addendum results and include the following elements, in particular:

- an inventory of Project's activities and locations where significant noise and vibrations impacts are foreseen;
- location of sensitive receptors and areas where noise and vibration must be particularly monitored or controlled;
- general principles and procedures for reducing noise and vibrations;
- definition of actions to mitigate, prevent, or avoid to the extent practical nuisances to site personnel and nearby populations;
- procedures to monitor noise and vibration and update mitigation measures as necessary; and
- resources and responsibilities to implement these procedures and implement necessary changes based on monitoring results.

Additional specific noise mitigation actions will be defined in operational procedures by GAC or its contractors covering their respective areas of operation and as necessary based on SEIA Addendum and Noise and vibration management plan details. The Noise and vibration management plan will be developed according to the principles given in *Table 18.7*.

Table 18.7 Principles applicable to the noise and vibration monitoring plan

Aspect	Management principle
Reduction of noise	• Maintain equipment in good repair. • Limit traffic speed on all roads and define Project routes and transport procedures to avoid excessive noise in sensitive areas. • Schedule transport activities that involve increased noise levels with due consideration for local community quiet times. • Limit activities in close proximity to residences that involve extraordinary noise during night and quiet times such as blasting, road maintenance works, unloading of equipment, etc.). • Install additional noise attenuation devises and barriers where noise levels are exceeding limits. • Provide training to Project employees on noise and vibration reduction procedures.
Reduction of vibration	• Reduce vibration from blasting and mining activities including by opting for particular blasting techniques (e.g. multiple-row blasting with short-delay ignition) and restricting blasting during quiet and night time. • Limit traffic speed and loaded vehicle weights on all roads and define Project routes and transport procedures to avoid excessive vibration in sensitive areas.

Aspect	Management principle
Monitor and manage impacts	• Perform noise and vibration monitoring at emission points and receptors areas. • Adapt and/or update procedures, as necessary. • Define resources and responsibilities to implement these procedures and implement necessary changes based on monitoring results. • Identify and follow up noise and vibration grievances filed through the Project Grievance Mechanism, monitor levels were necessary and seek resolution.

18.6.4 Integrated water management plan

The aim of this management plan is to integrate into the SEMP the preservation of soils and water resources that are part of Guinean regulation and inherent to development of the Project.

The Plan will cover:

- the water consumption by the Project; and
- the protection of soils, surface water, groundwater and seawater.

The Plan will be developed into a Surface and groundwater management plan and into a Seawater dredging and disposal management plan.

The *Surface and groundwater management plan* will be developed to document the quality and quantity of surface water and groundwater systems proximate to the specific Project components over the life of the Project and will include:

- an inventory of water consumption stations planned for each phase in the Project;
- procedures in terms of method of supply of potable water, potable water testing and analysis, and measures in case of water contamination as prescribed into the existing Supply and Testing of Potable Water procedure;
- a description of water consumption monitoring and reduction measures to be implemented for each phase in the Project;
- details mechanisms and procedures to manage storm water flows, limit erosion and quality impacts to surface waters and downstream water supplies;
- details of liquid effluent treatment and discharge mechanisms, for effluent from each phase in the Project (notably: origin, design of networks and collection ditches, design and performance of treatment units and surveillance of the quality of treated water prior to discharge);
- reference to the spill and emergency prevention plan and foreseen procedures to limit potential soil and downstream water impacts;
- a surface and groundwater quality and quantity monitoring plan including location-specific plans in both the mining and port area; and
- an update based on the results of GAC's ongoing hydrological investigations of the groundwater regime for water quality, supply, and monitoring purposes in the mining and port area, as necessary.

Operational procedures will be developed to define exact methods for the operation and cleanout of the sediment control structures. Such operational procedures may address the following:

- the design and maintenance of site drainage structures (e.g. culverts, ditches, bridges);
- the functionality of the inlet and discharge structures;
- cleanout procedures and appropriate sediment disposal locations, schedule; and
- the use of temporary sediment controls measures as needed.

The *Sea water, dredging and disposal management plan* will be specific to the marine loading structure and dredging works with the aim to limit concentrations of suspended particles associated with the construction and dredging activities. The Plan may include but will not be limited to the following elements:

- define construction and dredging practices and procedures;
- define placement procedures for dredged materials and disposal areas;
- define the process for maintenance dredging, including the frequency and timing of dredging events relative to its potential to affect marine flora and fauna;
- develop controls for limiting additional suspended solids in the river to the extent practical;
- develop a detailed water quality and habitat preservation monitoring plan;
- define a management of change procedure in case of excessive impacts to water quality and estuary biota and habitats; and
- make reference to the Emergency, prevention, preparedness and response plan and water safety protocols.

The environmental manager will ensure that water resource management reports are drawn up regularly, including results from the periodic monitoring of resource quality and availability, the results of environmental audits concerned with water resource management and the corrective measures implemented where necessary.

Table 18.8 Principles applicable to the integrated water management plan

Aspect	Management principle
Reduction of water consumption	• Collection and recycling of rain water and non-contaminated water used to wash equipment and surfaces, in order to use it for dust abatement purpose. • Monitoring of water consumption and identification of abnormally high consumption episodes, to detect any possible leakages and define corrective action.
Storm water management	• Collection and recycling of rain water that falls on non-contaminated areas (such as roofs and undeveloped surfaces within the mine infrastructure area). • Design water runoff management systems to limit erosion, storm water flows and discharge and enable abatement of suspended solid, separation of oil and water treatment systems (e.g. vegetative filters and non-vegetative covers including mulches and stone aggregates, limit slopes, runoff control structures, first flush settling ponds, oil/water separator, mine sewage treatment system, etc.)
Sewerage system	• Develop a sewerage system collecting grey & black water from building and water/oil separator connected to a water treatment unit. • Monitoring of water quality discharge. • Implement good sludge treatment practices in order to limit environmental impacts and favor valorization for agricultural production or mine rehabilitation use.
Implementation of management measures for hazardous products, effluent and waste products in order to prevent any infiltration of pollutants into groundwater / the coast	• Systematically implement a substitution principle: replace any hazardous products with a less hazardous equivalent wherever possible. • Storage and handling of products: use of retentions with recuperation of drips and spillages for the storage and unloading of hazardous products as well as for washing and maintenance activities. • No buried tank will be installed for the storage of hydrocarbons or other hazardous products. • Storages of hazardous products will be designed and built so as to allow adequate confinement and protection with regard to any leakages, in order to prevent any impact on the environment. Each tank will be located on retention with appropriate methods for leak detection. • Storages and networks of hazardous products, i.e. tanks, pipelines and connecting pipes will be regularly inspected by qualified staff and an inspection report will be drawn up. • Staff will be trained in good practices in terms of the storage and handling of products and in maintenance, to prevent any risks linked to hazardous products.

18.6.5 Terrestrial biodiversity management plan

The terrestrial biodiversity management plan (TBMP) will seek to limit adverse impacts to flora and fauna species to the extent practical, and to avoid adverse impacts to populations of any species listed as critically endangered or endangered by the IUCN Red List.

The TBMP aims at:

- protecting the terrestrial and freshwater flora and fauna;

- limiting disturbances to the natural habitat resulting from Project activities;
- addressing the protection of endangered, sensitive and protected species (species of concern) by implementing specific management plans for the protection of biodiversity, critical habitat, and habitats hosting certain species of nationally and internationally critically endangered or endangered IUCN red list plants; and
- developing sustainable management practices for habitat enhancement.

During the initial construction phase of the Project, it will be important to address and incorporate biodiversity and critical habitat issues into the TBMP. Promoting biodiversity conservation at the port and the mine area and critical habitat conservation at the mine area will take place throughout all Project phases.

The terrestrial biodiversity management plan will include among others:
- a description of the, natural habitats, species of conservation interest and critical habitats (CH);
- an analysis of the potential Project impacts using the results of the SEIA and additional relevant biodiversity studies;
- a plan with proposed mitigations to limit degradation of natural habitats and impacts on species of conservation concern following the mitigation measures hierarchy;
- an outline of the procedures for implementing and managing the mitigation measures;
- a description of the methods of assessment of the effectiveness of mitigation measures;
- monitoring and evaluation procedures; and
- budget and timing for implementation.

This plan will include a stakeholder and consultation program in order to achieve a transparent dialogue and ensure comments and suggestions from stakeholders with an interest in conservation are incorporated into the plan and the design of the mitigation measures.

The development of stand-alone plans may be necessary to adequately address specific issues. A separate and more in depth plan will be developed for each critical habitat with the aim to achieve net gain to those habitats and species that are considered critical. When possible, avoidance of CH areas by the Project will be required.

A separate Chimpanzee Management Plan (CMP) will be developed with the aim to:
- determine the Biodiversity value and Critical Habitat within the GAC concession;
- establish a precise and reliable Monitoring and Evaluation plan to measure GAC's operation impacts;
- recommend a biodiversity management plan that will include a mitigation hierarchy of the mining activities within the GAC concession; and

- establish an offset strategy to compensate for the residual negative impacts after implementation of the mitigation hierarchy.

18.6.6 Marine biodiversity management plan

The marine biodiversity management plan (MBMP) will seek to limit adverse impacts to marine flora and fauna species to the extent practical, and to avoid adverse impacts to populations of any species listed as critically endangered or endangered by the IUCN Red List.

The MBMP aims at:

- protecting the marine flora and fauna;
- limiting disturbances to the marine natural habitat resulting from Project activities;
- addressing the protection of endangered, sensitive and protected species (species of concern) by implementing specific management plans for the protection of biodiversity and habitats hosting certain species of nationally and internationally listed plants; and
- developing sustainable management practices for habitat enhancement.

During the initial construction phase of the Project, it will be important to address and incorporate biodiversity issues into the MBMP. Promoting biodiversity conservation at the port area a will take place throughout all Project phases.

The marine biodiversity management plan will include among others:

- a description of the, natural habitats and species of conservation interest;
- an analysis of the potential Project impacts using the results of the SEIA and additional relevant biodiversity studies;
- a plan with proposed mitigations to limit degradation of natural habitats and impacts on species of conservation concern following the mitigation measures hierarchy;
- an outline of the procedures for implementing and managing the mitigation measures;
- a description of the methods of assessment of the effectiveness of mitigation measures;
- monitoring and evaluation procedures; and
- budget and timing for implementation.

This plan will include a stakeholder and consultation program in order to achieve a transparent dialogue and ensure comments and suggestions from stakeholders with an interest in conservation are incorporated into the plan and the design of the mitigation measures.

18.6.7 Waste management plan

GAC's existing Waste Management Plan contains an inventory of wastes generated by the Project activities and defines general requirements, mitigation a monitoring controls for managing them. Wastes considered by

the Plan are all solid, liquid and hazardous wastes generated by the Project, as well as wastewater discharges from the sewage treatment system, storm water collection ponds, and other miscellaneous site discharges. The Plan also addresses wastes generated by the workers housing facilities and the overburden of material from above the grade that will be mined. Geochemical characteristics of exposed rock surfaces will be included in the Plan. In addition the Plan sets waste management objectives and targets and defines the roles and responsibilities for its correct implementation. Monitoring requirements are also included in the Plan.

This Plan is supported by a Waste Management Procedure which describes procedures for handling, storage and treatment of non-hazardous waste and requirements for monitoring. It is applicable to the early works phase of the Project. Hazardous waste management is described in the Hazardous Waste Management and Spill Prevention Plan in *Section 18.6.10*.

This sub-section describes the principles applicable to the development of an encompassing Waste Management Procedure for the Project including all Project phases, components and waste streams. The Procedure should include specific operational procedure for each Project area. It will be developed in accordance with existing requirements and commitments from the existing Waste Management Plan. These principles are defined on the basis of the requirements of Guinean regulations applicable to waste and current good practice relating to waste management.

The optimization of waste management is a continuous process and GAC will periodically review this procedure with a view to continual improvement. This revision should not be restricted to the evaluation of waste treatment and disposal facilities, but should also focus on the use of technical solutions with a view to follow GAC's existing waste management hierarchy of prevention, minimization, reuse, recycling, energy recovery, treatment and disposal.

Table 18.9 Principles applicable to the waste management procedure

Aspect	Management principle
Purchasing department – selection of materials and products that generate the least possible waste	• In its supplies policy, GAC will take waste generation potential into account in order to select options that generate the least waste, wherever possible.
Inventory management	• Inventory management system will be kept up to date with a view to identifying product consumption, ensuring the traceability of waste and identifying any wastage and over-consumption. • An inventory will be kept of all waste generated and eliminated (type and volumes). • GAC will develop objectives for reductions in the amounts of waste generated, year on year, based on a periodic review of inventories.

Aspect	Management principle
Staff training	• Waste will be handled and stored according to its type and risk classification, in compliance with health and safety rules and Hazardous materials management and spill prevention plan. • For each Project component an area for central accumulation of waste (ACAW) will be used to store waste. Compatible waste materials will be stored together. • Areas of the ACAW used to store hazardous waste will be covered and the ground will be waterproofed. Liquid and hazardous waste storage units will be fitted with retention systems. • The ACAW will be fenced and only authorized staff will be allowed access to the site. • The ACAW will be maintained in good order, clean and with waste products separated by type and risk classification, in order to minimize risks of pollution, fire and explosion, and the proliferation of vermin.
Final disposal of waste	• Recyclable waste will be regularly collected for recycling by recycling companies when available. Contracts for the collection of waste by these companies will be confirmed after verification of acceptability of their practices from an environmental, health and safety management point of view. • If no recycling companies exist at local or regional level, the Project will seek for national or international companies or develop the necessary waste recycling, valorization, treatment or dumping facilities in accordance with industry best practice. • All hazardous and non-combustible waste will be processed appropriately in the country or exported abroad for processing and final discharge. Any export of waste for elimination outside the borders of Guinea will meet the demands of the Basel Convention on the control of transborder movements of waste and other hazardous materials. • Potentially infectious waste will be place in dedicated, labeled recipients, for evacuation to a specialized center for incineration in a dedicated incinerator. • No waste will be burned in the open air.
Transport of waste off site	• When waste materials are sent off site, suitable transport vehicles will be used (if needed by means of use of a service provider) in order to comply with the rules on ensuring that loads are safe, properly labeled and traceable. • The transport vehicles used will be fitted with means with which to take action in case of any accidental spillage.
Cumulative impact	• Monitoring of what happens to waste in order to anticipate any saturation of the facility. • The waste management plan will describe possible alternatives to the local facility, in anticipation of any saturation.

18.6.8 Risk management plan

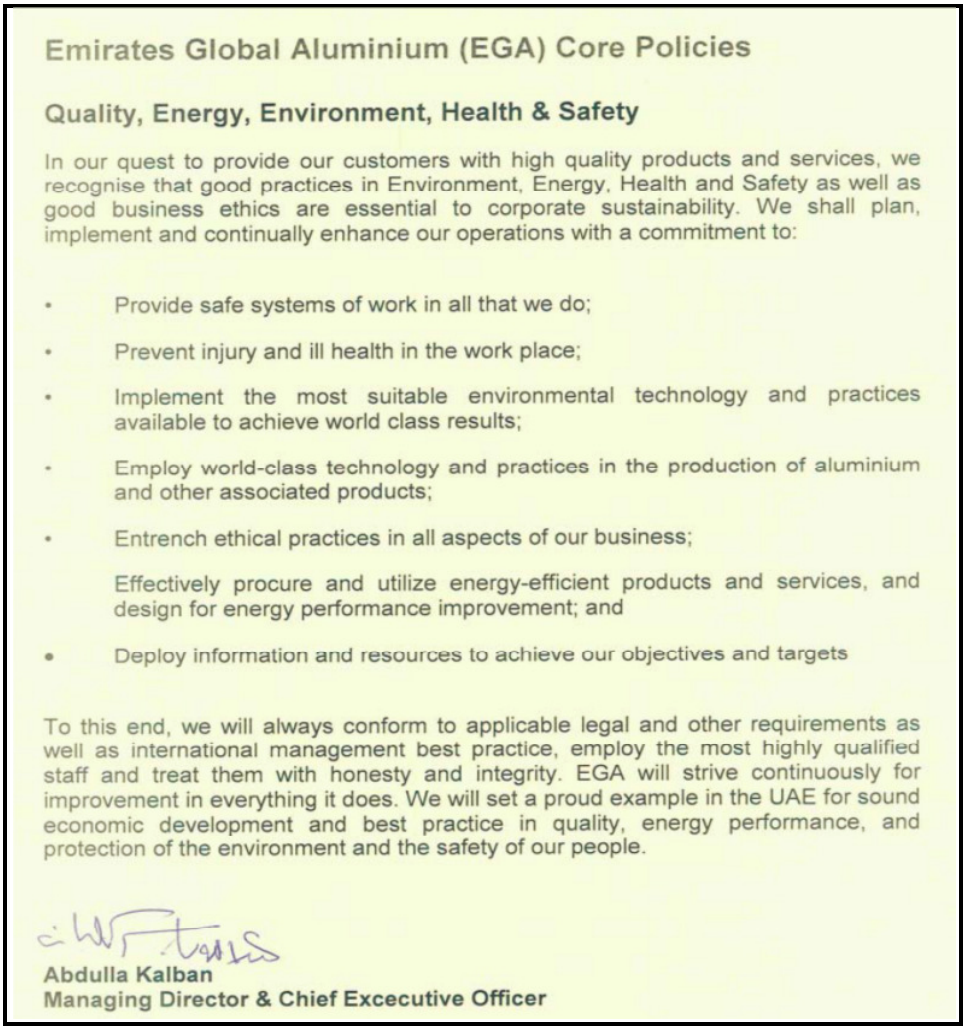
The Risk management plan seeks to ensure that risks are minimized as low as reasonably practicable for all activities affecting the Project, its operations, personnel and members of local communities. The Plan will be based on an overall assessment of the Project risks. Risks of all nature will be taken into

consideration including but not limited to industrial, environmental, health, accidental, natural, political and social risks. A risk register including control measures and procedures will be developed following a hierarchy of controls seeking to eliminate risks first and to propose risks controls, mitigation measures and appropriate incident response where required. Part of these measures will refer to Project policies, Discipline Specific Management Plans or operational procedures such as Travel policies, Hazardous materials management plan or Emergency prevention and response plan. The Risk management plan will be periodically reviewed to ensure that existing risks and controls are managed and implemented accordingly and that newly identified risks are taken into consideration.

18.6.9 Health, safety and security management plan

The Project HSS management plan (DSMP) will be developed in accordance with GAC Health and Safety Policy as presented in Figure 18.3.

Figure 18.3 EGA (GAC's parent company) Health and Safety Policy



Emirates Global Aluminium (EGA) Core Policies

Quality, Energy, Environment, Health & Safety

In our quest to provide our customers with high quality products and services, we recognise that good practices in Environment, Energy, Health and Safety as well as good business ethics are essential to corporate sustainability. We shall plan, implement and continually enhance our operations with a commitment to:

- Provide safe systems of work in all that we do;
- Prevent injury and ill health in the work place;
- Implement the most suitable environmental technology and practices available to achieve world class results;
- Employ world-class technology and practices in the production of aluminium and other associated products;
- Entrench ethical practices in all aspects of our business;
- Effectively procure and utilize energy-efficient products and services, and design for energy performance improvement; and
- Deploy information and resources to achieve our objectives and targets

To this end, we will always conform to applicable legal and other requirements as well as international management best practice, employ the most highly qualified staff and treat them with honesty and integrity. EGA will strive continuously for improvement in everything it does. We will set a proud example in the UAE for sound economic development and best practice in quality, energy performance, and protection of the environment and the safety of our people.

Abdulla Kalban
Managing Director & Chief Excecutive Officer

The Health, safety, and security management plan will define management procedures that address Guinean health and safety standards, as well as community health, safety and security conditions in accordance with IFC guidelines.

The Plan will be developed into a Personnel health, safety and security plan and a Community health, safety and security plan.

The *Personnel health, safety and security plan* will include:

- an assessment of the different health and safety risks for personnel in relation to the Project location, activities and on the job-specific risks;
- procedures for health and safety management, including personnel protective equipment and medical kits, based on the risk assessment;
- an health and safety awareness and training program;
- roles and responsibilities for implementation and follow-up;
- an accident action and response plan with due consideration for the remoteness of the site and the logistics of getting to and from the site; and
- internal incident tracking and a corrective action program to prevent recurrence of incidents.

Among others, the Plan will address the HSS under operational procedures.

The Project developed a Health Performance Requirements document which sets out minimum requirements in terms of risk exposure profile and control, medical assessment and surveillance, fatigue, drug & alcohol and fit-for-work procedures. In addition a ES&H Requirements document sets out the Project minimum requirements for environment, safety and health at operational level to be developed within operational procedures. These overarching documents refer to the Project EH&S Policy and set out Project and Contractors responsibilities for the implementation of ES&H requirements.

The Project existing HSS operational procedures which are subject to possible updates are as laid out in *Table 18.10*.

Table 18.10 GAC's existing HSS operational procedures

Theme	Procedures
Overarching	• Environment, Safety and Health Management Plan • ES&H requirements
Medical	• Pre-Deployment Medical • Medical & First Aid Services • Supply & Testing of Potable Water • Hearing Conservation Program

Theme	Procedures
Awareness & Prevention	• HSE Orientation & Training • Permit to Work System • General Site Requirements; • Job Hazard Analysis • Pre-STARRT Meetings, STARRT and Re-STARRT Cards • People Based Safety Process
Drugs & Behavior	• Drug and Alcohol Management Plan • Drug & Alcohol Screening • Fatigue Management
Risk and Emergency	• Fire Prevention & Protection; • Hazard Control • Emergency Response • Fatal Risks Controls
Work activities	• Personal Protective Equipment; • Radiation Protection • Fall protection, Prevention & Work at Heights • Crane Suspended Personnel Platform • Scaffold Control & Management • High Voltage Electrical Access & Live Electrical Works; • Floor & Wall Openings • Work Over or Near Water; • Confined Spaces; • Manual Handling; • Welding & Cutting Operations • Crane Use and Rigging Lifting
Equipment & Installations	• Portable Ladders • Elevating & Articulating Boom Work platforms; • Electrical Equipment • Control of Systems and Equipment Lock-Out Tag-Out • Compressed Gas Cylinders • Barricades And Signs
Materials & Substances	• Hazardous Substances and Dangerous Goods • Spill Prevention & Response • Waste Management
Transport	• Traffic & Vehicle Management • Journey Management • Truck Transportation
Inspection & Maintenance	• Equipment Inspections • Vehicle & Mobile Equipment Inspection • Housekeeping
Performance	• Incident Reporting, Recording & Investigation • Reports & Records

Where relevant, these procedures are referred to and outlined within the DSMP sections of this document.

In addition the following programs, procedures and standards will be developed separately or added to the above existing procedures in accordance with the Project Health Performance Requirements, ES&H Requirements and the Implementation Plan of the 2008 SEIA (*Knight Piésold, 2008*):

- Exposure profile and control procedures;
- Medical assessment and surveillance;
- Fit-for-work procedure;
- Fencing and security of the Project areas;
- Safety trainings prior to accessing Project sites;
- Occupational Noise Exposure;
- Occupational Dust and Air Quality Emissions Exposure and respiratory protection;
- Safety precautions during blasting operations;
- Heat and cold stress prevention;
- Excavations & trenching;
- Night work requirements;
- Electrical safety in the workplace;
- Malaria awareness and management;
- Blood borne pathogens and communicable and sexually transmissible diseases awareness and management, including monitoring of HIV/AIDS and distribution of condoms, protective and hygiene kits;
- Health and safety precautions for travel;
- Site-specific health and safety considerations;
- Health standards for all food and water provided to employees; and
- Medical follow-up and health awareness programs.

A *Community health, safety and security plan* will be developed taking into consideration that projects can increase the potential for community exposure to risks and impacts arising from equipment accidents, structural failures and releases of hazardous materials. Communities may also be affected by impacts on their natural resources, exposure to diseases, the use of security personnel and increased contact with Project personnel. While GAC acknowledges the Guinean government's role in promoting the health, safety and security of the public, it also accepts the responsibility to avoid or minimize the risks and impacts to community health, safety and security that may arise from managing and monitoring impacts to communities from:

- infrastructure and equipment safety;
- hazardous materials;
- communicable diseases;
- decreased security caused by massive influx and workers presence in local communities;
- transport activities and traffic safety;
- environmental health and natural resources; and
- emergency response and preparedness.

The Community health, safety and security plan will detail how these potential impacts will be managed, reduced and monitored by the Project.

References to more specific plans and studies will be made when relevant, among others a Workforce social codes of conduct has been developed.

18.6.10 Hazardous materials management and spill prevention & response plan

GAC will develop a consolidated and stand-alone Hazardous materials management and spill prevention & response plan which will be based on the principles detailed below and on the following GAC's existing documents:

- 9000-S-CPD-00061 Rev 0 GAC Project Procedure Waste Management;
- 9000-S-CPD-00025 Rev 2 GAC Project Procedure Hazardous Substances and Dangerous Goods; and
- 9000-S-CPD-00058 Rev 0 GAC Project Procedure Spill Prevention & Response.

It will include an Hazardous materials management plan based on the existing procedure for managing hazardous substances in order to manage the transport, storage, use and disposal of hazardous materials in a safe and environmentally responsible manner. Hazardous materials are fuels, chemicals or any substances which are potentially harmful to human health and/or the environment.

The existing procedure includes:

- a description of roles and responsibilities;
- a classification of hazardous chemical substances;
- a list of hazardous materials expected to be produced but not limited to, by the Project provisions for safe storage of hazardous materials;
- requirements for registering and labeling and
- provisions for training, inspections and monitoring.

In addition, the Hazardous materials management plan shall include:

- an identification list of all hazardous materials expected to be used or produced by the Project, including quantities, location and Project activities;
- a risk analysis and general measures foreseen by the Project for managing each risk (e.g. secondary containment, transportation and handling procedures, etc.); and
- a list of operational procedures and their general principles to be developed by GAC and its subcontractors to manage hazardous materials depending on their areas of activities.

In addition, based on the hazardous materials identification and risk analysis, the Plan will include a Spill prevention and response plan which will define the management and response practices to reduce the risk of accidental exposure of fuels and other hazardous materials to human and environmental pathways.

Accidental events may result in various environmental impacts, such as, for example, uncontrolled spillages of hydrocarbons, chemicals or other hazardous waste, notably in case of:

- a leak or crack of the fuel oil supply pipe, a tank, vat or container;
- a leak from a collection network;
- an accident situation in the processing installations, during the operational phase, leading to the spillage of hydrocarbons, sludge or potentially contaminated water into the environment; and
- a traffic accident involving damage to a diesel tank or a fuel oil tank.

An emergency response plan in case of spillage organizes a systematic, quick and efficient response to any kind of emergency, accident situation or spillage of water contaminated by hydrocarbons, or of any other hazardous chemical product, in order to reduce/remedy potential damage to the environment and property and plans for immediate confinement of any spillage and rapid cleaning of any deteriorated area.

The section covering the Spill prevention and response plan will be developed from the Project existing Spill Prevention and Response Plan procedure which currently includes:

- a description of roles and responsibilities;
- classification of a spill;
- spill prevention measures such as secondary containment;
- spill response, clean up, handling and disposal procedures;
- inspections, records and reporting guidelines; and
- provisions for training to Project employees and contractors.

In addition the Plan will include:

- a spill risk analysis matrix, potential locations and activities related to the risk and responses foreseen by the Project for each possible spill risk;
- the location of intervention equipment; and
- contact details of trained staff.

Considering hazardous materials management is part of preventing spills to occurs, the Hazardous materials management and spill prevention response plan is meant to be a consolidated and stand-alone document. Whenever possible it will avoid repetition and redundancy between its Hazardous materials management and Spill prevention and response component (e.g. risk analysis matrixes and spill prevention measures such as secondary containment are applicable to both components of the overarching plan).

The overarching Plan will be periodically audited and revised in order to ensure it remains relevant and operational throughout the Project's lifespan.

18.6.11 Overburden management plan

GAC will develop an overburden management plan (OMP) that will seek to limit adverse impacts (physical footprint, erosion and turbid runoff) from overburden generation within the mine area.

The OMP will be developed in line with *EGA-GAC Project Document 9000-S-CPD-00061 Rev0 Waste Management*, and will aim to apply the following measures:

- Inert material such as overburden, rock, gravel and/or organic material will be stockpiled for future re-use onsite, in a way to minimize generation and/or loss of sediment by wind, rain or surface water.

- Below-grade bauxite formations that may have been moved to access higher-grade material will be stockpiled in-pit or at a maximal distance of 2 to 5 km from the pit, for potential use during potential subsequent phases (e.g. for use as refinery feed). If below-grade bauxite storage occurs out of the pit, it will be located within a 1 km distance from the pit and include controls to prevent erosion and turbid runoff. This may include overburden storage profiling as well as (if necessary) water collection and retention ponds.

18.6.12 Emergency prevention and response plan

The Emergency prevention and response plan will define the response and reporting procedures to follow in the event of an emergency or natural disaster. It will outline the process for responding to onsite and transportation emergencies, fires, explosions, medical emergencies and accidental releases from engineered facilities. It is designed to minimize employee exposure to risk and injury and limit potential impacts to the environmental and the community in emergency situations.

The Plan is intended to be a consolidated and self-standing document and will be developed based on the following GAC's existing plans and procedures:

- GAC Procedure - Crisis and Emergency Management Plan r006;
- 9000-S-CPD-00065 Rev 0 GAC Project Procedure Emergency Response;
- M_PL_131025_Rev _0_Emergency Evacuation Plan;
- M_LS_131106_Emergency Evacuation Contacts;
- 9000-S-CPD-00044 Rev 0 GAC Project Procedure Fire Prevention and Protection; and
- 9000-S-CPD-00045 Rev 0 GAC Project Procedure Hazard Control.

The Plan will include among others:

- an identification of all plausible emergency situations such as fires and explosions, medical emergencies, transportation of dangerous goods, climatic events, natural disasters, social and political unrests, etc.;
- response procedures, reporting protocols to limit the severity of those events, should they occur, including evacuation categories, plan and contacts;
- training programs to Project personnel and members of local communities;
- roles and responsibilities in case of emergency; and
- monitoring and auditing program to ensure preparedness of all Project staff to emergency events and good maintenance of emergency support materials and tools (e.g. medical kits, evacuation signs, etc.).

The Plan will also address community emergency preparedness and will be disclosed in a culturally appropriate manner to all communities within the Project's overall social zone of influence.

18.6.13 Traffic, vehicle movement and transportation management plan

The Traffic, vehicle movement and transportation management plan will be developed to promote community safety and present appropriate strategies for moving Project staff and materials in a safely manner. Its purpose it to protect Project staff, local communities and Project materials during transportation activities. It will also contain provisions for coordination with the Government of Guinea on connection points between site access roads and main highways in accordance with IFC community health and safety guidelines as well as AfDB OS 1 that would apply for "associated facilities" and for any road upgrading work to be carried out.

The Plan will be developed based on GAC's existing plans and procedures including:

- 9000-S-CPD-00024 Rev 1 GAC Project Procedure Traffic And Vehicle Management;
- 9000-S-CPD-00060 Rev 0 GAC Project Procedure Truck Transportation;
- 9000-S-CPD-00049 Rev 0 GAC Project Procedure Journey Management; and
- 9000-S-CPD-00026 Rev 1 GAC Project Procedure Vehicle and Mobile Equipment Inspection.

Where necessary, operational procedures may be developed to cover specific activities such as vehicle inspection, truck transportation and journey management.

The Plan will be updated to include new Project areas and routes related to the development of the Bauxite Export Project and in accordance with the transportation management principles given in Table 18.11.

Table 18.11 Traffic, vehicle movement and transportation management principles

Aspect	Management principle
Vehicles and driving personnel compliance	• Vehicle and drivers compliance rules will be defined in order to guarantee vehicles good operating conditions and drivers appropriate health conditions, training and driving license. • Drivers will respect the Project HSS procedures with respect to fatigue management and drug & alcohol consumption. • EHS personnel must approve vehicles and driver's compliance, prior to their use by the Project and regular compliance audits must be performed during Project construction and operation. • Ensure direct or indirect enforcement of local and national laws, especially regarding traffic speed, and/or other safety standards.

Aspect	Management principle
Local community safety and wellbeing	• Provide road safety signage in local communities where necessary to increase pedestrian safety and enforce drivers' compliance (e.g. signage for speed limit, pedestrian cross over point, school, etc.). • Schedule Project transportation of materials and goods through local communities during day time and or low-traffic period as far as practicable. • Assess traffic impacts on local communities' wellbeing and safety, as necessary, and develop additional mitigation measures such as transport restrictions during quiet/night time, additional speed and weight limit to reduce noise, vibration and dust in sensitive areas, etc. • Provide road traffic safety training to local residents as part of the stakeholder engagement process.

Condition of public roads used by vehicles for the Project	• Public road preservation measures specific to the Project will be implemented, notably:
	  • compliance with regulatory limits on vehicle axle loads
	  • compliance with Project speed limits on road and tracks
	  • transport of site machinery using flatbed trucks
	  • creating driver awareness of road driving that respects the state of roads and highways.
	  • it may be necessary to improve certain sections of road or track, in agreement with local highway authorities.

Atmospheric emissions linked to car and truck traffic	• Vehicles used for the Project must comply with the emission limit specifications identified by regulations and by international best practice. • The vehicles will be duly maintained by GAC and its sub-contractors, in order to ensure correct functioning of their engines and their exhaust fume filtering systems. • Measures to reduce fuel consumption and atmospheric emissions will be studied.
Personnel transport and safety procedures	• Employees transport and commuting option will be assessed and provided where necessary and/or practicable to reduce the number of vehicles traveling to and from the Project each day. • Safety of different means of transport and transportation companies will be assessed. Safety procedures and restrictions to travel will be developed to minimize risks associated with personnel transport and travel.

Site machinery traffic	• Safety measures will be implemented to ensure road user safety, notably:
	  • the signaling of heavy vehicles using public roads (use of flashing lights and signs);
	  • escort of wide loads by escort vehicles, (leader cars and cars bringing up the rear); and
	  • limitation of the weight and volume of loads to ensure good road stability.
	• coordination with local authorities to agree on routes to be taken, times and road safety measures to be implemented and intervention and coordination measures to be implemented in case of incident.
	• where possible, GAC and its sub-contractors will ensure that vehicle loads are optimized, if necessary by means of loads shared between different Project operators in order to limit the number of vehicles to be mobilized.

Aspect	Management principle
Waste transport	• Any transport of waste, whether hazardous or not, will be undertaken in compliance with the waste management procedure, taking into account applicable regulations and international good practice relating to the packaging, packing, labeling and transportation of waste.
Parking on public roads	• Vehicles, particularly Heavy Goods Vehicles, which are stopped on public roads or in populated areas, must ensure that they are safely parked and do not obstruct the public highway. • If necessary, stops on public roads will be restricted in defined locations in order to limit traffic impacts such as release of fugitive dust from vehicles stopping on dusty ditches nearby habitations and agricultural fields, irregular settlements caused by frequent stopping and driver shopping and increased risk of traffic accidents from stopping on road sides.

Training	• Driving training will be provided to GAC and sub-contractor staff, to ensure that the drivers of vehicles and machinery working on the Project apply good road driving rules, in order to guarantee the safety of staff and third parties.
	• GAC and its sub-contractors will ensure that only staff who have taken road safety training and have reached the levels of competence required are authorized to drive the Project's vehicles and machinery.
	• In addition, all drivers must receive (at least):
	  • training that is specific to their type of vehicle; and
	  • safe and defensive driving training.
	• Driver training in driving rules to ensure the safety of off-site road users (for example pedestrians, farmers using the road to move their farm machinery, herdsmen moving their animals across the road);
	• Training on community impacts from traffic and awareness of sensitive areas including specific restrictions aiming to limit traffic impacts to local communities.

Measures in case of accident	• In case of a traffic accident involving one of the Project's vehicles, the GAC manager in charge of activity supervision will inform emergency services as quickly as possible. Details of the incident or accident will be recorded in an accident report.

18.7 SOCIAL SPECIFIC MANAGEMENT PLANS

In addition to the environmental specific management plans presented above, several specific themed social management procedures are to be developed in addition to the existing ones. The essential principles and procedures of these Discipline Specific Management Plans (DSMP) are defined in the following sections. Social specific management plans are:

- employment conditions and awareness management plan;
- local development plan;
- cultural heritage management plan;
- stakeholder engagement plan;
- grievance mechanism and resolution plan;
- livelihood restoration and resettlement framework;
- livelihood restoration and resettlement action plan; and
- in-migration management plan.

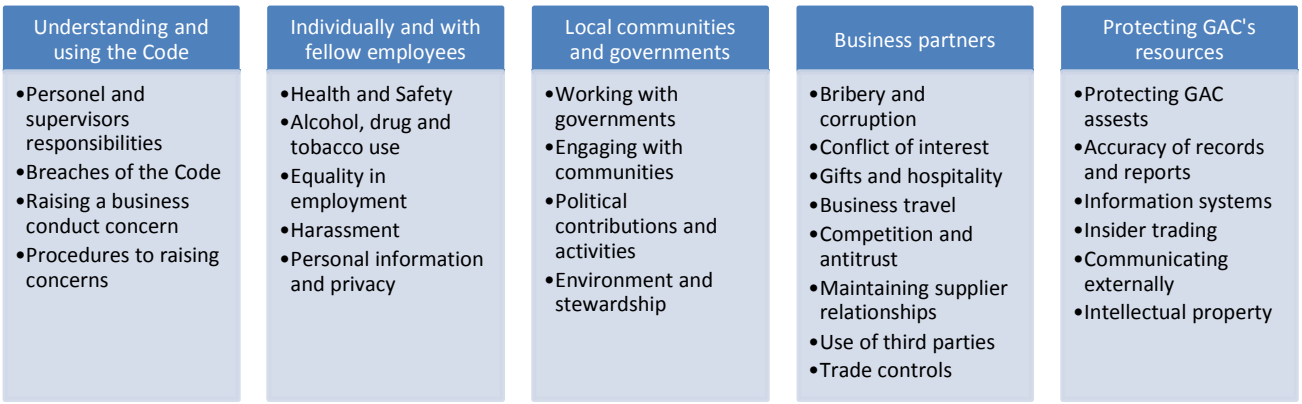
These plans must be integrated by GAC and its contractors into their social and environmental management system. They will be designed to be adaptable to the various Project phases, in order to remain relevant to the specific issues arising in each phase. Eventually the promoter and its contractors will have the responsibility to develop and implement operational procedures for their own installations and areas of operation and in line with the previously developed DSMP.

Where appropriate, some existing GAC policies and requirements may as well be presented below as they define the benchmarks and requirements to the Project social performances.

18.7.1 Code of Business Conduct

GAC's Code of business conduct is developed from its company values, integrity and mutual respect. All Project personnel are expected to obey to this code in every aspects of its work and social specific management plans are tailored to ensure respect to the code. GAC's Code of business conducts defines principles, rules and procedures for each of the areas presented in Figure 18.4.

Figure 18.4 Areas covered by GAC's Code of Business Conduct



18.7.2 Employment conditions and awareness management plan

The Employment conditions and awareness management plan will be developed to define GAC standards and objectives with regard to the labor and working conditions of its personnel and subcontractors employees. The plan will seek to promote employees awareness of these rights to ensure their correct implementation and the development of a constructive and transparent relationship with its personnel. The plan will be developed in accordance with national law and IFC PS 2 and AfDB OS 5 requirements on labor and working conditions with the objectives to promote:

- fair treatment, non-discrimination and equal opportunity of workers;
- protect workers and avoid the use of forced and child labor, including in the supply chain; and
- promote safe and healthy working conditions, and the health of workers.

The plan will include at minimum the following:

- reference where relevant to GAC's existing Code of Business Conduct and applicable rules;
- a human resources policy;
- a description of the working conditions and terms of employment;
- consideration for collective agreements and respect of the workers' right to organize and bargain collectively;
- a workers accommodation quality and management policy;
- a retrenchment plan;
- a workers grievance process;
- a stated policy against forced and harmful child labor;
- provision of a safe and healthy work environment; and
- a workers awareness program including ways and plan to disseminate information to workers on their rights by the means of training or communication campaigns.

The Plan will specify where it is fully applicable to subcontractors in accordance with IFC PS 2 and AfDB OS 5, and the Project will ensure it is respected by contractors. It will also implement commercially reasonable

efforts to require suppliers and other intermediaries to apply the applicable requirements of PS-2 in conducting their businesses, including addressing child labor and forced labor in the supply chain.

The Plan will include English language training for non-English-speaking staff and make reference to the health and safety programs, trainings and procedures of the Health, safety and security management plan.

18.7.3 Local Development Plan

GAC recognizes the importance of contributing to the socio-economic development of Guinea and the local communities where it operates. It also acknowledges that the Project will have both social positive and negative impacts that will require to be optimized or managed. Therefore it will develop a Local Development Plan (LDP) aiming at:

- supporting the social, economic and institutional development of local communities and Guinea in general;
- limiting the potential for economic dependency on the Project;
- attenuating the influx of job-seekers and mitigating the impacts it may have on local communities; and
- enhancing the Project's positive socio-economic impacts by developing local and preferential sourcing and hiring policies and procedures.

Overall, LDP objectives will also be developed with the aim to ensure long-term sustainability of its programs or benefits through:

- capacity building of the program participants and beneficiaries;
- support to self-subsistence and food security;
- diversification of incomes and opportunities;
- partnerships with Guinean or local community based organizations, NGOs, government or institutions and businesses, and
- support to SME.

The selection and tailoring of these programs will be based on a LDP Strategy. This strategy will be developed based on the Project's socio-economic assessments and understanding of the needs, other studies publicly available, consultations with local communities and other stakeholders, and local, national and international development programs.

The LDP will define short-, medium-, and long-term programs intended to benefit the wider Guinean community, with particular emphasis at least in the near term on Project-area communities and local Government.

Eventually the LDP will define investment categories and specific objectives which may include:

- Land based productivity:
  - commercialize land based products;
  - improve the environment by moving away from slash-and-burn agricultural practices;

- increase crop productivity through programs such as more intensive land use, new or improved seeds, crop diversification, and the use of inputs; and
- increase animal productivity through programs such as animal husbandry, breeds introduction or diversification, quality control and veterinary programs, pasture land and water quality and quantity.

- Employment and training:
  - maximize number of Guineans employed by the Project through special recruitment and training measures;
  - develop training programs that aim at training Guinea's future mining workforce at national level;
  - develop special career advancement measures for local employees including through trainings and capacity building; and
  - implement resourcing plans that aim at replacing expatriate staff, where practicable, with Guinean staff within an estimated 5 to 10 year period.

- Business development:
  - maximize the economic benefits that flow from the Project to the region and the country through local procurement policy and procedures, capacity building and loans to local potential suppliers;
  - help diversify local people's income streams; and
  - increase local people's income and improve standards of living.

- Health:
  - increase local access to staffed and equipped health facilities;
  - improve the quality of the health care provided in local facilities; and
  - improve local communities awareness on hygiene, health protection measures and communicable diseases and increase accessibility to protective equipment.

- Education:
  - expand access to staffed schools in the Project area of influence; and

- Infrastructure:
  - enhance local transportation routes to facilitate trade and improve residents access to regional economy including the opportunities generated by the Project;
  - improve waste disposal practices in the Project area of influence; and
  - improve the supply of safe drinking water for affected communities.

- Environment:
  - enhance overall understanding of the benefits of good environmental stewardship and the consequences of poor stewardship;
  - provide opportunities to enable the local population to adopt good environmental actions;
  - educate local populations about the Project's activities and its impacts on the environment; and

- raise capacity of local and national officials to monitor compliance of projects with environmental obligations.

- Institutional capacity:
  - educate local officials about the Project's cost and benefits so they can make sound decisions on management of opportunities and risks;
  - facilitate Government access to capacity building from international development agencies or NGOs, especially with regard to the mining sector, urban and rural planning, agricultural development, and environmental monitoring;
  - assist national and local government to build capacity to monitor Project compliance under various authorizations, permits and approvals;
  - assist Government to effectively manage regional growth; and

As part of the LDP a Monitoring and evaluation plan will be developed with the aim to assess the progress, outcomes, efficiencies and failures of its programs. The LDP will be a living document, continually updated with the lessons learned from the programs it supports and taking into consideration the evolution of the socio-economic and governance conditions.

GAC's LDP will include a Local Development Fund (the Fund) to support social and environmental programs to benefit the wider Guinean community and an Integrated Regional Development (IRD) program for the area.

The Fund contributions will focus on large community programs and projects. GAC will contribute financially to the Fund and expects to attract other private and public sector contributors. The Fund development strategy will be consistent with national and international development strategies as well as recommendations of the Community Development Framework Study for the Mining Sector in Guinea[1] and other relevant studies available.

GAC proposes to support a strategic partnership that will catalyze and support an integrated regional development (IRD) program. Core components of the IRD would include a permanent institutional arrangement, public financing at the regional and local levels, and regional ownership, aims and responsibilities. Funding and implementation of supporting activities as part of the IRD program will not be limited to public institutions, and its selection will be based on:

- natural, human, and cultural resources of the area;
- local initiative and enterprise;
- major problems, such as the limited capacity of areas and social groups to participate in economic and development activities; and
- program focus such as capacity building (skills, institutions, and infrastructure).

([1]) Synergy Local Consulting Ltd., 2007. Community Development Framework Study for the Mining Sector in Guinea. Report prepared **CommDev and the Chambre des Mines de Guinée with support from the Ministry of Mines and Geology, Government of Guinea**

All programs and projects that are considered in the LDP will be reviewed, assessed and selected in accordance with the LDP objectives and categories through a formal scoring process and by a team composed of legal and social specialists with the aim to maximize its benefits and reduce risks associated with funding, including risks of bribery and corruption. Funding under the LDP will not be available for the following types of activities or circumstances:

- political actions or social events;
- programs that discriminate according to religion, ethnic group, or gender unless there is a clear justification why the proposed beneficiaries warrant special assistance; and
- illicit activities.

18.7.3.1 Local and preferential hiring and sourcing

As part of its effort to optimize the Project benefits and reduce its impacts to local communities and Guinea in general, the LDP will include a component for local and preferential hiring and sourcing. The Local and preferential hiring and sourcing plan (operational procedure level) will include provisions and procedures to preferentially distribute Project benefits to those who are most affected by the Project, including and in order of priority for those who have been either physically or economically displaced through involuntary resettlement and residents of the local communities. These provisions include training opportunities and local advertisement of employment and training opportunities.

GAC existing Recruitment Procedure (9000-H-CPD-00009 Rev 0 Procedure Recruitment) and Procurement Policy will be updated to include specific provisions with regard to preferential hiring and sourcing.

The Local and preferential hiring and sourcing plan will include:

- an updated recruitment and hiring policy;
- an updated procurement policy;
- a list of provisions and procedures for preferential hiring and sourcing;
- a local worker enhancement program providing trainings to local people to meet Project construction and operation needs and increase their employment opportunities in general;
- a capacity building program aiming at building local business competencies to meet the Project standards including quality, health and safety requirements;
- a communication program aiming at communicating opportunities and available trainings to local communities and businesses;
- an employment database to monitor distribution of employment, trainings and available workforce to the Project;
- a local procurement database which will be fed by the different departments to monitor local procurement trends and opportunities; and
- roles and responsibilities for implementation of the Plan.

18.7.3.2 In-migration management as part of the LDP

Opportunity-seeking in-migration is likely to be induced by the Project around the Mine area and in Kamsar. People influx will be in search for opportunities such as direct employment at the Mine and indirect employment and economic opportunities from Project supply and increased local consumption.

GAC will work with local authorities to develop and implement an In-migration management plan as a component of the LDP. The In-migration management plan overall structure is discussed in more detail in *Section 18.7.8*. This will be an important component of GAC's local development plan, as will seek to reduce potential indirect impacts such as:

- increased pressure on local resources, land, products and services, and infrastructure which could lead to unsustainable use of local natural resources and land, price inflation of housing market, land and subsistence products, and degradation of roads or decreased access to schools, medical facilities and recreational or religious facilities;
- transition of a customary land management system towards private property;
- changes to social dynamics, family structures and decreased use of reciprocity relationships;
- social tensions with in-migrated population and conflicts with Project workers related to unmet expectations with regard to employment and changes to family structures due to persons preferring to move in with Project employees;
- reduced safety and security from an increase in petty crimes, drug and alcohol consumption; and
- increased sexually transmitted diseases or other communicable diseases through increase in prostitution, population density and poor sanitation services.

As part of the LDP Monitoring and evaluation plan, specific measurable objectives, and provisions for monitoring in-migration levels and impacts will be developed with the aim to continuously adapt the In-migration management plan.

18.7.4 Cultural heritage management plan

The Cultural heritage management plan will be developed with the aim to protect sites or objects of local to international cultural importance in accordance with the IFC PS 8, AfDB OS 1 and Guinean environmental law.

The Plan will include the following:

- a description of the cultural heritage sites and objects identified in the Project area and an evaluation of their importance based on documentation review, field based study and consultations;

- an assessment of the Project potential impacts on cultural heritage based on Project activities, identified sites or objects and knowledge of the areas where additional cultural heritage sites or objects may be encountered;
- a description of legal, IFC PS 8 as well as AfDB OS 1 requirements in relation to the protection of cultural heritage by projects;
- a procedure detailing how the Project will protect cultural heritage sites and objects including watching brief, chance find procedure, consultation requirement with local communities and Guinean authorities, rules for continued community access and mitigation guidelines such as preservation in its place, removal, preservation by records or compensation; and
- a definition of roles and responsibilities to ensure implementation according to the Plan.

This Plan includes a human remains protocol. Decisions on specific mitigation measure will be based on:

- an assessment of the value of the cultural heritage site or object by competent professionals;
- communities sensitivities informed by consultations; and
- consultations and opinions of regulatory authorities.

Modifications to the surrounding environment of cultural heritage sites or objects such as impacts to landscape or noise and air-quality impacts potentially affecting the use and experience of these sites by local residents will also be considered by the Project. The Plan will define protocols with the aim to mitigate these impacts wherever practicable through consultation with local communities and by developing solutions such as guaranteeing continued and safe access, revegetation of the area, removing the site to another location, compensation, etc.

Operational procedures will be developed for phases of the Project where major earthmoving activities are required.

18.7.5 Stakeholder engagement plan

A Stakeholder Engagement Plan (SEP) is intended to serve as a guidance document to manage and record interactions between the Project and stakeholders at different stages of a project's design and execution.

A SEP has been developed as part of the initial stage of Social and Environmental Impact Assessment (SEIA) Addendum studies for the Project. This SEP updates a former SEP document developed by GAC with support from Knight Piésold in 2008 (*GAC, Knight Piésold Consulting, Social and Environmental Assessment, Vol. 4, Stakeholders engagement plan, Rev 0, January 2008*).

The objectives of this SEP are to:

- provide a framework for communication with stakeholders to ensure that the Project is:
- well understood by external stakeholders;
- build a respectful and open dialogue between the Project and stakeholders;
- identify Project stakeholders and understand their interests, concerns and influence in relation to Project activities;
- give stakeholders an opportunity, through consultations and other mechanisms, to express their expectations and concerns with regard to the Project, and for these to be reflected in the SEIA Addendum and Project Social and environmental Management Plan;
- define and support compliance with regards to external stakeholder engagement required as part of the Project;
- provide a framework for monitoring stakeholder relationships and identify new issues, expectations and potential constraints that may be raised by stakeholders;
- participate to public awareness and education by disseminating information through its stakeholder engagement program on the Project area social and environmental baseline, Project impacts and on key local issues such as waste management, traffic safety, health risks associated with communicable diseases and improvement of the local environment.
- facilitate GAC's community engagement and support strategy; and
- facilitate multilateral communication among stakeholders and ensure disclosure of information as widely and transparently as possible.

The SEP includes:

- an identification of Project stakeholders and affected communities and their relation and expectation with regard to the Project impacts;
- a description of stakeholder engagement channels and strategy for stakeholder engagement;
- a description of stakeholder engagement activities performed to date and a summary of stakeholders perceptions;
- a planning of future engagement activities, including post to the SEIA disclosure activities and during the Project lifetime;
- a monitoring of stakeholder engagement activities performed with regard to those planned in the previous versions of the SEP; and
- a quarterly internal and annual public reporting of stakeholder engagement activities.

The SEP is a living document which will be updated frequently during the Project lifetime and will include evolutions in terms of Project phases and activities, stakeholders' consultations, stakeholders' expectations and concerns and Project planning of engagement activities.

18.7.6 Grievance mechanism and resolution plan

The establishment of a grievance[1] management system is widely accepted international best practice for the management of stakeholder interactions and social impacts. It is a requirement of the IFC Performance Standards and AfDB Integrated Safeguards System. Complaints should be addressed promptly using an understandable and transparent process that is culturally appropriate and readily acceptable to all segments of affected communities, and is at no cost and without retribution. The mechanism should be appropriate to the scale of impacts and risks presented by the Project and beneficial for both the project and stakeholders. The mechanism must not impede access to other judicial or administrative recourse.

In accordance with international good practice, GAC has established a specific mechanism for dealing with grievances that do not involve court action. It includes the following steps:

- receive and register the complaint or grievance;
- carry out a preliminary review and categorize the complaint;
- address the complaint; and
- close the complaint.

A software application is used to collate the grievances. This database is managed by the Compensations division based in Tinguilinta.

This grievance management system provides a formal way to register stakeholders' concerns and for these to be addressed in good faith and through a transparent and impartial process. Grievances are monitored to provide signals of any escalating conflicts or disputes.

18.7.7 Livelihood restoration and resettlement framework

At the mine area development of infrastructure during construction, and of land clearance and haul roads during operation are likely to cause:

- physical destruction of residents houses, community infrastructures or patrimonial sites, and
- transformation of land initially used by local communities as productive land for agriculture, pasture, hunting, forest products gathering and water provisioning.

Reinstallation covers both "*physical displacement"* (resettlement or loss of shelter) and *"economic displacement"* (loss of access to productive land or income generating activity). IFC PS 5 and AfDB OS 2 on Land Acquisition and Involuntary Resettlement refers both to the loss of an asset or source of income

(1) A grievance is a complaint or concern raised by an individual or organization who judges that they have been adversely affected by the Project during any stage of its development. Grievances may take the form of specific complaints for actual damages or injury, general concerns about project activities, incidents and impacts, or perceived impacts.

(incl. subsistence activity) or to a loss or restricted access to such asset or source of income caused by a project.

Risks associated with resettlement are mainly:

- homelessness caused by loss of shelter;
- impoverishment from loss of workplaces, productive land or asset and/or other income sources;
- reduced food security from loss of access or increased pressure on forest products;
- social disarticulation from loss of cultural identity and changes to family structure, social networks and traditional governance; and
- social tensions and increase rates of crimes, disease and mortality within impacted and hosting areas.

In order to mitigate these impacts and in accordance with IFC PS 5, and AfDB OS 2 and the Project commitments, the Project must develop a strategy and approach to land reclamation and resettlements with the objectives to:

- avoid, and when avoidance is not possible, minimize displacement by exploring alternative project designs;
- avoid forced eviction;
- anticipate and avoid, or where avoidance is not possible, minimize adverse social and economic impacts from land acquisition or restrictions on land use by (i) providing compensation for loss of assets at replacement cost and (ii) ensuring that resettlement activities are implemented with appropriate disclosure of information, consultation, and the informed participation of those affected;
- improve, or restore, the livelihoods and standards of living of displaced persons; and
- improve living conditions among physically displaced persons through the provision of adequate housing with security of tenure at resettlement sites.

Therefore the Project will develop a Livelihood Restoration and Resettlement Framework (LRRF) which will develop the approach of the Project in planning and managing land reclamation, resettlements and restoration of livelihoods of those affected by the Project. The LRRF will comprise the following:

- the institutional and legal framework including stakeholders, Guinean legislation, land tenure systems and international standards of the social management of land acquisition processes;
- a description of the Project principles and approach that is at minimum compliant with the requirements of national legislation and international standards;
- a stakeholder engagement mapping of both reclamation and hosting areas including plans for engagement and mechanisms to manage negotiations and information disclosure related to land acquisition and resettlement;
- an assessment of the impacts caused by displacement including the different types of assets that will be affected, the different modes of

ownerships of these assets and the benefits they bring to their owners or users;
- policies and rules the Project proposes to follow to determine eligibility for compensation (incl. who is eligible and for what assets) and entitlements to compensation including the compensation categories applicable such as in-kind or cash compensation, supportive programs such as trainings, capacity buildings, community development or social investment initiatives, transition allowances, or rights to salvage assets prior to land reclamation;
- the supportive programming that the Project will develop to restore or improve affected people's livelihood;
- the grievance management system that the Project will use to capture and resolve grievances from people affected by land acquisition; and
- the monitoring and evaluation plans that will be implemented to ensure the effectiveness of the resettlements, compensations and livelihoods restorations.

The LRRF will be developed with the aim to:
- ensure that transparent compensation and livelihood restoration rules are adopted;
- prioritize compensation to loss of land (« physical displacement ») with securing land especially when this land is collectively owned;
- develop a livelihood restoration plan;
- proceed to land acquisition and other types of displacement only when compensation and restoration modes are settled with affected parties and agreements have been put in place; and
- ensure that a grievance mechanism is accessible to all affected parties.

The LRRF will be developed with due consideration to the mitigation measures proposed in the Project SEIA Addendum which are but not limited to:
- finalize mining installation plans in order to minimize physical displacement;
- orient displaced people towards hosting areas offering equal economic opportunities than those acquired by the Project;
- develop collective compensations which will benefit to all households (hosts and displaced) such as community infrastructures (school, health facilities, wells, mosque, etc.);
- take into account dependency relationships between families and community lineages of physically displaced households in particular with regard to the choice of reinstallation sites;
- develop preferential hiring procedures for the Project displaced people as described in the Local Development Plan;
- develop economic restoration programs and projects promoting income generating activities benefiting to displaced persons;
- adapt stakeholder engagement plan towards frequent information disclosure and consultations with affected communities and displaced persons in order to limit social tensions during the entire Project lifetime;

- involve local government and traditional authorities in the implementation processes of the resettlement action plan;
- include collective compensation measures and mechanism for stock breeders and herders directly impacted by the Project footprint such as technical trainings supporting animal health, etc.;
- secure mining installations with fencing or soil mound in order to reduce interactions of Project mobile equipment and vehicles with herds and ruminants; and
- include individual and collective compensation measures and mechanisms for agriculture land (including fallow land) directly impacted by the Project footprint, among others through replacement of impacted land with developed and upgraded land that have an high agricultural potential and by developing agricultural development projects such as technical trainings, provision of infrastructure, supply of materials and inputs and seasonal finance or subsidies.

The LRRF will serve as a basis for the development of each stand-alone Resettlement Action Plans (RAP) developed for individual land acquisition processes. RAP will be more detailed and practicable and will be developed throughout the land reclamation process during the Project lifetime. These specific Plans will include the following:

- detailed presentation of baseline conditions, based on the socio-economic census conducted for the displacement process, and compared to the baseline conditions presented in the SEIA;
- consultation results: the input from stakeholders regarding the given displacement;
- detailed assessment of land access impacts for both those displaced and host communities: a complete account of affected populations and household counts, land areas, structures and planted assets to be affected, and an in-depth discussion of acquisition related impacts to livelihoods, access, heritage, social cohesion and overall quality of life;
- final eligibility and entitlement criteria: the procedural steps for establishing the cut-off date, as well as the specific entitlements negotiated with affected people. To the greatest extent possible, entitlements will be maintained as comparable across acquisition processes, to preserve Project practice as equitable and transparent;
- the designs of replacement assets: such as replacement structure designs, site plans for resettlement sites, and infrastructure design;
- implementation timeline;
- organization structure and implementation arrangements: the description of roles and responsibilities of different internal and external stakeholders, for all components of the Plan. Notably, the composition of the RAP Implementation Team within the Project will evolve as the resettlement progresses, and different activities (e.g. technical planning) are completed and others activities (e.g. construction, support programming) are taken up; and
- budget for the Plan's implementation, including any staffing, construction, and other program input costs.

The RAP will include a monitoring program for carrying out the resettlement and assessing resettlement success, livelihood restoration, and levels of broad community support. The program will include a range of monitoring indicators and reporting frequencies. In addition, a third-party audit will be performed to assess the performance of the Resettlement Action Plans implementation with regards to its initial objectives and requirements. Monitoring results may lead to modifications of the Plan.

18.7.8 In-migration management plan

As part of the Local Development Plan that is described in *section 18.7.3*, the Project will develop an In-Migration Plan that addresses how the Project will seek to:

- minimize Project-induced in-migration as far as possible;
- manage and direct the flow of in-migrants in accordance with regional planning objectives;
- implement mitigation measures to address the adverse social and environmental consequences, and
- maximize the benefits of in-migration.

The In-Migration Plan will cover the following key elements:

- communication;
- minimizing potential for in-migration;
- managing and directing influx;
- enhancing physical infrastructure;
- building human capacity to manage influx; and
- monitoring and evaluation of in-migration;

Under the In-Migration Plan's communication activities, the Project will:

- engage with government authorities on issues, risks, and opportunities regarding in-migration;
- engage with local communities to understand their concerns, raise awareness of risks and opportunities;
- identify solutions to issues relating to in-migration;
- develop and implement a targeted communications plan in areas known to be potential sources of in-migration;
- use migrant networks to inform potential in-migrants of the scale and nature of opportunities, manage their expectations, and where appropriate discourage them from moving to the Project area; and
- communicate the Project's policy of recruiting through Local Employment Offices and the locations of those offices through activities targeted at potential in-migrants.

To further minimize the potential for in-migration around Project activities, the Project will:

- maintain a clear security zone around all Project land to avoid informal settlement around the perimeter of Project activities, including accommodation camps;
- operate employee bus services from local settlements as soon as relevant to discourage people from moving from their village to locations closer to Project sites in search of jobs and improve existing roads and build new roads to facilitate access from larger centers to Project sites;
- plan routes for transport of Project materials, goods and personnel taking into account the potential for in-migrants to be attracted into informal roadside settlement; and
- require Project and supplier/contractors vehicles to use planned truck stops as far as possible to discourage setting up of roadside stalls in unsuitable locations.

To manage and direct influx in ways that will minimize its impacts, the Project will work closely with national, regional, local authorities, village leaders and communities to:

- support regional development planning that encourages distribution of opportunities across a wider area to avoid concentration of attraction at key Project locations;
- undertake urban planning and development in larger centers to accommodate in-migrants, in complement with planning for Project employee housing and infrastructure;
- support development of village zoning plans for settlements at high risk from in-migration, to direct in-migrant related development to defined areas where impacts will be minimized and to encourage local people to remain in their villages;
- explicitly include consideration of biodiversity impacts of in-migration, and integration of appropriate responses into the overall program;
- assist with the identification and demarcation of transitional zones for settlement, business, and informal trading in anticipation of an influx of people and associated housing demands, with the aim of directing future settlement patterns and preventing informal settlement; and
- where appropriate and necessary, assist the local authorities in designing controls to restrict access to areas reserved for specific use, and to prevent informal land occupation in the planned area.

The Project's recruitment policies will contribute to directing influx through the following measures:

- the Project will preferentially hire unskilled labor from local communities using a transparent process for distribution of opportunities developed in consultation with the local community and taking into account other impacts on individual settlements;
- resettled households will have priority access to vocational training and employment;
- a database of people looking for work will be maintained and will identify candidates' place of origin; and

- there will be no on site recruitment and all recruitment will be managed from the Project's location designated for jobs application including in the capital Conakry and Kamsar city and Sangarédi,.

In partnership with local authorities and relevant organizations where available and appropriate (e.g. donors, civil society and NGOs), the Project will assist in planning for anticipated increased demands on local infrastructure and services in communities that are significantly affected by in-migration due to Project activities. This assistance will include:

- support for upgrading health, education, water and sanitation facilities in settlements affected by Project activities; and
- focusing Project-workforce housing and vocational training and business support services in larger towns with the most capacity to accommodate new residents.

To support local capacity for in-migration management, the Project will:

- implement an Integrated Capacity Building Program to provide opportunities for local authorities and village communities to plan, prioritize, build and maintain necessary infrastructure;
- in considering capacity-building measures for local government authorities, prioritize institutional strengthening to support a parallel increase in administrative capacity by government partners to cope with increases in in-migration and associated impacts;
- provide technical support to relevant government authorities with the aim of assisting them in effectively administering land development and land use changes as appropriate;
- continue to support the establishment and operation of In-Migration Committees in settlements identified to be at high risk from in-migration. Committees will take part in promoting spatial planning, monitoring in-migration, identifying arising issues, and promoting good relations between local people and in-migrants; and
- work with local authorities and village leaders to actively manage in-migration and its impacts, particularly through registering newcomers and directing them to appropriate accommodation options.

The Project will carry out monitoring of settlements to determine patterns of in-migration, understand the origins, characteristics and motivations of in-migrants, and identify the impacts of in-migration, and will use the results to evaluate the success of its In-Migration Plan and revise it as required. Monitoring, evaluation and plan updating will be undertaken in partnership with In-Migration Committees, local administrations, village leaders, and the community.

18.8 CLOSURE AND RESTORATION AFTER OPERATIONS

18.8.1 Status of closure planning

The Project is committed to restore and rehabilitate land at closure of operations. Therefore a detailed Mine Closure Plan will be developed and periodically updated, in consultation with local communities and the Republic of Guinea. Closure planning will be a dynamic process requiring regular review during mine life to take into account changes in Project configuration, legal obligations, corporate requirements, community expectations and technical knowledge.

A Conceptual Closure and Implementation Plan was developed in 2008 as part of the SEIA performed in 2008 (*Knight Piésold, 2008*) to cover GAC's overall development plan including a refinery and red mud disposal facility. Subsequently a Preliminary Mine Rehabilitation Plan was developed to cover rehabilitation of plateaus 32, 33, 34 & 37. The development of the Mine Closure Plan will cover the entire Mine area of the Bauxite Export Project following the approach developed below and principles and requirements of the previously developed rehabilitation plans.

On closure it is anticipated that the port site and rail spurs will be handed over to the government of Guinea for their use and therefore the Mine Closure Plan addresses only the mine site area. If needed, a specific Port Closure Plan will be developed before the closure of the Project in consultation with government authorities in order to plan decommissioning of Port facilities and equipment and hand over of the site to the government of Guinea.

18.8.2 Objectives

The Project's general objectives for mine closure will be:

- to relinquish the site in a condition that minimizes risks to human health or safety and to the natural environment;
- to relinquish a stable and uncontaminated site, where the majority of the site is suitable for an agreed future land use;
- to construct post-mining landforms that are consistent with the natural environment landforms;
- to create sustainable water drainage patterns, allowing water flows from the Project area to be consistent with natural water flows, and to ensure that water quality is suitable for the proposed land use; and
- to establish sustainable endemic vegetation units consistent with surrounding undisturbed vegetation and suitable for the support of the future land use option;
- to maintain, or enhance where possible, soil productivity;
- to re-establish the native ecosystem (indigenous flora and fauna) to reflect pre-Project conditions, and, where possible, generate a net positive impact on biodiversity.

Mine closure will be conducted in a manner that:

- provides employees with the opportunity to determine their own quality-of-life outcomes resulting from mining cessation and closure, including redeployment if possible, or retirement;
- transfers appropriate skilled and experienced personnel within GAC;
- retains human resources to implement closure plans; and
- maintains a safe and healthy working environment throughout the closure process.

18.8.3 Stakeholder engagement

Throughout closure the Project will maintain and document a comprehensive stakeholder information, communication and consultation program.

Plans for future land use the Project will be proposed in consultation with Guinean authorities, taking into account feedback from consultation with affected stakeholders, including local communities, businesses, and others as relevant. Particular attention will be given to proposing plans that take into account vulnerable groups and provide opportunities for those groups to benefit. They will consider the specific values and sensitivities of the surrounding physical and biological environment, as well as the socio-economic circumstances of the immediate locality and the region. The mine closure plan will take into account local and regional land use plans, and objectives agreed with the community and the Republic of Guinea.

18.8.4 Mine area rehabilitation

18.8.4.1 Status of mined areas prior to closure and rehabilitation

Upon mine closure, the mine pits will remain as terrain of lower-than-before elevation – since the bauxite deposits extend on average to approximately 8 m deep from the surface, the mine pits area will be on average 8 m lower than before (i.e. a relatively modest change in elevation considering that the bauxite deposits are located at the top of plateaus, up to approximately 200 m above the bottom of valleys).

The mine closure plan will aim to minimize the formation of pit lakes within these open pits as lakes present an ongoing safety hazard to people and any wildlife or livestock that visit the mined-out areas.

18.8.4.2 Progressive closure and rehabilitation of mined areas

Across Project life, mining activities will progressively deplete the bauxite resources, and so the initial pits will progressively be closed and rehabilitated to allow for the opening of new pits.

The estimated average mining life of one pit will be approximately two to four years.

The Project plans to mine the high grade bauxite ore and associated refinery grade ore in a single mining campaign. Refinery grade bauxite, extracted simultaneously with export grade bauxite, will be stockpiled on the plateaus for future use. GAC does not intend to re-mine an already mined area in the future. This approach will allow rehabilitating definitively a mined area immediately after the end of its first and only mining operation reducing the mining operation's footprint.

Once a pit becomes disused, initial mine closure and rehabilitation activities may start. These will follow the principles of the Mine Closure and Rehabilitation plan, particularly with regards to safety, drainage, and reinstatement of soils and ecosystems in a manner consistent with the natural environment, and land use plans agreed through the stakeholder engagement process.

Progressive pit closure and rehabilitation may include:

- flora inventory before pit exploitation;
- consultation program and rehabilitation plan agreement;
- establishment of nurseries;
- re-contouring and re-grading the pit surfaces to avoid sharp terrain discontinuities and steep pit edges, and to reinstate natural drainage conditions;
- decompaction of mine base to allow for greater re-vegetation success and permit water infiltration;
- surface spreading of topsoil put aside during site preparation;
- re-vegetation or preparation of the land for agriculture (depending on stakeholder expectations);
- managing access to rehabilitated pits to avoid interference or health and safety hazards associated with the proximity of actively mined pits or mine-related vehicle traffic;
- return of rehabilitated land to the communities.

Rehabilited pits will be subject to regular environmental monitoring during the Project lifetime to verify that rehabilitation objectives are being met, and define corrective actions if not.

18.8.4.3 Mine infrastructure and facilities

All mining facilities not required for ongoing social or environmental purposes will be dismantled and removed to be reused elsewhere or recycled. The Plan will include specific provisions for but not limited to:

- the decommissioning and removal of tanks;
- demolition and removal of buildings;
- break-up and removal of foundations;
- decommissioning and removal of pipelines;
- removal of transmission lines;
- removal of culverts and bridges;
- removal and treatment of wastes, including hazardous materials;

- decommissioning of machinery and mobile equipment; and
- management of contaminated soil.

General surface rehabilitation will be implemented at areas where mine facilities were removed, where land has been generally disturbed during mine operations, and at the waste emplacement areas. Areas will be revegetated as far as practicable and, where appropriate, land will be returned to its previous use or to alternative uses agreed with the local community and the government.

All major access and haul road areas within the mine perimeter will be removed and surfaces rehabilitated and revegetated. Minor access roads to villages will remain, to allow for community access.

18.8.4.4 Temporary mine closure care and maintenance

Defined or indefinite period of temporary closure (care and maintenance) of the mine, and therefore of the Project facilities may occur as a result of a change in market conditions or mine-related factors. A state of inactivity may lead to permanent closure if prevailing conditions do not improve. A timeframe for determining when temporary closure leads to permanent closure will be identified in the Mine Closure Plan.

The objective of temporary closure is to ensure that the site meets proper physical and geochemical stability, and that all environmental and safety requirements are met or exceeded through monitoring and maintenance of the site throughout this period.

Activities during temporary closure will include, but not be limited to:

- collect site runoff from the Crusher and Mine site areas and maintain water management structures and treatment facilities to ensure controlled discharges;
- monitor and maintain all retaining wall structures and erosion and sediment control measures to ensure slope stability;
- monitoring and maintain all buildings and facilities at the mine site;
- maintain the site access roads;
- ensure security measures are implemented and appropriate to prevent entry or vandalism.

The following measures will be conducted to bring the Project to a temporary closure state:

- chemicals or reagents with a short shelf life (depending on the anticipated timeframe for temporary closure) will be returned to suppliers/manufacturers or where the chemicals may not be returned, they will be disposed of in a proper manner as per manufacturer's requirements;
- all fuel storage tanks will be emptied by a trained and licensed contractor. The storage tanks and distribution systems that will not be reused will be decommissioned (cleaned) and sold for scrap;

- monitoring will be conducted at regular intervals (exact timing to be determined) to ensure compliance with the applicable permits/ approvals;
- inspection of structures such as the ore stockpiles, fuel and storage tanks, pipelines and site ditches and culverts to ensure physical stability and integrity;
- collection of surface runoff from the Project facility areas including monitoring to ensure the water management collection systems are efficiently operating.

18.8.5 Monitoring & reporting

The rehabilitated areas will be monitored during the life of the mine and the monitoring program will consist of the following elements:

- inspection of the overall stability of the rehabilitated areas for evidence of erosion, landslide, etc. following a major storm event and at the end of the initial rainy season;
- monitor for water quality upstream and downstream of rehabilitated areas (using baseline obtained for the SEIA and then annual monitoring results);
- inspection of the re-vegetated areas after the first year;
- after two years, an evaluation of the effectiveness of the rehabilitation activities (number and type of plant species, plant heights, productivity, threatened species, eroded areas, etc.); and
- every five years, investigate success of re-vegetation and conduct faunal surveys to assess use of rehabilitated areas.

Sampling methods (parcels, techniques, etc.) for the monitoring program will be determined as the detailed closure plan is developed. Monitoring results will be used to revise the success of the Plan with regard to its original objectives. Upon need the Plan will be enhanced and additional rehabilitation activities will be performed where needed.

Follow-up reports will be prepared, and the results will be shared with concerned parties and the local population through community meetings.

18.9 IMPLEMENTATION PLAN

This section describes the structure, the means and capacity that are needed to ensure an efficient and strict implementation of the Project Social and environmental Management Plan. Therefore the following aspects of the implementation plan are described below:

- roles and responsibilities for the correct implementation and follow-up of the SEMP;
- training and awareness programs that are needed to ensure the plan is communicated and followed by all Project employees and subcontractors;
- deadlines to be respected to ensure a phased approached to the implementation of the SEMP;
- budget to be provisioned to ensure cost associated with the SEMP implementation are covered by the Project;
- surveillance and monitoring of the implementation and results of the SEMP to ensure it is implemented in accordance with its objectives and requirements, including regular revisions of the SEMP to achieve continuous improvement and to account for social, environmental, legal, political and Project changes; and
- environmental reporting and stakeholder engagement in order to communicate transparently on the SEMP implementation and results and to take into account relevant stakeholders feedback into the SEMP revisions.

18.9.1 Roles and responsibilities

This section describes the organization of social and environmental management for application of the SEMP during the various phases of the Project.

18.9.1.1 The proponent

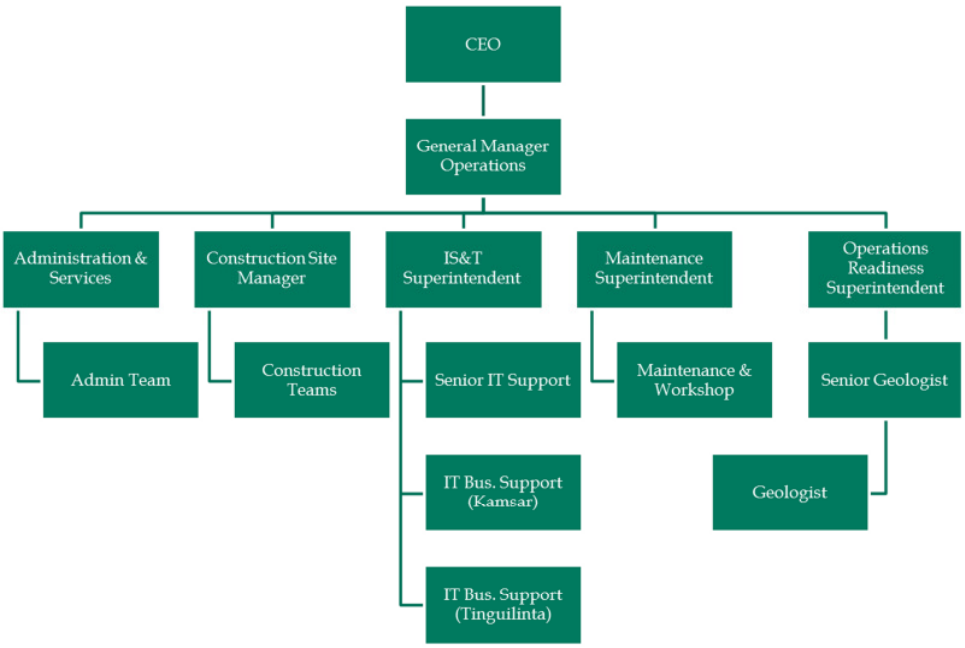
As Project promoter and owner, GAC will take general responsibility for correct application of the SEMP. Responsibilities for the implementation the SEMP are specifically assigned to the senior management team. Senior management will be responsible to ensure that the SEMP is implemented by the Project employees and contractors, including but not limited to by providing the necessary support and infrastructure, tools, staffing and financial means.

GAC management team and supporting staff will be responsible for developing the Discipline Specific Management Plans (DSMP) and operational procedures described in the overarching SEMP. The development of some DSMP or operational procedures may be delegated through the contracts to Project contractors and subcontractors when their scope is associated with activities only undertaken by them.

GAC management team remains responsible to ensure that management plans and other requirements of the SEMP are implemented globally and at site level by all Project employees and contractors.

The following organization chart in *Figure 18.5* identifies the reporting structure and the specific responsibilities assigned to each GAC manager. The Chief Executive Officer is ultimately responsible for all actions and management plans called for by this SEMP since all senior management staff and Project contractors report directly to him.

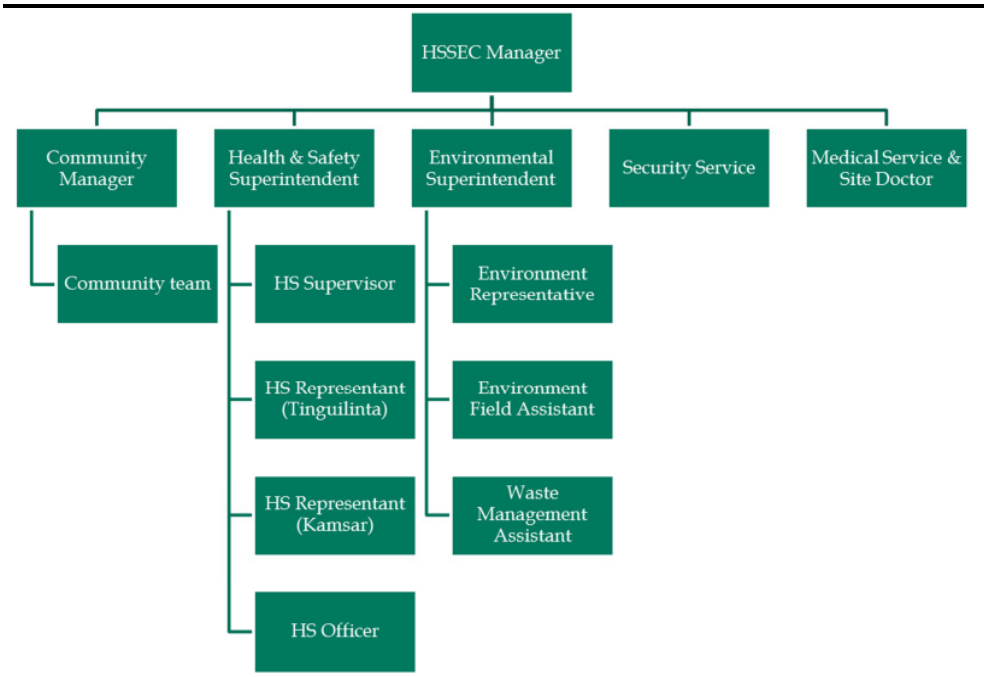
Figure 18.5 Operations management team



The Environmental, Social and Health and Safety team members and the Site managers will be responsible for the implementation of the SEMP at the Port and Mine area. They will report to the HSSEC Manager directly in line with the GAC CEO.

The HSSEC Manager is responsible for all environment, health and safety management plans associated to the SEMP and for environmental awareness and training, health and safety training, security, waste management, regulatory compliance, compliance audits, stakeholder engagement, resettlement plan implementation, community training and capacity building, Local Development Plan, stakeholder engagement and grievance resolution. These responsibilities will be assigned to individual positions within the HSSEC team as appropriate (*Figure 18.6*), but the ultimate management responsibility lies with the GAC HSSEC Manager and CEO.

Figure 18.6 HSSEC management team



Key HSSEC Manager responsibilities include the following:

- acting as a point of contact with Project contractors and subcontractors with respect to environmental, social and safety issues;
- documenting that environmental procedures are followed as planned by GAC and its contractors;
- auditing the Project contractors with regard to the implementation of the SEMP;
- liaising with members of the public, communities, local organizations, and governmental and non-governmental organizations on social and environmental issues; and
  reporting results of social and environmental mitigation and enhancement measures and monitoring activities to the Guinean authorities, project lenders, and other applicable parties.

18.9.1.2 Contractors and subcontractors

GAC will retain an EPCM contractor who will be responsible for the engineering, procurement, construction and management activities during the construction phase. Additional smaller task-specific contractors may be involved in the construction and operational activities of the Project.

While GAC is always responsible for implementing the commitments of the SEMP, Project contractors will accomplish these responsibilities on GAC's behalf for the activities within their remit. They will be contractually obliged to implement the commitments of this Plan according to their areas of operation and specific activities.

They will also be responsible for continuous management of potential social and environmental impacts associated with their activities within the context of their mandate from GAC, whether these activities are carried out by them or by their sub-contractors.

18.9.2 Training and awareness programs

Training and awareness programs aim at supporting the implementation of the SEMP by disseminating information, increasing awareness and building capacity of all those who have a shared responsibility to support the Project in achieving high environment, health and safety standards.

18.9.2.1 Training of Project personnel and local communities

Training of Project employees and contractors in issues relating to environmental management, industrial and work station safety and social awareness is an important element on which the Project's ability to meet the objectives of the SEMP depends.

Training is required at GAC in order to maintain a high level of knowledge of HSSEC procedures and standards, commensurate with the social and environmental management objectives and plan.

Most of Discipline Specific Management Plans include a section on training of Project personnel to ensure plans and procedures are known, implemented and respected by all. Such training are but not limited to:

- understanding of social and environmental sensitivities associated with the Project and of mitigation and enhancement measures in place or foreseen;
- knowledge of risks associated with work and applicable health & safety procedures;
- task-specific training for each new job assignment;
- understanding of adequate procedures associated with the use and handling of hazardous materials;
- awareness of health risks and prevention measures associated with sexually transmittable diseases and other communicable diseases;
- knowledge of safety and community friendly transportation and travel procedures;
- awareness of employment conditions and personnel rights;
- knowledge of, and training in, emergency procedures;
- knowledge on workers code of conduct;
- understanding of local communities and rules of interactions;
- understanding of the Project Local Development Plan and associated development programs;
- awareness of cultural heritage sites in the Project area and Project procedures to avoid, minimize or compensate impacts;
- understanding of resettlement initiatives, principles and monitoring; and
- knowledge of Project stakeholder engagement plan and grievance mechanism.

Other subjects could be defined depending on staff competencies at various work stations and their hierarchical levels. Not all trainings should be provided to every Project personnel, trainings should be assigned in function of employee's areas of activities, specialization and duties, type of job performed and exposure to risks, etc.

An initial health, safety environment and community training will be provided to all new Project personnel, contractor and consultant and as an annual refresher throughout the life of the Project. Contractors and consultants who work at the Project will be required to adhere to all of the Project's health, safety, environment and community policies and procedures.

It is the responsibility of the HSSEC Manager to ensure all trainings and awareness programs required by the SEMP and associated DSMP and operational procedures are effectively implemented and attended by Project personnel. A register of all trainings available and requirements in terms of personnel attendance, timing and frequency must be developed. All training attendees will be recorded in the training register.

In addition the HSSEC team will work with GAC's communication department to develop banners, posters, leaflets, and safety and traffic signs, easily understandable by all, to ensure basic environmental, health and safety rules are reminded to Project personnel.

In parallel to these internal training and communication campaigns, there will also be communication actions, consultations and training provided to local communities. These awareness actions, which are measures to accompany the Project's residual impacts, were presented in *Section 18.4* and within relevant DSMP such as but not limited to Social investment, Emergency response, Health and safety and livelihood restoration action plans.

18.9.2.2 Training and capacity building of Guinean environmental authorities

As indicated in the Local Development Plan, capacity building will be provided to Guinean local, regional and national authorities with respect to the surveillance and monitoring of projects. Support and capacity building will be provided to local authorities to manage in-migration in the area by developing census and land tenure management capacities, preventing spontaneous settlements and developing infrastructures and services in response to population growth. Official planning and traditional authorities will also be involved in the resettlement process which will increase their competence in land tenure management.

18.9.3 Implementation deadlines

The timing of implementation of measures described in the SEMP will depend on the timing of activities or impacts they cover. DSMP and operational procedures need to be developed as soon as reasonably practicable to ensure

they can be implemented prior to the start of construction or activities they cover (e.g. Resettlement Action Plan must be implemented prior to land reclamation while the Noise and vibration management plan must be ready for the start of construction). If necessary, Preliminary Management Plans, limited in scope; may be developed to cover specific activities which are not yet covered by one the DSMP or operational procedures described above.

More details on the timing of implementation of the impacts mitigation and enhancement measures are given in the impacts mitigation and enhancement plan in *Section 18.4.*

It is the responsibility of GAC senior management and its HSSEC Manager to ensure that all measures described in the SEMP are implemented on time.

18.9.4 High-level budget estimates for implementation

The budget given for each management measures was estimated on the basis of an average cost of 6 000 000 Guinean Franc/person-month. This amount is proposed as an estimated average cost of employment, including salary and taxes. It also takes into account the likely material/equipment costs of implementing measures, wherever possible. For mitigation measures that are already integrated into Project design, the budget required for their implementation is deemed to be included in the Project's investment expenditure (CAPEX) and operational expenditure (OPEX). The actual amounts exclude costs associated with:

- resettlement Action Plan (RAP) OPEX and CAPEX;
- offset Program for chimpanzees to be eventually developed ;
- mining site rehabilitation and closure ;
- initial CAPEX (e.g. construction of a wastewater treatment plant); and
- OPEX related to management structure (e.g. salaries of management team –EHS manager or Social manager or Human resources manager etc.)

The budget for each management measure presented in *Section 18.4* includes the costs of implementing the measure. These estimates are still to be refined closer to the time of implementation; as they are based on the costs of equipment and salaries at the time of writing the SEMP.

Some of these mitigation measures have been implemented during the project conception phase. For those measures, the associated costs are included in the investment costs (CAPEX) and in the operational costs (OPEX).

Estimated budget for the implementation of mitigation and enhancement measures that have not been taken into account during the conception phase is presented in *Table 18.12*. It will be GAC senior management's responsibility to ensure sufficient budget is provisioned on a yearly basis to enable the SEMP implementation.

Table 18.12 Budget for SEMP implementation

Mitigation measures	Activity	Port area		Mine area	
		CAPEX	OPEX Per year	CAPEX	OPEX per year
All figures provided in this table are in millions of Guinean Francs (mGNF) and USD					
Implementation of environmental management plans	Offices equipment, cars and staff salary to manage the plans implementation (SEMP)	USD 41 600 mGNF 320	USD 28 600 mGNF 220	USD 87 750 mGNF 675	USD 70 200 mGNF 540
Training of staff and contractors	All training or sensitization planned to be delivered to GAC and contractors staff		Construction (first year) USD 39 000 mNGF 300 Operation: USD 19 500/y mGNF 150/y		Construction (first year) USD 84 500 mGNF 650 Operation: USD 41 600/y mGNF 320/y
Physical impacts monitoring (air, noise, vibration)	Monitoring equipment, consumables, internal and external laboratories charges to monitor and report on air quality, noise, vibration	USD 10 400 mGNF 80	USD 10 400 mGNF 80	USD 26 00 mGNF 200	USD 35 100 mGNF 270
Physical impacts monitoring (surface and ground water)	Monitoring equipment, consumables, internal and external laboratories charges to monitor and report on surface and groundwater quality, discharged wastewater quality	X	X	USD 15 600 mGNF 120	USD 65 000 mGNF 500
Biodiversity	Wildlife monitoring program implementation (will likely be partially contracted)				USD 117 000 mGNF 900
Implementation of social management plans	Offices equipment, cars and staff salary to manage the plans implementation (SEMP)	USD 39 000 mGNF 300	USD 26 000 mGNF 200	USD 78 000 mGNF 600	USD 52 000 mGNF 400
Road safety and communities movements difficulties	Improve safety at crossing points with haul roads, build alternative tracks and crossing point over watercourse	To be determined			To be determined

Mitigation measures	Activity	Port area		Mine area	
		CAPEX	OPEX Per year	CAPEX	OPEX per year
Landscape and noise impacts for communities	Revegetation and reforestation of sites located on the edge of settlements			USD 58 300 mGNF 450	USD 97 500 mGNF 750
Local Development Plan and Local Development Agreement implementation	Improvement of communities' access to infrastructure and public services (education, healthcare, drinking water etc.)		To be determined		To be determined
Local development tax					USD 500 000 for the first 15 years; then USD 1 000 000 mGNF 4 000 for the first 15 years then 8 000 mNGF

18.9.5 Social and environmental surveillance and monitoring

18.9.5.1 Internal monitoring

Surveillance and monitoring of Project's social and environmental impacts are a key aspect of an effective social and environmental management system. It informs the Project how well the potential impacts have been forecasted and if the proposed reduction and enhancement measures are correctly implemented and whether they are sufficient or not. Monitoring results and reporting enable the fine tuning of the measures and support management decision on required changes to the managing system and organization allowing for continuous improvement of the Project environmental, social and safety performance. The need for changes to measures in place will be based on social and environmental quantitative thresholds or qualitative criteria as defined in the SEIA Addendum for the Project and/or the Social and environmental Monitoring Plan.

The monitoring required to document the effectiveness of the impacts reduction and enhancement measures is developed using the results of the SEIA Addendum. Impacts to be monitored and used methodologies (e.g. sampling tools, frequency and location) are detailed in the Project Social and environmental Monitoring Plan in *Chapter 19*. This Plan draws up on GAC's existing Environmental Monitoring Plan adapting it to GAC's Bauxite Export Mining Project and the results of its SEIA Addendum.

GAC will be responsible for conducting the required monitoring with support from its contractors which will be required to accomplish some of the monitoring obligations, specifically for construction and operational impacts directly dependent on them. Depending on the monitoring needs and complexity of the impacts, specialist consultants working on GAC's behalf may be contracted to perform part of the monitoring work. GAC remains ultimately responsible for the Project social and environmental performance and for its monitoring.

Monitoring will occur throughout all phases of the Project with the aim of demonstrating Project's compliance with relevant Guinean regulation, international financing standards and guidelines applicable to this Project, Project permits and commitments, including but not limited to from the Project SEIA Addendum.

As described in *Section 18.4*, Impacts *mitigation and enhancement plan*, appropriate monitoring indicators have been developed to support the monitoring effort of the Project. Monitoring will be performed during all phase of the Project, including during closure and rehabilitation. For example, key aspects of monitoring are but not limited to:

- discharges and treatment of waste and waste waters;
- control of air quality, noise and vibration;

- project water consumption and water quality and availability;
- occupational health and safety;
- community wellbeing, health and safety;
- influx management;
- protection of critical habitats and biodiversity;
- stakeholder engagement;
- resettlement of displaced persons and restoration of livelihoods; and
- effectiveness of sites rehabilitation measures.

The Social and Environmental Monitoring Plan will include provisions on the development of an effective social and environmental data collection and management system allowing for continuous or regular collection, classification and recording of required project data and documents that are necessary to conduct the Project social and environmental surveillance and reporting.

Reporting of the Project social and environmental performance will be based on monitoring results. The Project will accomplish the required monitoring and will submit required reports to the Guinean authorities and financial institutions as outlined in *Section 18.9.6, Social and environmental reporting and stakeholder engagement* and detailed in *Chapter 19, Social and environmental Monitoring Plan*.

18.9.5.2 Prefectural surveillance committee

The Government of Guinea plans to put in place at a local level (Préfecture de Boké) a committee dedicated to the surveillance of the SEMP implementation. Rules defining the organization and functioning of this committee are not yet fixed.

18.9.5.3 Independent audit

In order to ensure third party independent control of the Project social and environmental performance, GAC has also committed to conduct periodic independent audits of its activities. During the initial phase of the Project, before the financial close, the lenders will appoint a Lenders Consultant which will review the technical, environmental, social and economic viability of the Project. In terms of social and environmental viability, it will review the following documents:

- SEIA Addendum;
- Social and Environmental Management Plan;
- Stakeholder Engagement Plan; and
- Environmental, social and safety procedures and systems in place or foreseen.

The Project viability will be reviewed with regard to the Guinean regulation, requirements and guidelines from International financing institutions, other international organizations and industry best practice as defined in section 18.3.

At the Project start or at Lender's Project Completion an independent consultant will be jointly appointed by the lenders and the Project to perform regular/annual audits of the Project social and environmental performance during the entire Project lifetime including mine closure and post closure for relevant actions undertaken. The responsibility of how the Project addresses the audits recommendations lies with the Project Director which may decide to assign the daily follow-up to its HSSEC Manager and their team.

On its own, GAC will also perform independent audits of its contractor's social and environmental performance, including supply chain requirements. The responsibility of the audit will lie with the HSSEC Manager and auditing tasks may be delegated to other employees and/or external consultants as relevant.

18.9.5.4 Management of change

During the Project implementation changes may be required to address unforeseen conditions or situations. Where changes to the Project processes, design or activities are necessary a Management of Change process will be triggered. The process will allow for social and environmental issues to be addressed as part of any significant changes to the Project. Results of this process may require updates or addendums to the Project SEIA studies or to GAC's or contractors respective Social and environmental Management Plans, and Procedures in place.

The Management of Change process will be implemented as follow:

1. Identification of item/situation requiring change.

2. Preparation of a Change Request Document that:
    - outlines the nature of the situation requiring change;
    - outlines the impacts of the change (e.g. cost, schedule, safety, operability); and
    - identifies potential environmental, social, economic or health concerns.

3. Review the Change Request Document for compatibility with GAC's Environmental studies and GAC's or contractor SEMP or procedures by and as applicable:
    - the task manager level for minor changes;
    - the CEO, Project Director and HSSEC Manager for significant changes; and
    - the environmental ministry and financial lenders (as appropriate) for significant changes.

4. Documentation of the approval or rejection of the change request.

5. Application for, and receipt of, any approvals required to effect the change under the Guinean law.

6. If considered necessary update or addendums to the Project SEIA studies or to GAC's or contractors respective Social and environmental Management Plans, and Procedures in place.

7. Implementation of the approved change, including communication to appropriate parties concerning the nature, scope and timing of the change, including measures that have been taken to mitigation potential social and environmental impacts.

8. Summary of project changes and status to be included in annual reports to the environmental ministry and lenders.

18.9.6 Social and environmental reporting and stakeholder engagement

External Social and environmental reporting and Project transparency serves the purpose of maintaining Project's stakeholders' confidence in the Project. It provides a mean of engaging with stakeholders and to demonstrate the Project social and environmental performance. Eventually it enables stakeholders to engage or challenge the Project with respect to social and environmental issues which supports the Project objective of continuous improvement.

Internal monitoring enables to disclose and share information internally to support compliance by the Project employees and contractors to the Project and to its social and environmental objectives including actions that are required by all for their achievement.

The Project will develop mechanisms for appropriate internal and external reporting of the Project social and environmental performance and more specifically on the implementation of the SEMP and monitoring results. Reporting will include but not be limited to:

- SEIA Addendum including the SEMP upon disclosure;
- Stakeholder Engagement Plan and annual updates as the Project evolves;
- annual Environmental, Social and Health & Safety Report to corporate owners and stakeholders published in English and French;
- Community Information Bulletin distributed approximately on a quarterly basis;
- other external reports to Guinean authorities, Project lenders, local communities or other Project stakeholders as relevant or required;
- internal quarterly report on stakeholder engagement activities;
- internal quarterly report on Project's social and environmental performances including mitigation actions taken or recommended;
- internal monthly grievances monitoring report;
- revenue declaration of payments made to the Government of Guinea to the Extractive Industries Transparency Initiative (EITI) committee in Guinea;

- periodic reports highlighting deviations of the SEMP, Project changes and other issues pertaining to performance as they occur; and
- timely reports for emergency and crisis situation including, but not limited to accidents and occupational illnesses, spills, fires and other incidents should they occur.

During construction EPCM contractor will be required to provide GAC HSSEC Manager with a quarterly report containing current monitoring results (and an historical summary), details on environmental issues encountered, effectiveness of the solutions implemented and of social and environmental mitigation measures under their responsibility. These quarterly reports will be used as source of information for GAC's internal quarterly reports.

The Annual Environmental, Social and Health and Safety report will summarize the Project activities and achievements and characterize the health, safety, social and environmental performances over the past period; and anticipate the plans and actions that will be accomplished in the forthcoming year. These Annual reports should include a compilation of monitoring accomplished and address, but not be limited to, the following:

- description of significant environmental, health and safety incidents that occurred during the reporting period;
- description of significant community issues and/or grievances that occurred during the reporting period;
- summary of significant activities accomplished and outcomes pursuant to the SEMP, including commitments in the SEP, RAP and livelihood restoration program and LDP;
- summary of the Social and environmental Monitoring Plan results;
- explanation of violations of any Guinean law, regulation or social and environmental requirements should they occur and actions or strategy for their resolution;
- summary of reclamation and revegetation work carried out and projection of the planned land disturbances and reclamation activities to be accomplished in the coming period;
- summary of the status of permits, licenses, or other approvals that will be required or will expire;
- description of significant changes to the Project occurred during the reporting period or foreseen including steps undertaken as part of the Management of Change process; and
- disclosure of Project payments to the Guinean government and the relevant terms of key agreements between GAC and the GoG to assure transparency of payments.

More details on the Project external reporting are provided in the Stakeholder Engagement Plan, including activities undertaken so far, reports published or distributed and plans for future engagement.

TABLES

FIGURES

19.1 INTRODUCTION

Social and environmental monitoring activities are an important element of the Project's social and environmental management plan (SEMP). It will aim at verifying whether the predictions made in the impact assessment studies for both social and environment aspects are correct, as the Project progresses – therefore allowing to document the effectiveness of mitigation and enhancement measures, and allowing to work on the adjustment or definition of additional mitigation measures, if required.

This chapter presents general guidance and protocols for collecting the information, data and samples required to meet the monitoring commitments, along with guidance on monitoring procedures, indicators and data management. Where possible, specific monitoring locations are indicated, or to the least the strategy for defining them when the infrastructure construction details and the mining plan will be defined.

A key aspect of an effective SEMS is how well it can efficiently be adjusted or corrected to reflect changes in environmental and social conditions, Project design and operation, and allow for appropriate/timely modifications in order to maintain a high level of Projects health, safety, environment, and community safety and wellbeing performance. Where possible, specific indicators, thresholds and guidelines for corrective action in the SEMS are presented in this section. Some actions may require further development and refining as the Project database for each resource is expanded. Implementing a technically adequate monitoring approach, including sampling/data collection, analysis, interpretation, and reporting program is key to disclosing an accurate picture of Project impacts on the environment and the community.

Monitoring will occur throughout all phases of the Project, with the aim of demonstrating:

- compliance with relevant Guinean standards, Equator Principles/IFC EHS Guidelines/ AfDB Operational Safeguards, and management commitments;
- the need for any contingency investigations and/or mitigation measures if unexpected impacts are detected; and
- facilitating continuous improvement and best management practice.

During construction, GAC may delegate some monitoring activities to the Project's EPCM contractor. However, GAC remains the ultimate entity responsible for implementing the monitoring plan.

19.1.1 *Overview*

The purpose of this monitoring plan is to set the framework through which data can be collected in order to:

- establish a phased monitoring strategy that considers progression of mining activities over the 20-year concession period;
- assess the performance of controls at both the mine site and the port terminal to applicable standards and support compliance reporting;
- allow for ongoing data collection to support a robust set of baseline data prior to mining, assess performance against standards during mining, and post closure monitoring to assess the success of closure procedures;
- provide data to form the basis for the development of mining concession ambient standards where appropriate;
- use results to refine and adapt controls and develop ambient standards where appropriate; and
- inform operations and management on environmental and social performance.

The main monitoring themes to be undertaken during both construction and operations; at the mine concessions as well as within Kamsar port; are the following:

- Physical:
  - air quality;
  - noise and vibration;
  - surface water quality/quantity;
  - groundwater quality and soils
  - seawater quality;
  - topography and visual resources;
  - waste; and
  - hazardous materials.

- Biological:
  - flora and vegetation;
  - fauna;
  - freshwater ecosystems.

- Social:
  - resettlement practices and livelihood restoration;
  - demographics and social dynamics;
  - power, governance and civil society;
  - land use;
  - agriculture/livestock;
  - fishing and access to natural resources;
  - local socioeconomic context;
  - health and safety;
  - education;
  - mobility, flows and transport;
  - living conditions; and
  - cultural heritage.

19.1.2 Standards and good practice guidance

National and international standards and good practice guidance applying to the Project are presented in the Social and Environmental Impact Assessment (SEIA) report. This includes, in particular, standards for the management of air and water quality, noise & vibration, communities resettlement, stakeholder engagement and local communities wellbeing. The intention of this Monitoring Plan is to set out the initial methodology through which data will be collected to assess environmental/social parameters in the GAC concession against these standards.

More precisely, the standards applying for the Project arise from:

- Guinean regulation and international standards as described in Chapter *2, Institutional and Regulatory Framework*, in particular:
  - norms on biodiversity, forestry, air emission, noise & vibration, water quality and waste management as detailed in *Section 2.2.6*;
  - the Guinean Mining Code (2013), including specific requirements on employment, health & safety and the environment in general;
  - specific social legislations as detailed in *Section 2.2.7*;
  - IFC Performance Standards and EHS guidelines as detailed in *Section 2.5* ; and
  - AfDB Operational Safeguards and Sector Keysheets as detailed in *Section 2.6.*

- Project's commitments on environmental and social impacts, mitigations and performance targets as defined in Chapters 8 and 9;

- GAC design criteria documents, procedures, policies and management plans as listed in Chapter *18, Social and Environmental Management Plan;*

- additional guidance on social themes such as but not limited to:
  - Stakeholder Engagement: A Good Practice Handbook for Companies Doing Business in Emerging Market, IFC, 2007;
  - Projects and People: A Handbook for Addressing Project Induced In-Migration, IFC, 2009;
  - Handbook for Preparing a Resettlement Action Plan, IFC, 2002;
  - World Bank Operational Policy 4.12 – Involuntary Resettlement, Revised April 2013;
  - Strategic Community Investment: A Good Practice Handbook for Companies Doing Business in Emerging Market, IFC, 2010.

19.2 PROJECT AREA COVERED IN THE MONITORING PLAN

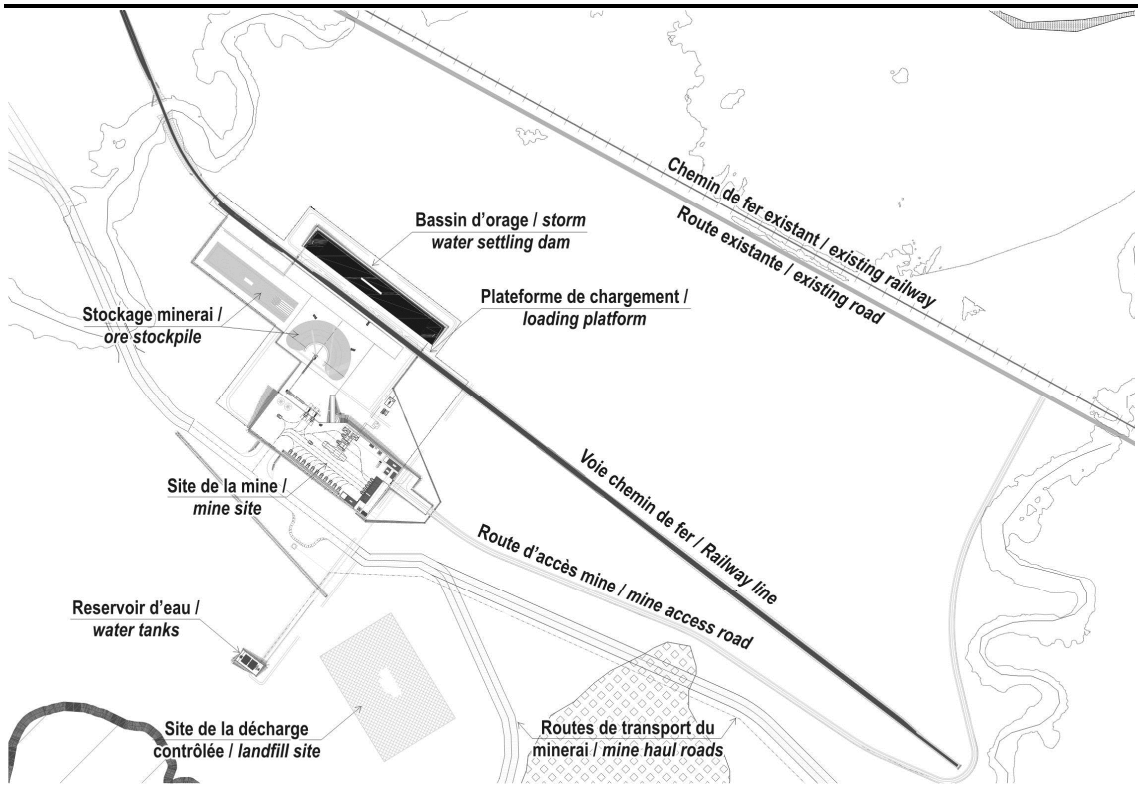
19.2.1 Mine area

Various facilities and infrastructure will have to be developed as part of the construction phase in the MA, including:

- extension of the railway line with a rail spur from the ANAIM line to the GAC loading station;
- processing facility;
- bauxite stockpiling;
- bauxite loading area;
- fuel depot;
- electricity generator;
- water storage and processing area;
- housing;
- administrative buildings;
- car park for the vehicles and trucks and mechanical workshop; and
- haul roads and bridges.

Figure 19.1 represents the spatial coverage of the proposed processing facility in the MA.

Figure 19.1 General layout of mine infrastructure area at plateau 26



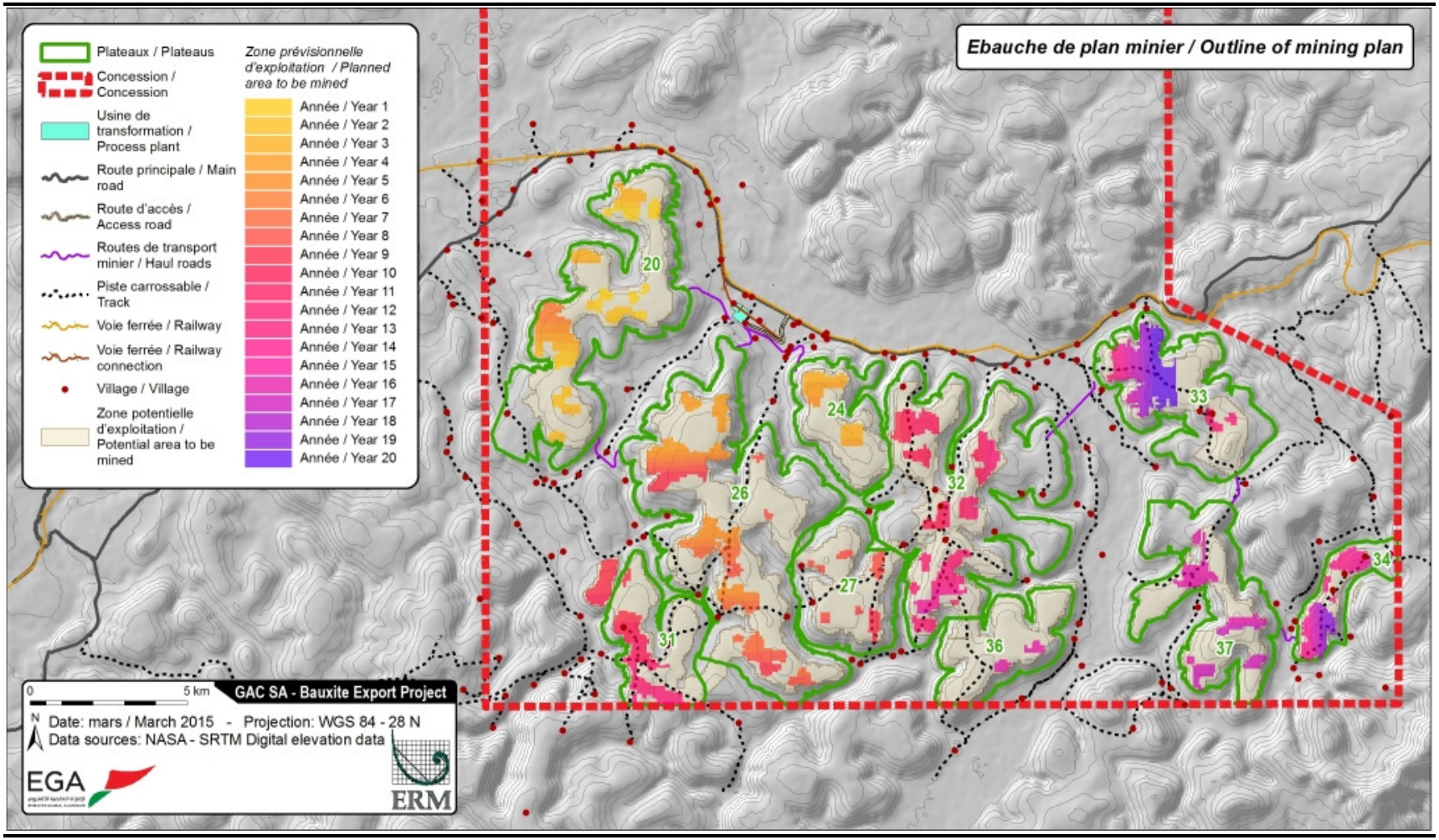
Mining operations will progress from west to east, commencing at Plateau 20. At any given stage during mine life, GAC expects that three or more plateaus could be concurrently mined.

The anticipated mining sequence is shown in *Figure 19.2*. The progression of works from west to east will be reflected in the prospective placement of the monitoring equipment and the schedule for initiating monitoring. It is therefore recommended that this plan be reviewed following confirmation of the mining sequence at detailed design.

The mine has been designed to provide both export and future refinery-grades to the crusher and plateau stockpiles respectively. Refinery-grade material will be mined concurrently with export grade and stockpiled separately for future use. Areas of solely refinery grade ore will not be mined but left in-situ. No further mining will be undertaken in these areas. This will allow for immediate mine restoration to occur on the mined-out areas.

The mine area is essentially rural and is located across the Rural Communes (RC) (which corresponds to two Sub-Prefectures) of Sangarédi and Tanéné, physically and administratively separated by the river Tinguilinta. Both are connected to Boké Prefecture (Administrative Region of Boké). The mine area contains a total of 155 settlements as well as camps or cattle herders with a total population estimated at 17,786 inhabitants in 2,610 households.

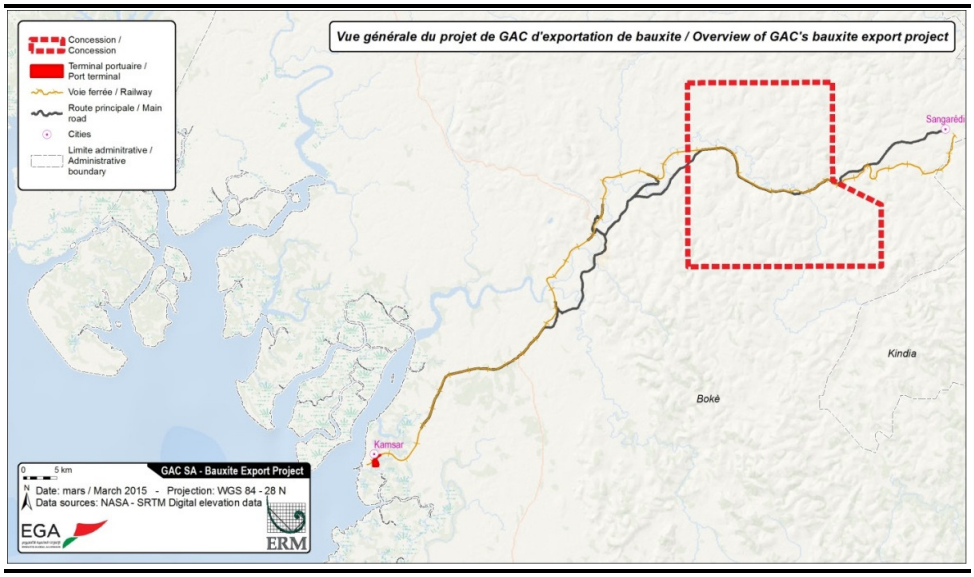
Figure 19.2 Outline of indicative mine plan



19.2.2 *Kamsar port terminal*

The project will include additional infrastructure in Kamsar port to facilitate the export of bauxite. *Figure 19.3* shows the location of the Kamsar port in relation to the GAC concession.

Figure 19.3 Location of Kamsar port in relation to the GAC concession

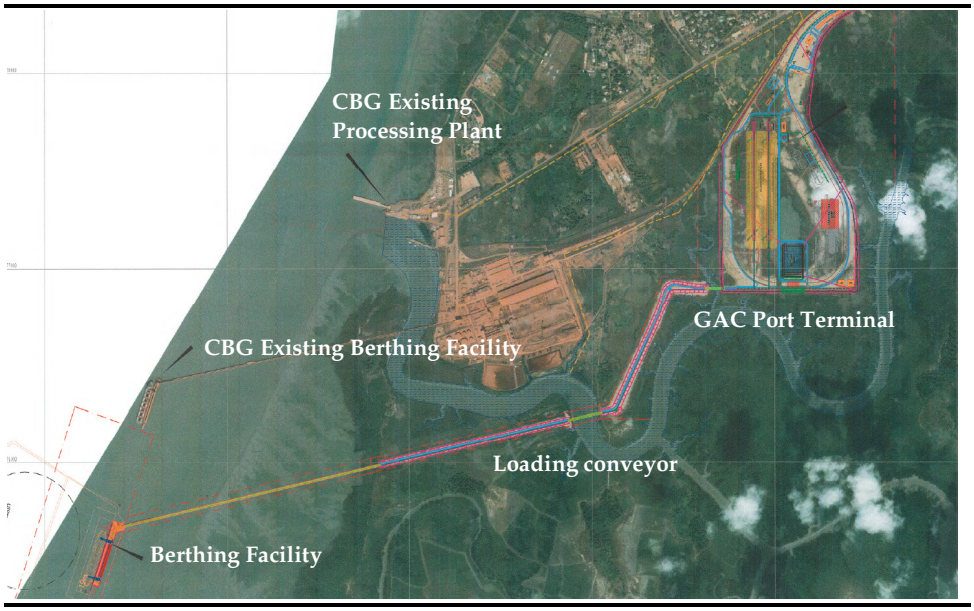


The location and layout of GAC Port Terminal are illustrated in *Figure 19.3.* The facilities that will be built and operations that will affect the port area are:

- rail terminal and train off-loading facilities;
- bauxite stockpile area;
- new loading berth to be located approximately 2.5 km to the west of the GAC port platform, south of the existing CBG [(1)] mineral loading berth in the Rio Nuñez estuary;
- supporting utilities and ancillary facilities, including water desalination, power generation, and workforce accommodation;
- dredging works; and
- navigational activities along the dredged approach channel to / from the loading or offloading berths.

(1) Compagnie des bauxites de Guinée

Figure 19.4 Overview of proposed port component



19.3 MONITORING PROGRAM

19.3.1 Physical monitoring

19.3.1.1 Air quality

Pollutant of interest

The Project at the mine area will primarily emit dust from blasting, vehicle traffic on unpaved surfaces, bauxite transportation and handling infrastructure. To a lesser extent, the Project will also emit gases from fossil-fuel combustion in stationary and mobile equipment.

Project activities at the port will primarily emit some fugitive dust from bauxite handling and traffic on unpaved roads and surfaces, and to a lesser extent, gases from combustion of fuels in stationary and mobile equipment.

On the base of these emissions, the main pollutants of concern for the air quality monitoring program both at the mine and at the port, are:

- Dust deposition– as it can be a nuisance to human receptors as it settles on property and agricultural areas.
- Particulate matter (PM_{10} and $PM_{2.5}$) - varies widely in physical and chemical composition, source and particle size. PM_{10} particles (the fraction of particulates in air of very small size (<10 µm)) and $PM_{2.5}$ particles (<2.5 µm) are of concern to human health, as they are small enough to penetrate into the bronchiole (PM_{10}) and alveolar ($PM_{2.5}$) regions of the lungs and so potentially pose significant health risks. Larger particles meanwhile, are not readily inhaled, and are removed relatively efficiently from the air by sedimentation.
- Gaseous oxides of nitrogen (NOx) – NOx comprises both nitric oxide (NO) and nitrogen dioxide (NO_2). NO_2 is a respiratory irritant. Inhalation of such particles may cause or worsen respiratory diseases, such as emphysema or bronchitis, or may also aggravate existing heart disease. NOx also reacts with volatile organic compounds in the presence of sunlight to form ozone (O_3) which can damage lung tissue and reduction in lung function mostly in susceptible populations (children, elderly and asthmatics). NOx may also adversely affect sensitive ecology, through the direct action of NOx on plants and through the acidification and nitrification of soils.
- Gaseous sulfur dioxide (SO_2) – SO_2 is an irritant associated with induced respiratory weakness and diseases. SO_2 can affect sensitive ecology, through the direct action of SO_2 on plants and through the acidification of soils.

The following part of this Section briefly outlines the monitoring equipment to be employed for the monitoring of the above mentioned pollutants of interests along with related timing.

Dust deposition

Dust deposition will be monitored by means of dust plates. Dust plates consist of a 5 x 10 cm thin plate made of aluminum or steel and covered with a greasy film. The latter captures the dust. Dust plates enable to measure the deposition of dry dust according the French standard NF43-007 on Atmospheric Pollution, Deposition Measurements by means of Plaquette DIEM.

The exposure period of the dust plates varies according to how polluted the investigated area is. The exposure period can last up to 14 days in scarcely polluted areas and only up to seven days in highly polluted areas. After the exposure period dust plates are retrieved and sent to a laboratory for the analysis.

The dust plates to be used for the air quality environmental program will be provided by an accredited laboratory. For the purpose of the air quality monitoring program dust plates will be replaced every 2 weeks. After this period plates will be sent to the laboratory for analysis. Additional information on the equipment, its deployment and lab analysis is available in *Section 19.3.8.1*.

Particulate matter

PM_{10} and $PM_{2.5}$ can be measured though:

- portable, battery-operated air quality monitoring devices; and
- fixed continuous monitoring stations.

These typically include devices based light-scattering photometry (assessing particle concentration, size and mass based on their ability to scatter laser light), as well as, for fixed continuous monitoring stations, beta attenuation monitors (employing the absorption of beta radiation by solid particles extracted from air flow).

Continuous monitoring devices require powering, safe storage and (for fixed equipment) site security, along with regular maintenance (e.g. daily inspections and biweekly to monthly data extraction).

GAC proposes performing real-time dust monitoring as follows:

- Using a portable sampler: at least for 8 weeks evenly distributed over the year, with a minimum of 2 continuous weeks of monitoring for each season (if using portable mobile monitoring devices). This is envisaged for the construction phase.
- Continuous year-round measurement using fixed devices is nonetheless envisaged for the operational phase, as this should provide a better indication of routine Project performance during bauxite extraction, hauling and handling activities.

NOx and SO_2

Atmospheric concentrations of NOx and SO2 will be monitored by using diffusion tubes sampling technology.

Diffusion tubes are designed for passively sampling atmospheric pollutants. They consist of small plastic tubes containing a chemical which reacts with NO, NO_2 and SO_2 present in the air. Once in place, diffusion tubes have one end left open to the atmosphere, and are retrieved after the exposure period and sent to a laboratory for the analysis.

The diffusion tubes to be used for the air quality environmental program will be provided by an accredited laboratory.

For the purpose of the air quality monitoring program tubes will be collected and replaced every 4 weeks. After this period tubes will be sent to the laboratory for analysis.

Additional information on monitoring equipment is available in *Section 19.3.8.1*.

Monitoring stations within the GAC concession

The air quality monitoring program will monitor the pollutants of concern at the same air quality monitoring locations at which baseline data were collected. *Table 19.1* shows the monitoring sites used for the air quality baseline along with their expected monitoring period. The latter varies from station to station and is dependent on the project development (starting/closure date of the mining activities), as the monitoring of atmospheric pollutants is finally aimed at ensuring the compliance with air quality standards when the project is in operation. Monitoring is expected to be performed continuously at three permanent monitoring stations located in the near proximity of sensitive receptors which are supposed not to be resettled.

NOx and SO_2 monitoring stations are labeled as "AQ", dust deposition monitoring stations are labeled as "D" and suggested PM_{10} and $PM_{2.5}$monitoring station are labeled as "PM". Real time monitoring of particulate matter is recommended at the 3 permanent monitoring locations and its feasibility should be evaluated during the project operation on the base of logistics and safety reasons.

Table 19.1 Air quality and dust monitoring sites summary at the mine area

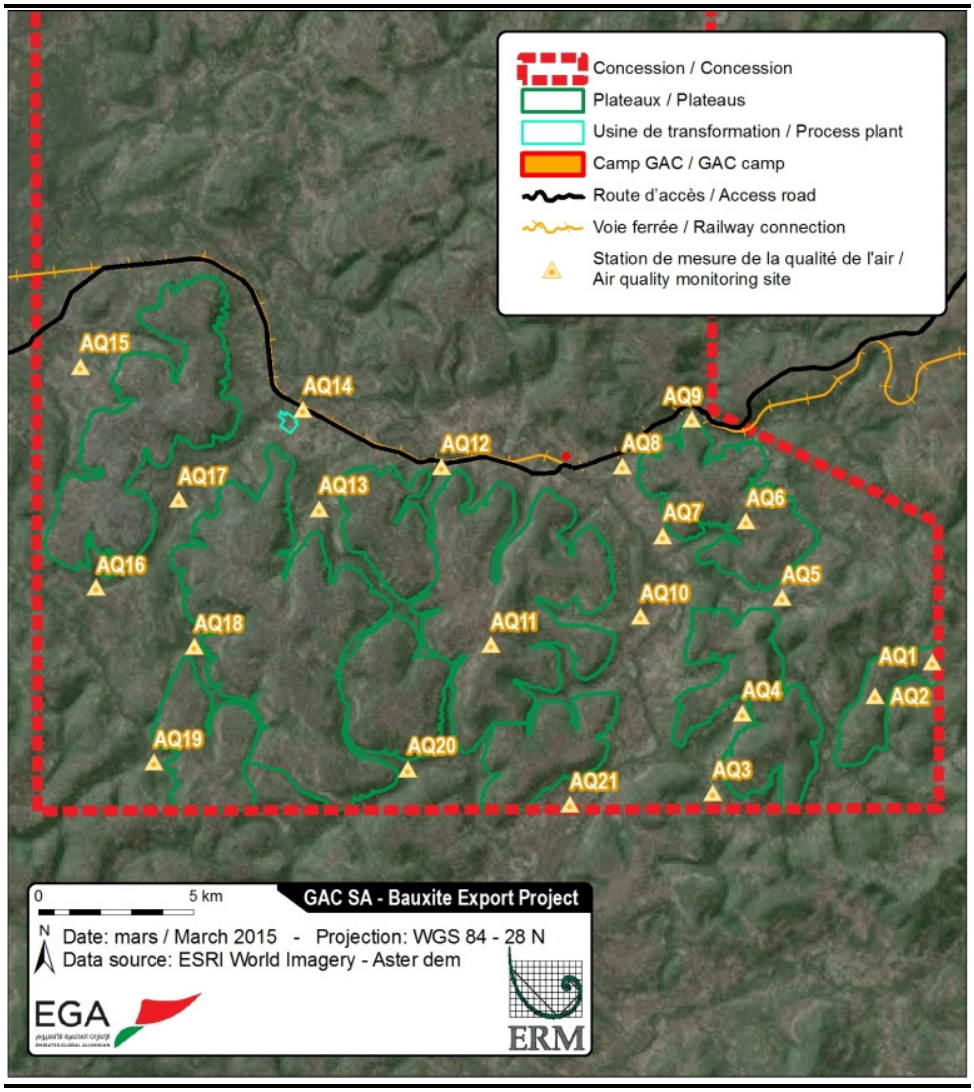
AQ Stations	Dust stations	Active period	X coordinate [m] UTM 30N	Y coordinate [m] UTM 30N
AQ1	D1	One year before start of mining on Plateaus 33 to the start of mining on Plateau 34.	620002	1211722

AQ Stations	Dust stations	Active period	X coordinate [m] UTM 30N	Y coordinate [m] UTM 30N
AQ2	D2	One year before start of mining on Plateaus 32 and 33 to the start of mining on Plateau 33.	618152	1210618
AQ3	D3	One year before start of mining on Plateaus 32 and 33 to a minimum of one year after closure on mining on Plateaus 34, 36 and 37.	612905	1207479
AQ4	D4	One year before start of mining on Plateaus 32 and 33 to a minimum of one year after closure on mining on Plateaus 34, 36 and 37.	613857	1210056
AQ5	D5	One year before start of mining on Plateaus 32 to a minimum of one year after closure on mining on Plateaus 34, 36 and 37.	615142	1213800
AQ6	D6	One year before start of mining on Plateaus 32 and 33 to the start of mining on Plateau 33.	613988	1216288
AQ7	-	One year before start of mining on Plateaus 32 to a minimum of one year after closure on mining on Plateaus 34, 36 and 37.	611296	1215812
AQ8	D7	One year before start of mining on Plateaus 32 and 33 to a minimum of one year after closure on mining on Plateaus 34, 36 and 37.	609985	1218056
AQ9	-	One year before start of mining on Plateaus 32 and 33 to a minimum of one year after closure on mining on Plateaus 34, 36 and 37.	612229	1219584
AQ10	D8	One year before start of mining on Plateaus 32 and 33 to a minimum of one year after closure on mining on Plateaus 34, 36 and 37.	610566	1213188
AQ11	D9	One year before start of mining on Plateau 20 to the start of mining on Plateau 32.	605716	1212271
AQ12	D10 PM1(1)	Permanent (entire mining period, pre-mining to post-closure).	604130	1218046
AQ13	PM2(1)	Permanent (entire mining period, pre-mining to post-closure).	600177	1216688
AQ14	D11 PM3(1)	Permanent (entire mining period, pre-mining to post-closure).	599656	1219905
AQ15	D12	One year before start of mining on Plateau 20 to a minimum of one year after closure on mining on Plateaus 26 and 31.	592457	1221284
AQ16	-	One year before start of mining on Plateau 20 to a minimum of one year after closure on mining on Plateaus 26 and 31.	592972	1214123
AQ17	D13	One year before start of mining on Plateau 20 to a minimum of one year after closure on mining on Plateaus 26 and 31.	595626	1217011
AQ18	D14	One year before start of mining on Plateau 20 to a minimum of one year after closure on mining on Plateaus 26 and 31.	596132	1212224
AQ19	D15	One year before start of mining on Plateau 20 to a minimum of one year after closure on mining on Plateaus 26 and 31.	594834	1208478
AQ20	-	One year before start of mining on Plateau 26 and 31 to a minimum of one year after closure on mining on Plateau 36.	603037	1208251
AQ21	D16	One year before start of mining on Plateaus 27 and 32 to a minimum of one year after closure on mining on Plateaus 36 and 37.	608297	1207154

AQ Stations	Dust stations	Active period	X coordinate [m] UTM 30N	Y coordinate [m] UTM 30N

Notes:
AQ: NOx and SO_2 Monitoring sites
D: Dust deposition monitoring sites
PM: Particulate matter
(1) Real time dust monitoring at three permanent monitoring locations is highly recommended and should be evaluated on the base of logistics and safety reasons

Figure 19.5 Map of AQ monitoring sites at the mine site



Monitoring stations at Kamsar Port

The air quality monitoring program will target the pollutants of concern at the port, i.e. NOx, SO_2, PM_{10} and $PM_{2.5}$.

Monitoring is expected to be permanent for PM_{10} and $PM_{2.5}$ using permanent monitoring stations, and long-term for NOx and SOx using diffusion tubes.

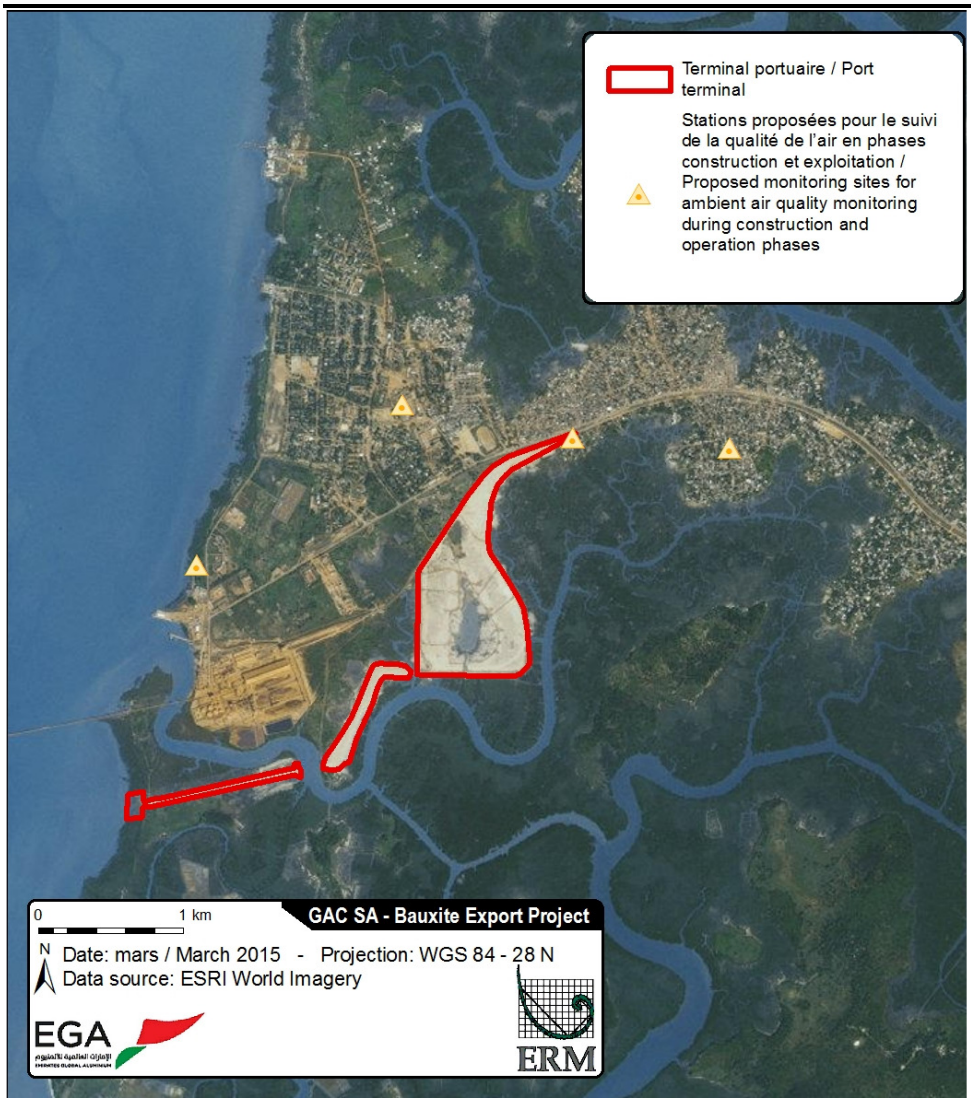
Considering that the port terminal is located in a broader urban area with a high density of sensitive receptors, the monitoring program is expected to use up to 4 monitoring points:

- two "reference" monitoring points used in the SEIA addendum studies (named AQ22 and AQ23 in the SEIA Addendum) located at the Kamsar Container Terminal (AQ23) and at the entrance of the GAC port terminal (AQ22), in the vicinity of sensitive receptors located along the existing ANAIM rail line; and

- up to two additional monitoring points, to be sited at locations representative of sensitive receptor points in the urban area of Kamsar.

The proposed monitoring locations are indicated in *Figure 19.6*. Their final location may vary depending on site constraints (including security and integrity of equipment), specific servicing / maintenance requirements, such as the availability of a reliable power supply), as well as environmental factors (in particular the potential presence of other sources of emissions that could bias the monitoring results (such as the immediate vicinity of third party generator sets, or unpaved roads).

Figure 19.6 Map of proposed AQ monitoring sites (indicative locations) for GAC's port terminal



Note that the final location of the monitoring sites may vary upon implementation of the monitoring network, depending on site selection constraints and opportunities, mainly related to site security and equipment integrity, availability of a power source, and potential sources of bias in the surrounding environment.

Summary

The following *Table 19.2* presents a brief summary of air quality monitoring activities included in the air quality monitoring program both at the mine and at the port sites. The table also addresses GHG monitoring (indirectly through calculation of emission sources) and odor (through GAC's grievance mechanism).

Table 19.2 Summary of air quality monitoring strategy in port and mine areas

Potential impact	Monitoring indicators	Parameters	Locations	Timing/frequency	Measuring Equipment	Responsible
Atmospheric concentrations of NO_x, SO_x	Atmospheric concentration in µg/m³, of SO_2 and NO_x.	NO_2 NO SO_2	cf Table 19.1, Figure 19.5, Figure 19.6	Monthly retrieval and replacement of diffusion tubes. The active monitoring period at each station is reported in *Table 19.1*.	Diffusion tubes	GAC personnel / subcontractors
Dust deposition	Daily dust deposition in mg/m²/day Number and resolution rates of grievances	Dust deposition	cf Table 19.1, Figure 19.5, Figure 19.6	Two-weekly retrieval and replacement of dust plates. The active monitoring period at each station is reported in *Table 19.1*.	Dust plates	GAC personnel / subcontractors
				Using mobile devices: 8 weeks evenly distributed over the year, with a minimum of 2 continuous week of monitoring for each season.	Portable, battery-operated air quality monitoring devices.	
Atmospheric concentrations of Particulate Matter (PM_{10} and $PM_{2.5}$)(1)	Atmospheric concentration in µg/m³, of PM10 and PM2.5	PM_{10} $PM_{2.5}$	cf Table 19.1, Figure 19.5, Figure 19.6	From start of bauxite extraction operation: continuous year-round measurement using fixed devices.	Fixed PM monitoring stations.	GAC personnel / subcontractors

Potential impact	Monitoring indicators	Parameters	Locations	Timing/frequency	Measuring Equipment	Responsible
Nuisance odors (only mine)	Number and resolution rates of grievances	n.a.	Mine concession	Continuous	Project register	GAC personnel
Release of greenhouse gases (GHG).	Carbon footprint of Project installations and activities (to be calculated yearly)	Tons of $CO_{2eq.}$	Mine concession and port	Annual	Project register	GAC personnel

19.3.1.2 Noise and vibration

The noise monitoring will consist of noise measurements depending of the projects activities. As the noise measurement will be punctual and will depend of the Project time horizons, the monitoring locations cannot be defined at this stage; nonetheless, as mine Project progresses the main sensitive receptors are identified.

A Sound Level Meter (SLM) will be used to monitor the noise levels at receptors. The SLM will be calibrated prior to use with a portable certified acoustical calibrator and the calibration will be checked and verified after each period of use. The noise measurements will let to determine the Equivalent Noise Pressure Level (LAeq) in decibel (dB) in correspondence of a receptor in a specific reference time (daytime and/or nigh time).

The noise measurements will be performed according to ISO 1996-2:2007 and to the following requirements:

- absence of precipitations (rain, snow, etc.);
- wind speed < 5 m/s;
- microphone with anti-wind foam cap;
- microphone orientated vertically (random incidence) in order to record sources coming from all directions; and
- microphone positioned at a proper height (assumed receptors' height), in this case 1.5 meters above ground level.

Ground-borne vibration levels for the Project area will be recorded in terms of acceleration in mm/s^2 in three mutually perpendicular directions (horizontal, vertical, longitudinal).

Detailed noise and vibration monitoring plan will take into account:

- general mining plan ;
- closest sensitive receptors ;
- noise complaints received from communities ;
- blasting activities ;
- peaks of traffic on the haul roads during the operations; and
- period (i.e. daytime and nighttime).

Equipment specifications are available in *Section 19.3.8.2.*

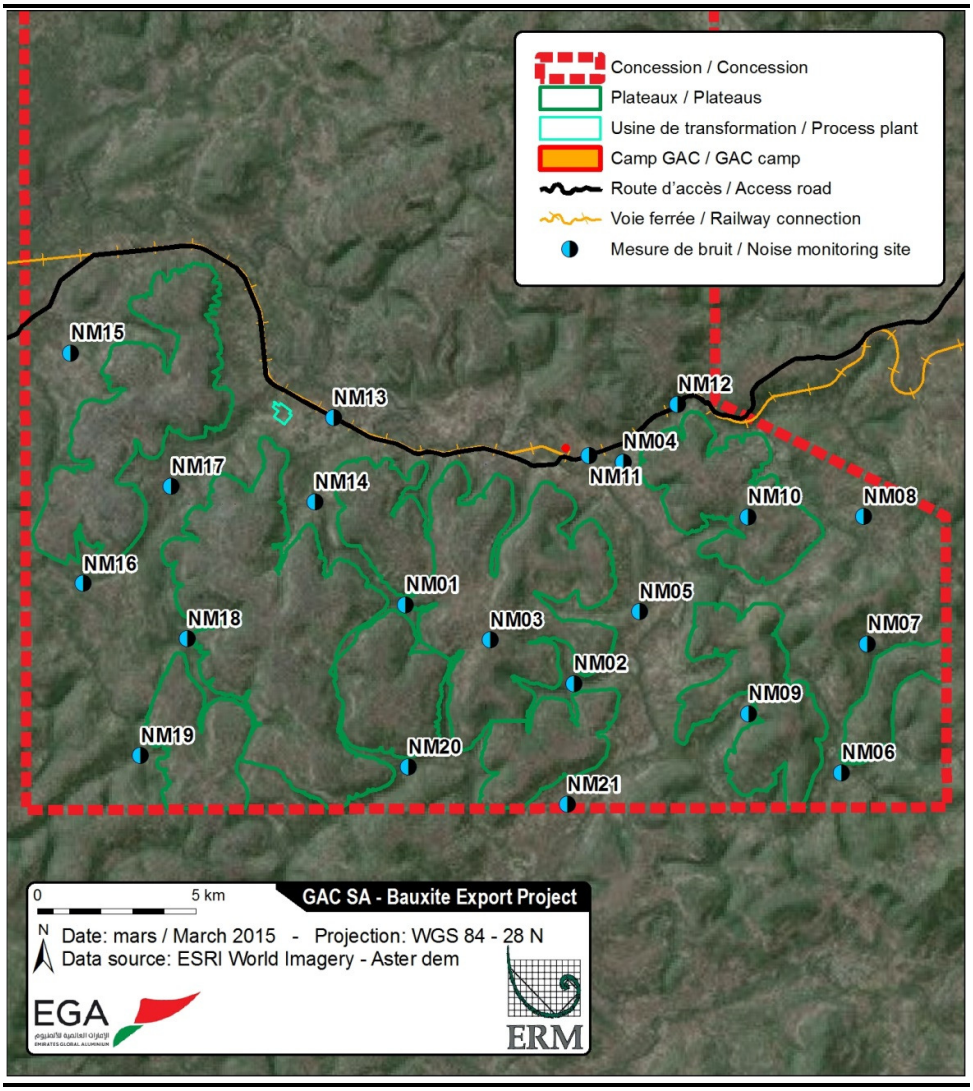
Monitoring stations within GAC concession

Prospective monitoring sites will be located in proximity of inhabited areas that may be close to project Mine areas (listed in *Table 19.3*). Like in the case of Air Quality monitoring some monitoring locations in correspondence of the inhabited areas will be considered permanent (e.g. sites near the process plant) whilst other will be associated to the different active plateaus as Project mine proceeds.

Table 19.3 Noise and vibration monitoring sites at mine plateaus

NM Sites	Receptors	X coordinate [m] UTM 30N	Y coordinate [m] UTM 30N	Monitoring period
NM01	Bhounna	603064	1213382	Years 8-14
NM02	Sorontoré	608410	1210885	Years 8-14
NM03	Bagamala	605753	1212268	Years 8-14
NM04	Barkéré	609975	1217918	Years 8-14
MM05	Kériré	610495	1213160	Years 8-14
NM06	Sinthiourou Mamadou Bailo	616887	1208064	Years 8-14; Years 15-21
NM07	Sampirin Missidé	617700	1212141	Years 8-14; Years 15-21
NM08	Soucka	617580	1216186	Years 8-14
NM09	Thiankoye	613937	1209929	Years 15-21
NM10	Wossou	613921	1216183	Years 8-14
NM11	Doubhi Dow	608897	1218115	Years 8-14
NM12	Filobowal N'dantari	611704	1219733	Years 8-14
NM13	Balahoun Pont	600789	1219322	Entire Project life
NM14	Balahoun Hakoundé Thiandhi	600199	1216648	Years 1-7; Years 8-14
NM15	Missidé Höré Wendou	592472	1221362	Years 1-7
NM16	Kantambafenda	592876	1214051	Years 1–7
NM17	Lopé Tambagour	595658	1217140	Years 1–7; Years 8-14
NM18	Lopé Kaoumar	596171	1212309	Years 1-7; Years 8-14
NM19	Tapotche	594689	1208603	Years 1-7; Years 8-14
NM20	Fétoré Foulbhé	603159	1208249	Years 8-14
NM21	N'Danta Ido	608209	1207064	Years 15-21

Figure 19.7 Proposed noise and vibration monitoring sites at mine plateaus



Monitoring stations Kamsar Port

Prospective permanent monitoring sites will be located in proximity of inhabited areas in Kamsar Cité.

Table 19.4 Proposed noise and vibration monitoring sites at Kamsar Port

NM Sites	Receptors	X coordinate [m] UTM 30N	Y coordinate [m] UTM 30N	Monitoring Period
NM22	Kamsar Cité	543053	1176253	Entire Project life

Table 19.5 Summary of noise /vibration monitoring strategy in port and mine areas

Potential impact	Monitoring indicators	Parameters	Locations	Timing/frequency	Measuring Equipment	Responsible
Terrestrial noise	Ambient noise levels at receptor points - Equivalent Noise Pressure Level (LAeq) in dB(A) Workplace noise levels, in dB(A) (process plant only) Number and resolution rates of noise grievances	Thirty minutes to 1-hour noise measurements during daytime and nigh time at receptors near the plateaus. 24 hours noise measurements at receptor near the process plant. Short measurements (10 minutes) at the process plant, near the noisiest process area (e.g. crushing area).	See *Table 19.3*	Monitoring will commence as soon as sensitive receptors located near the mine and process plant are confirmed (based on final Project mine areas). Monitoring will continue throughout the entire Project life: • on a biannual basis at permanent receptors near the process plant (permanent monitoring sites); • on a monthly basis at receptors near active plateaus • (as Project mine footprint progresses). • On request where grievances have been expressed.	Type 1 Sound Level Meter (SLM), according to IEC61672 (e.g., LarsonDavis SoundTrack LxT® Type 1 SLM) Project register/management system	GAC personnel / subcontractors
Terrestrial vibrations	Number and resolution rates of vibration	Ground-borne vibration levels	At inhabited areas located	• On a monthly basis at receptors	Vibration and overpressure monitor	GAC personnel / subcontractors

Potential impact	Monitoring indicators	Parameters	Locations	Timing/frequency	Measuring Equipment	Responsible
	grievances (PROJECT REGISTER) Vibration levels in m/s^2 Site inspection (port only)		near blasting sites and along the railway path	near active plateaus where blasting activities are in place. • On a biannual basis at receptors near the railway path. • On request where grievances have been expressed.	(e.g., F&V 8440 vibration transducer, Minimate Plus), compliant with ISO standards	

19.3.1.3 Surface water quality/quantity

The surface water data that will be collected falls into four categories:

- water quality;
- continuous stream flow;
- intermittent stream flow; and
- meteorological data.

Similar water quality parameters will be monitored at the GAC mine concession and the Kamsar port. At the GAC concession, parameters protective of drinking water standards will be monitored, as well as stream flow measurements in the rivers. At the port, drinking water parameters are not required because waters are not reported to be utilized for potable supplies, so a slightly different parameter list that includes salinity is required to be monitored.

The following water quality parameters will be collected at all CN-, CP- and OP- stations on the schedules shown in *Table 19.8*. All Group 1 and Group 3 parameters apply to all sites. Group 2 parameters apply only to OP1, OP2, OP6 and OP7 and are intended to monitor wastewater treatment plant and process area discharges. Note that there is overlap between Group 1 and Group 2 parameters. They represent standard parameters for mining operations based on IFC general EHS guidelines and industry sector guidelines on water and sanitation, and environmental guidelines from other sources. Total Suspended Solids (TSS) and turbidity will be Key Performance Indicators and used to estimate the sediment transport in the river and monitor the release of sediment from the plateaus to the river. TSS and Total Dissolved Solids (TDS) readings in the field will be taken in addition to laboratory testing, if practicable (i.e. due to equipment requirements, training and an evaluation of likely success obtaining results in this catchment). Some sites may be dry at the time of data collection events. In such cases, data collection notes will indicate dry conditions and provide a photographic reference.

Table 19.6 Parameters and frequency of the monitoring program

Water quality - Group 1* Laboratory (Quarterly)	**Water quality - Group 2**** Laboratory (Quarterly)	**WQ*** - Group 3** In-situ (Weekly)
Total Suspended Solids (TSS)	pH (acidity)	pH
Total Dissolved Solids (TDS)	Biological Oxygen Demand (BOD)	Temperature
pH (acidity)	Chemical Oxygen Demand (COD)	Dissolved Oxygen
Chemical Oxygen Demand (COD)	Total nitrogen	ORP
Biological Oxygen Demand (BOD)	Total phosphorus	Turbidity
Oil and Grease	Oil and grease	Total Suspended Solids and Total Dissolved Solids, if practicable (TSS)
Aluminum	Total suspended solids (TSS)	Conductivity
Arsenic	Total coliform bacteria	
Cadmium		
Chromium (VI)		
Copper		

Water quality - Group 1*	Water quality - Group 2**	WQ*** - Group 3
Cyanide		
Cyanide Free		
Cyanide WAD		
Iron (total)		
Lead		
Manganese		
Mercury		
Nickel		
Phenols		
Zinc		
Temperature		
Kjeldahl N		
Nitrates/Nitrites		
Alkalinity		

* IFC mining; ** IFC sanitary; ***WQ = Water quality good practice parameters (IFC, EBRD, UNEP / WHO)

Two types of stream flow data will be collected: continuous and intermittent. Continuous data will be collected at four sites (FLOW1, FLOW2, FLOW3 and FLOW4), which will be fitted with data loggers. Intermittent sites (OP2, OP3, OP8, OP9, and OP13) will be fitted with staff gauges. The intermittent sites and two of the continuous sites are co-located with water quality monitoring points. The staff gauges can be directly read at the time of the water quality data collection. All flow monitoring sites will require: 1) establishment of a cross section station; and 2) depth and velocity measurements monthly for 6 months to develop a stage discharge relationship for the cross section. Since many of the sites may have little to no flow during the dry season, this 6-month period should occur between June and November, but allowing for safe access during peak flow periods. A meteorological station including a rain gauge is also to be in continuous operation in the process area.

Flow data will be collected at the continuous flow stations FLOW1, FLOW2, FLOW3 and FLOW4. Intermittent data will be collected at OP2, OP3, OP8, OP9, and OP13. Note that OP13 can be deferred until one year before mining begins in the Sampirinwol River sub-catchment (approximately Year 13). If practicable, stream gauge establishment and data collection may begin before this time. *Table 19.7* shows the data collection phase activities.

Table 19.7 Data collection phases

Preparatory data collection and activities	Intermittent data collection	Continuous data collection
Cross section establishment at least 12 months prior to mining (FLOW1, FLOW2, FLOW3, FLOW4 OP2, OP3, OP8, OP9, and OP13) Establish continuous gauges with data loggers (FLOW1, FLOW2, FLOW3, FLOW4) Establish staff gauges (OP2, OP3, OP8, OP9, and OP13) Flow and velocity cross sections at one month intervals for at least 12 months	Water stage from staff gauge at OP2, OP3, OP8, OP9 and OP13 at time of water quality data collection events.	Security and condition check and data retrieval at data loggers every 2 weeks or shorter interval. Data loggers to be set for 1-hour minimum logging frequency.

Preparatory data collection and activities	Intermittent data collection	Continuous data collection
prior to mining (FLOW1, FLOW2, FLOW3, FLOW4, OP2, OP3, OP8, OP9, and OP13) Calculation of stage-discharge relationships complete before start of mining (FLOW1, FLOW2, FLOW3, FLOW4, OP2, OP3, OP8, OP9, and OP13)		

Precipitation data are of particular and immediate interest for the project. A precipitation gauge should be installed as soon as practicable, but no later than 12 months prior to the start of mining activities. The precipitation gauge shall be placed where it can be conveniently and reliably monitored and maintained. It shall be placed on level ground and in a location where structures or trees do not interfere with accurate data collection. Data will be collected at no longer than 1-hour intervals. Precipitation gauge establishment may require some period of data quality checking and equipment adjustment, so adequate time to adjust the installation should be incorporated into the planning process. For the initial installation period, a secondary check with a manual gauge should be used. All initial data should be reviewed by a qualified and experienced hydrologist familiar with such equipment.

The meteorological station shall also be sited such that equipment, structures and trees do not interfere with accurate data collection. The equipment array will collect barometric pressure, relative humidity, cloud cover and solar radiation data at no longer than 1-hour intervals.

The equipment condition shall be checked daily. Data will be retrieved, logged and placed in an Excel spreadsheet with separate tabs for precipitation and other meteorological data.

Monitoring stations within GAC concession

Water quality data will be collected at five control points (four permanent and one temporary), three compliance points (one permanent and two temporary), and 13 operational (five permanent and eight temporary) points. Additional water quality data will be collected at the settlement basins on the plateaus. These monitoring points will be established when the location of these basins is determined during detailed design.

Continuous stream flow data will be collected at four continuous gauges as follows:

- three new gauges on the Tinguilinta (one at the southern entry point to the concession and one midway between the entry and exit points of the Tinguilinta, and at the outlet on the western concession boundary), proximal to the central operations area; and
- one new gauge at the confluence of the Kéwéwol and Kalinko confluence where they enter the eastern concession boundary.

Water quality will also be monitored at these locations.

Intermittent stream flow data will be collected at five locations co-located with water quality sampling sites. These sites will be fitted with staff gauges (see *Section 19.3.7.3)* and may be dry at some times.
Meteorological data including rainfall will be collected at one site at the processing plant area. The addition of further data collection stations will be reviewed as necessary.

In all, 25 monitoring points are defined by this monitoring plan at the mine site. Some are co-located flow and water quality monitoring sites. Of the 25 points, 14 are permanent and will be active throughout the mining period until closure and 11 are temporary and will be phased-in and phased-out as mining activities move across the concession. The following summarizes the monitoring points:

- *Figure 19.8* shows the monitoring locations;
- *Table 19.8* provides a summary of the monitoring points, their function, and the general type of data to be collected;
- *Table 19.9* provides a summary of the proposed monitoring point coordinates and river locations; and
- *Table 19.10* reports the tributary coverage in the monitoring plan.

It should be noted that certain monitoring stations (particularly permanent locations and those at key operational activity locations) will be set up a minimum of one year in advance of construction and mining activity commencing in order to provide a sound baseline for future decision making. The period that monitoring is required following mining cessation will be defined relative to the finalized mine plan and confirmed within closure planning (as this will be dependent upon restoration planning and the timescales for removal of drainage and settlement infrastructure). In addition, river crossings, water management and supply options being investigated during the next stages of design are likely to require additional intermittent or continuous monitoring to inform design progression.

Figure 19.8 Monitoring points within the GAC concession

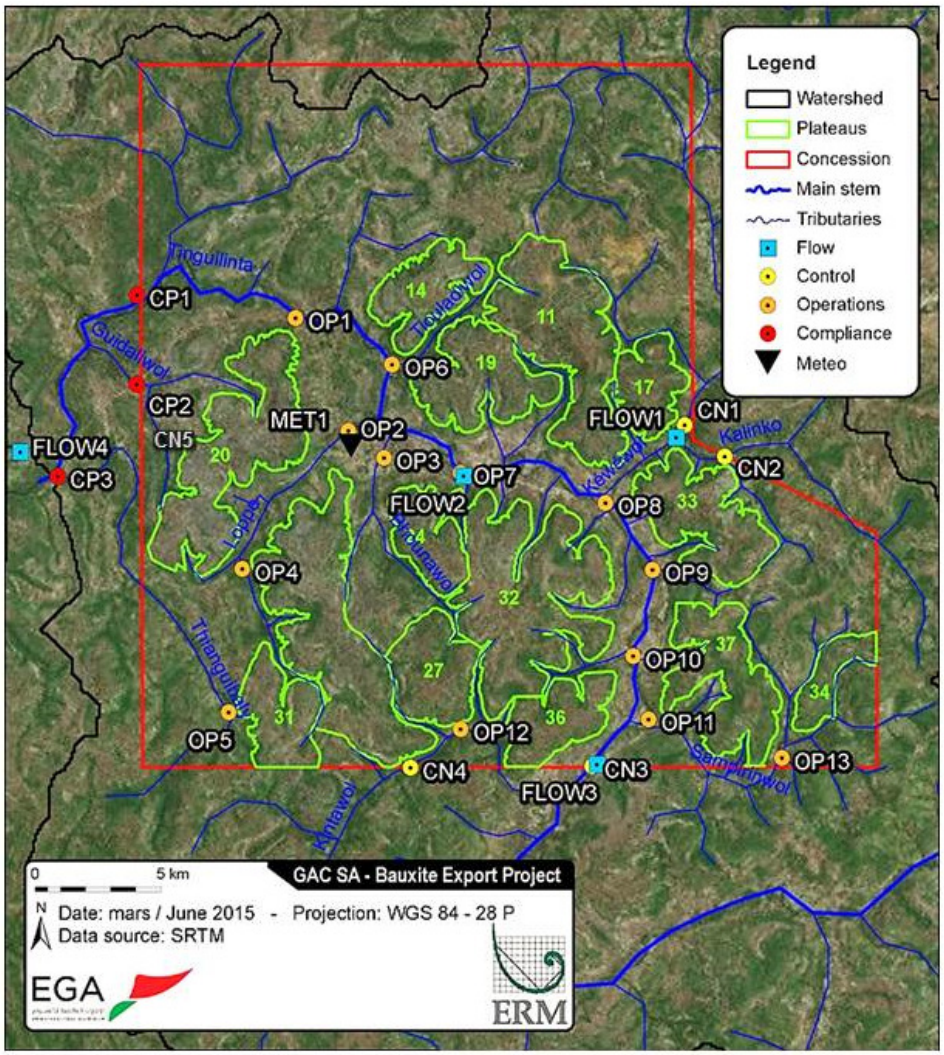


Table 19.8 Monitoring stations summary (permanent sites are shaded)

Point	Type	Function	Data collected	Active Period
CN1	Control & compliance	Collect water quality data in the Kéwéwol River as it enters the GAC concession	Water quality	Permanent (entire mining period, pre-mining to post-closure)
CN2	Control & compliance	Collect water quality data in the Kalinko River as it enters the GAC concession	Water quality	Permanent (entire mining period, pre-mining to post-closure)
CN3	Control & compliance	Collect water quality data in the Tinguilinta River as it enters the GAC concession	Water quality	Permanent (entire mining period, pre-mining to post-closure)
CN4	Control & compliance	Collect water quality data in the Kintawol River as it enters the GAC concession	Water quality	One year before start of mining on Plateau 26 to a minimum of one year after closure on mining on Plateaus 27, 32 and 36. Closure monitoring period to be defined within closure planning
CN5	Control & compliance	Collect water quality data in the Tinguilinta River as it exits the GAC concession	Water Quality	Permanent (entire mining period, pre-mining to post-closure)
CP1	Compliance	Collect compliance data for all activities affecting Tinguilinta River	Water quality	Permanent (entire mining period, pre-mining to post-closure)
CP2	Compliance and Operation	Collect compliance data for all activities affecting Guidaliwol River	Water quality	One year before start of Plateau 20 mining to a minimum of one year after closure of Plateau 20. Closure monitoring period to be defined within closure planning
CP3	Compliance	Collect cumulative compliance data for all activities affecting Tinguilinta, Guidaliwol, and Thianguibaly Rivers	Water quality	One year before start of mining to a minimum of one year after closure of Plateau 31. Closure monitoring period to be defined within closure planning
OP1	Operation	Collect data on Tinguilinta capturing all mine activities prior to compliance point except Plateau 31	Water quality	Permanent (entire mining period, pre-mining to post-closure)
OP2	Operation	Collect data on Loppé River capturing mining on Plateaus 20, 26 and 31 and Process Area activities	Water quality Intermittent flow data	Permanent (entire mining period, pre-mining to post-closure)
OP3	Operation	Collect data on Bhounnawol River capture mining on Plateaus 26, 27, 24 and 32	Water quality Intermittent flow data	One year before start of mining on Plateau 26 to a minimum of one year after closure of Plateau 32. Closure monitoring period to be defined within closure planning
OP4	Operation	Collect data on Loppé River capturing mining on Plateaus 20, 26 and 31 and Process Area activities		One year before start of mining to a minimum of one year after closure of Plateau 31. Closure monitoring period to be defined within closure planning
OP5	Operation	Collect data on Thianguibaly River capturing mining on Plateau 31		One year before start of mining on Plateau 31 to a minimum of one year after closure of Plateau 31. Closure monitoring period to be defined within closure planning

Point	Type	Function	Data collected	Active Period
OP6	Operation	Collect data on Tinguilinta capturing all mine activities prior to compliance point except Plateau 31 and west side of Plateau 20		Permanent (entire mining period, pre-mining to post-closure)
OP7	Operation	Collect data on Tinguilinta capturing activities on Plateaus 24, 32, 36, 37, 34 and 33 and as extended control for Plateaus 20, 31, 26, 27 and 24	Water quality Co-located with FLOW2 continuous gauge	Permanent (entire mining period, pre-mining to post-closure)
OP8	Operation	Collect data on Tinguilinta that capturing activities on Plateaus 32, 36, 37, 34 and 33 and as extended control for Plateaus 20, 31, 24, 26, 27 and 24	Water quality Intermittent flow data	Permanent (entire mining period, pre-mining to post-closure)
OP9	Operation	Collect data on Tinguilinta River capturing activities on Plateaus 32, 36, 37, 34 and 33	Water quality Intermittent flow data	One year before start of mining in Plateau 32 to a minimum of one year after closure of Plateau 33. Closure monitoring period to be defined within closure planning
OP10	Operation	Collect data on Tinguilinta River capturing activities on Plateaus 32, 36, 37, and 34		One year before start of mining in Plateau 32 to a minimum of one year after closure of Plateau 34. Closure monitoring period to be defined within closure planning
OP11	Operation	Collect data on Tinguilinta River capturing activities on Plateaus 36, 37, and 34		One year before start of mining on Plateau 34 to a minimum of one year after closure of Plateau 34. Closure monitoring period to be defined within closure planning
OP12	Operation	Collect data on Kintawol River capturing activities on Plateaus 26 and 27		One year before start of mining on Plateau 26 to a minimum of one year after closure of Plateaus 26 and 27. Closure monitoring period to be defined within closure planning
OP13	Operation	Collect data on Sampirinwol River capturing activities on Plateaus 37 and 34	Water quality and intermittent flow data	One year before start of mining on Plateau 34 to a minimum of one year after closure of Plateaus 34. Closure monitoring period to be defined within closure planning
FLOW1	Control	Collect flow data for water availability planning and refinement of hydrological model. Location at east side of concession at confluence of Kéwéwol and Kalinko Rivers	Continuous flow data. Located just downstream of CN1 and CN2	Permanent (entire mining period, pre-mining to post-closure)
FLOW2	Operation	Collect flow data for water availability planning and refinement of hydrological model. Location at OP7 midway between the east and west sides of the concession, immediately upstream of the central operating area	Continuous flow data. Co-located with OP7	Permanent (entire mining period, pre-mining to post-closure)
FLOW3	Control	Collect flow data for water availability planning and refinement of hydrological model. Located at the inflow of the Tinguilinta River to the concession	Continuous flow data. Co-located with CN3	Permanent (entire mining period, pre-mining to post-closure)

Point	Type	Function	Data collected	Active Period
FLOW4	Compliance	Collect flow data for water availability planning and refinement of hydrological model at the outlet of the Tinguilinta River from the concession (western boundary).	Continuous flow data	Permanent (entire mining period, pre-mining to post-closure)
MET1	Operation	Collect rainfall and other meteorological data for refinement of hydrological model and to inform understanding of event-driven compliance problems. Station will be located at a convenient location in the central operating (processing) area	Meteorological data	Permanent (entire mining period, pre-mining to post-closure)

Table 19.9 Monitoring point locations

ID	Coordinates		River	Stream type
	Latitude North	Longitude West		
CP2	11 03 13.40	14 10 06.79	Guidaliwol	Tributary
CP3	11 01 15.85	14 11 50.14	Tinguilinta	Main stem
OP1	11 04 38.37	14 06 38.61	Tinguilinta	Main stem
OP2	11 02 12.94	14 05 30.21	Loppé	Tributary
OP3	11 01 38.15	14 04 43.67	Bhounnawol	Tributary
OP4	10 59 15.54	14 07 49.27	Loppé	Tributary
OP5	10 56 11.59	14 08 07.66	Thianguibaly	Main tributary
OP6	11 03 38.10	14 04 32.59	Tinguilinta	Main stem
OP7	11 01 18.46	14 03 03.23	Tinguilinta	Main stem
OP8	11 00 39.26	13 59 54.37	Tinguilinta	Main stem
OP9	10 59 13.19	13 58 53.10	Tinguilinta	Main stem
OP10	10 57 21.94	13 59 18.66	Tinguilinta	Main stem
OP11	10 56 01.02	13 58 58.62	Tinguilinta	Main stem
OP12	10 55 49.16	14 03 04.23	Kintawol	Main tributary
OP13	10 55 10.51	13 56 04.48	Sampirinwol	Tributary
CN1	11 07 18.66	13 58 09.99	Kéwéwol	Main tributary
CN2	11 01 38.31	13 57 17.74	Kalinko	Main tributary
CN3	10 55 00.81	14 00 12.52	Tinguilinta	Main stem
CN4	10 54 59.64	14 04 10.35	Kintawol	Main tributary
CN5	11 01 44.57	14 12 37.38	Tinguilinta	Main stem
FLOW1	11 02 03.18	13 58 21.15	Tinguilinta	Main stem
FLOW2	11 01 14.27	14 03 59.64	Tinguilinta	Main stem
FLOW3	10 55 02.75	14 00 06.35	Tinguilinta	Main stem
FLOW4	11 01 44.57	14 12 37.38	Tinguilinta	Main stem
MET1	11 01 53.30	14 05 26.88	Process Area	None

Table 19.10 Tributary monitoring summary

Tributary	Monitoring Point	Indirect
Guidawol	CP2 (serves as operational and compliance)	CP3 is cumulative compliance point
Thianguibaly	OP5	CP3 is cumulative compliance point
Loppé	OP2, OP4	OP1, OP6, CP1 is compliance point
Bhounnawol	OP3	OP1, OP6, CP1 is compliance point
Kintawol	OP12	CN4 is control
Belidjouma		OP7 located downstream of confluence with Tinguilinta
Pouttéré		OP9 located at confluence with Tinguilinta
Kolawol		OP10 located at confluence with Tinguilinta
Kéwéwol	CN1	OP8 at confluence with Tinguilinta
Kalinko	CN2	OP8 at confluence with Tinguilinta
Sampirinwol	OP13	OP11 at confluence with Tinguilinta

Monitoring stations Kamsar Port

Data to be collected in the port are:

- water quality data will be collected upstream of, and at discharge locations ;
- additional water quality data will be collected at the settlement basin ; and
- meteorological data including rainfall will be collected at one site in the port area.

The locations of site discharge points will be confirmed during detailed design, at which stage the locations of related monitoring will be developed and included within this plan.

Table 19.11 Summary of surface water monitoring strategy in port and mine areas

Potential impacts	Monitoring indicators	Parameters	Locations	Timing/frequency	Measuring Equipment	Responsible
Increased erosion (port only) Degradation of quality of surface water (port)	Inspection of soils on site Surface water turbidity Discharge and surface water monitoring results	TSS See *Table 19.6*	Upstream of, and at discharge locations, and settlement basin.	Quarterly (lab) / weekly (in situ) Quarterly (lab) / weekly (in situ)	Multi-parameter probe / Sample Laboratory Multi-parameter probe / Sample Laboratory	GAC personnel / subcontractors GAC personnel / subcontractors
Degradation of quality of surface water (mine)	Inspection of soils on site Surface water turbidity Surface water monitoring results Discharge water monitoring results Number of findings during Environmental and H&S audits	See *Table 19.6*	5 control points 3 compliance points 13 operational points.	Quarterly (lab) / weekly (in situ)	Multi-parameter probe / Sample Laboratory	GAC personnel / subcontractors
Impact to water quantity and Tinguilinta flow (mine)	Tinguilinta flow monitoring Ratio between volume pumped and seasonal flow conditions	See *Table 19.8*	*Continuous stream flow* 3 new gauges on the Tinguilinta 1 new gauge at the confluence of the Kéwéwol and Kalinko confluence *Intermittent* 5 locations co-	Continuous	Flow gauging staff gauges	GAC personnel / subcontractors

Potential impacts	Monitoring indicators	Parameters	Locations	Timing/frequency	Measuring Equipment	Responsible
			located with water quality sampling sites.			
Impacts on surface water drainage and flow conditions in Tinguilinta and affected tributaries (mine)	Surface water monitoring results Discharge water monitoring results	See Table 19.6	See above	Quarterly (lab) / weekly (in situ)	Multi-parameter probe / Sample Laboratory	GAC personnel / subcontractors

19.3.1.4 Ground water quality

Groundwater serves as an important recharge source to surface watercourses in the region of the mine, especially in the dry season, when it is also a direct water resource for the local inhabitants from wells and seeps.

Currently, the groundwater is also being considered as an alternative resource for Project needs at the mine in the dry season. Therefore, groundwater monitoring is critical to the Project in order to provide baseline information, record the undisturbed hydrogeological conditions and to aid in the development of GAC's understanding of the hydrogeological regime and the development of the Conceptual Site Model (CSM). In particular, the verification of aspects such as GAC's plans for managing impacts through variations in wet and dry season extraction methods can only be confirmed through the collection of groundwater data.

The overarching objective at the early phase of the Project is to establish a robust and defensible baseline data set against which possible future project impacts can be measured and compared. The 2015 SEIA Addendum presents a baseline data set for the Project, which has been used to identify potential parameters which will require project-specific quality threshold limits. The monitoring program recommended in this document will validate those threshold limits by increasing the number of samples from the area to be disturbed by mining activities and giving more information on any seasonal variability in groundwater quality and elevations.

The groundwater at the port is not anticipated to be significantly affected by GAC's operations there due to the mitigations in place or planned, such as lining, bunding, diversion of clean run off water to infiltration areas, and use of desalinated water for all plant, process and potable supplies. However as a precaution continued monitoring is recommended in order to demonstrate that and monitor for significant changes in groundwater elevation.

The baseline data will lay the foundation for the establishment of future monitoring requirements and will be used to validate and update the groundwater models as the project develops. This will increase the confidence in water model predictions and will in turn help to better manage the impacts on water resources identified during the SEIA.

Specific objectives for groundwater monitoring are:

- describe field procedures for groundwater monitoring based on internationally accepted norms and standards, and incorporate these into Standard Operating Procedures (SOP) for the Project.
- piezometer installation and use;
- monitoring well installation.

Considering the international standards applied for the Project, the following thresholds for groundwater quality will be used (Table 19.12); frequency of sampling may vary between monthly and quarterly periods:

Table 19.12 ***Preliminary groundwater quality thresholds to be updated as appropriate based on ambient (natural) concentrations.***

Parameter [a]	Units [b]	Potable	Ambient aquatic life acute	Ambient agriculture		Estuarine environment
Priority data source		WHO [c] 2011	USEPA [d] 2011	irrigation CCME [e] acute	livestock CCME acute	USEPA acute
Physical Parameters						
pH	s.u.	6.5 - 8.5 [g]	---	---	---	
Conductivity	µS/cm	2,500	---	---	---	
Total Dissolved Solids	mg/L	500 [g]	---	---	3,000	
Total Suspended Solids	mg/L	---	Narrative	---	---	
Turbidity	NTU	1	Narrative	---	---	
COD	mg/L	---	---	---	---	
Temperature	°C	---	Species	---	---	
Organics						
Oil & Grease	mg/L	---	Narrative	---	---	
Phenols	mg/L	---	---	---	0.002	
Anions and Cations [f]						
Aluminum	mg/L	0.2 [g]	0.75	5	5	
Antimony	mg/L	0.02	---	---	---	
Arsenic	mg/L	0.01	0.34	0.1	0.025	0.069
Cadmium	mg/L	0.003	0.002	0.0051	0.08	0.04
Chromium	mg/L	0.05 (total)	0.016 (VI)	0.008 (VI)	0.05 (VI)	1.1 (VI)
Copper	mg/L	2	---	variable	variable	0.0048
Iron	mg/L	0.3 [g]	---	5	---	
Lead	mg/L	0.01	0.065	0.2	0.1	0.21
Manganese	mg/L	0.05	---	0.2	---	
Mercury	mg/L	0.006	0.0014	---	0.03	0.0018
Molybdenum	mg/L	---	---	narrative	0.5	
Nickel	mg/L	0.07	0.47	0.2	1	0.074
Selenium	mg/L	0.04	calculated	variable	0.05	0.29
Uranium	mg/L	0.03	---	0.01	0.2	
Vanadium	mg/L	0.2	---	0.1	0.1	
Zinc	mg/L	5 [g]	0.12	calculated	50	0.09
Calcium	mg/L	150	---	---	1,000	
Chloride	mg/L	250 [g]	860	variable	---	
Dissolved Oxygen	mg/L	---	Matrix	---	---	
Fluoride	mg/L	1.5	---	1	variable	
Magnesium	mg/L	50	---	---	---	
Nitrate	mg/L	50	---	---	100	
Nitrite	mg/L	3	---	---	10	
Nitrogen (total)	mg/L	---	---	---	---	
Phosphorus (total)	mg/L	---	---	---	---	
Potassium	mg/L	50	---	---	---	
Sodium	mg/L	50	---	---	---	
Sulphate	mg/L	250 [g]	---	---	1,000	

Parameter [a]	Units [b]	Potable	Ambient aquatic life	Ambient agriculture		Estuarine environment
Microbiological Parameters						
Faecal coliform	no./100 ml	0	---	---	---	
E. coli	no./100 ml	0	---	---	---	
Total coliforms	MPN/100 ml	5	---	---	---	

Highlighted boxes indicate parameters which have returned values above these threshold values under baseline conditions in sampling programs carried out in the Project to date.

(a) BOD5 = biochemical oxygen demand with the amount of dissolved oxygen consumed in 5 days; COD = chemical oxygen demand; WAD = weak acid dissociable; TDS = total dissolved solids; TSS = total suspended solids.

(b) mg/L = milligrams per liter; TCU = total color units; µS/cm = microSiemens per centimeter; s.u. = standard units; °C = degrees Celsius; NTU = nephelometric turbidity units; no./100 ml = number per 100 milliliters.

(c) WHO = World Health Organization

(d) USEPA = United States Environmental Protection Agency

(e) CCME = Canadian Council of Ministers of the Environment

(f) Dissolved concentrations

(g) Secondary maximum contaminant level (MCL); all other values in the column are primary MCLs

Monitoring stations within GAC concession

A total of 11 monitoring locations for groundwater quality have been proposed for the mine site area (Table 19.13 and Figure 19.8). These are:

- 6 groundwater quality sampling locations in and around the plant;
- 2 groundwater quality sampling location from donor-installed wells within the southern part of the concession;
- 2 groundwater quality sampling locations from hand dug wells within the southern part of the concession area; and
- 1 groundwater quality sampling location from a spring within the southern part of the concession area.

The selected monitoring locations will allow groundwater samples to be collected from a number of sources; specifically: previous observation wells located within the concession area, from traditional wells located within villages and from springs located on the slopes of the plateaus (specifically slope areas between plateaus 20 and 26).

In additional to the planned monitoring locations, a program of surveying and monitoring of springs is advised. The first stage of this will be mapping with field flow measurement, followed by targeted additional characterization in a smaller sample of springs in key locations.

Figure 19.10 shows the potential spring areas and current mining polygons. Surveying and monitoring of springs should be prioritized within 500 m of areas to be disturbed. The prioritized springs should be monitored for flow on a quarterly basis in the initial characterization period.

A total of 52 potential monitoring locations for groundwater elevation (piezometers) have been proposed (*Table 19.14* and

Figure 19.9*).* These are:

- 14 piezometer locations on plateau 20 (1);
- 11 piezometer locations on plateau 26 (1); and
- 17 piezometer locations on plateau 33.

The locations of the potential and installed piezometers are presented in

(1) These have been installed by GAC

Figure 19.9, Figure 19.11and Figure 19.12. The proposed monitoring frequency is also detailed in Table 19.14.

The monitoring points have previously been visited during the initial field campaign carried out by ERM in August 2014 – January 2015 as part of the SEIA works. The selection is designed to be spatially representative across the mining area and also representative of the groundwater which sensitive receptors rely on, that is the shallow weathered zone aquifer and alluvial valley aquifer on the plateaus, on the slopes and in the valley floors.

The final locations will be confirmed prior to construction activities and subsequently this monitoring plan will be continually updated to reflect this. This list will be reviewed annually by the appointed project water quality consultant.

Table 19.13 Groundwater quality monitoring locations and frequency

Well Id	Area	Plateau Nr	X UTME	Y UTMN	Type	Monitoring Frequency		
						Water Level	Laboratory Parameters	Field Parameters
MW-01	Plant	-	599189	1219931	MW	M	Q	M
MW-02	Plant	-	599768	1219621	MW	M	Q	M
MW-03	Plant	-	600458	1219241	MW	M	Q	M
MW-04	Plant	-	598683	1219089	MW	M	Q	M
MW-05	Plant	-	599160	1218581	MW	M	Q	M
GW10	Lope	31	595499	1212037	SPR		Q	M
GW04	Tinguilinta	32	607552	1217850	HDW	M	Q	M
GW02	Sorontore	32	608268	1210900	PMH		Q	M
GW02	Sorontore	32	608268	1210900	PMH		Q	M
GW07	Wossou	33	614093	1216342	HDW	M	Q	M
GW08	Wossou	33	614047	1216236	PMH		Q	M

Notes: MW Monitoring Well
SPR Spring
PMH Donor-installed well
HDW Hand Dug Well
M Monthly
Q Quarterly
Coordinates in WGS84 Datum, UTM 28N

Table 19.14 Piezometer locations and monitoring frequency

Piezo Id	Location	Plateau Nr	X UTME	Y UTMN	Monitoring Frequency
20364048	Diarabaka	20	592197	1215094	M
20514096	Diarabaka	20	593400	1218850	M
20538072	Diarabaka	20	592800	1219450	M
20541135	Diarabaka	20	594375	1219525	M
20541159	Diarabaka	20	594975	1219525	M
20550186	Diarabaka	20	595650	1219750	M
20550204	Diarabaka	20	596100	1219750	M
20550228	Diarabaka	20	596700	1219750	M
20574204	Diarabaka	20	596100	1220350	M
20622210	Diarabaka	20	596250	1221550	M

Piezo Id	Location	Plateau Nr	X UTME	Y UTMN	Monitoring Frequency
20682192	Diarabaka	20	595800	1223050	M
26256319	Dakandouka	26	598996	1212403	M
26286301	Dakandouka	26	598546	1213153	M
26316223	Dakandouka	26	596596	1213903	M
26343238	Dakandouka	26	596971	1214578	M
26355268	Dakandouka	26	597721	1214878	M
26376265	Dakandouka	26	597646	1215403	M
26400247	Dakandouka	26	597196	1216003	M
26403280	Dakandouka	26	598021	1216078	M
26418229	Dakandouka	26	596746	1216453	M
26448313	Dakandouka	26	598846	1217203	M
26490313	Dakandouka	26	598846	1218253	M
3330018	Wossou	33	611798	1216320	M
3333022	Wossou	33	612098	1216542	M
3333042	Wossou	33	613599	1216543	M
3335028	Wossou	33	612550	1216693	M
3341036	Wossou	33	613149	1217143	M
33304866	Wossou	33	614250	1214607	M
33316902	Wossou	33	615150	1214907	M
33328866	Wossou	33	614250	1215207	M
33334884	Wossou	33	614700	1215357	M
33347028	Wossou	33	612550	1217590	M
33349044	Wossou	33	613748	1217743	M
33352866	Wossou	33	614250	1215807	M
33354020	Wossou	33	611951	1218114	M
33356050	Wossou	33	614198	1218268	M
33362012	Wossou	33	611352	1218713	M
33376866	Wossou	33	614250	1216407	M
33400866	Wossou	33	614250	1217007	M

Notes:

M Monthly

Coordinates in WGS84 Datum, UTM28N

Figure 19.9 Proposed groundwater monitoring locations overview

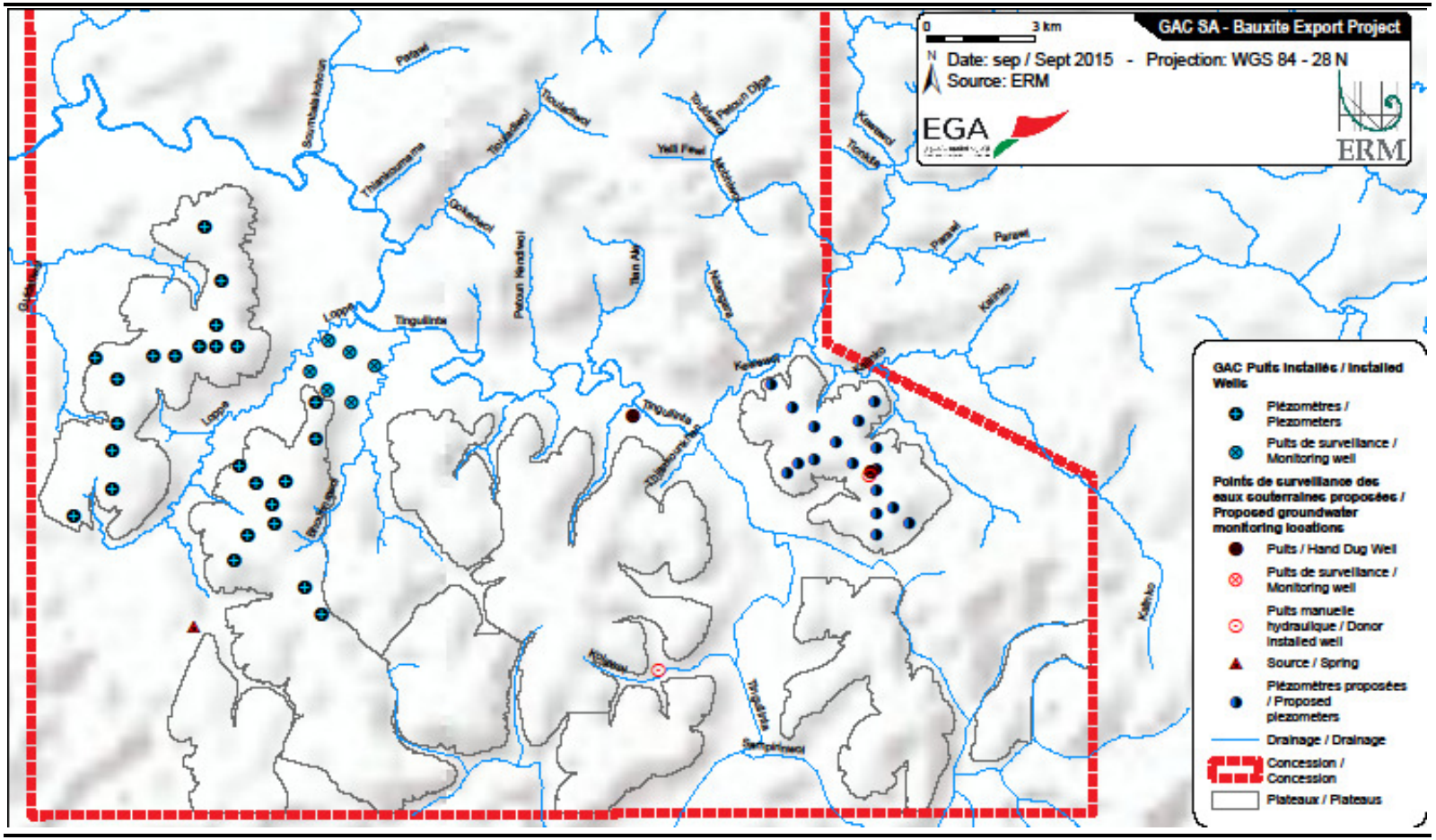


Figure 19.10 Potential spring areas

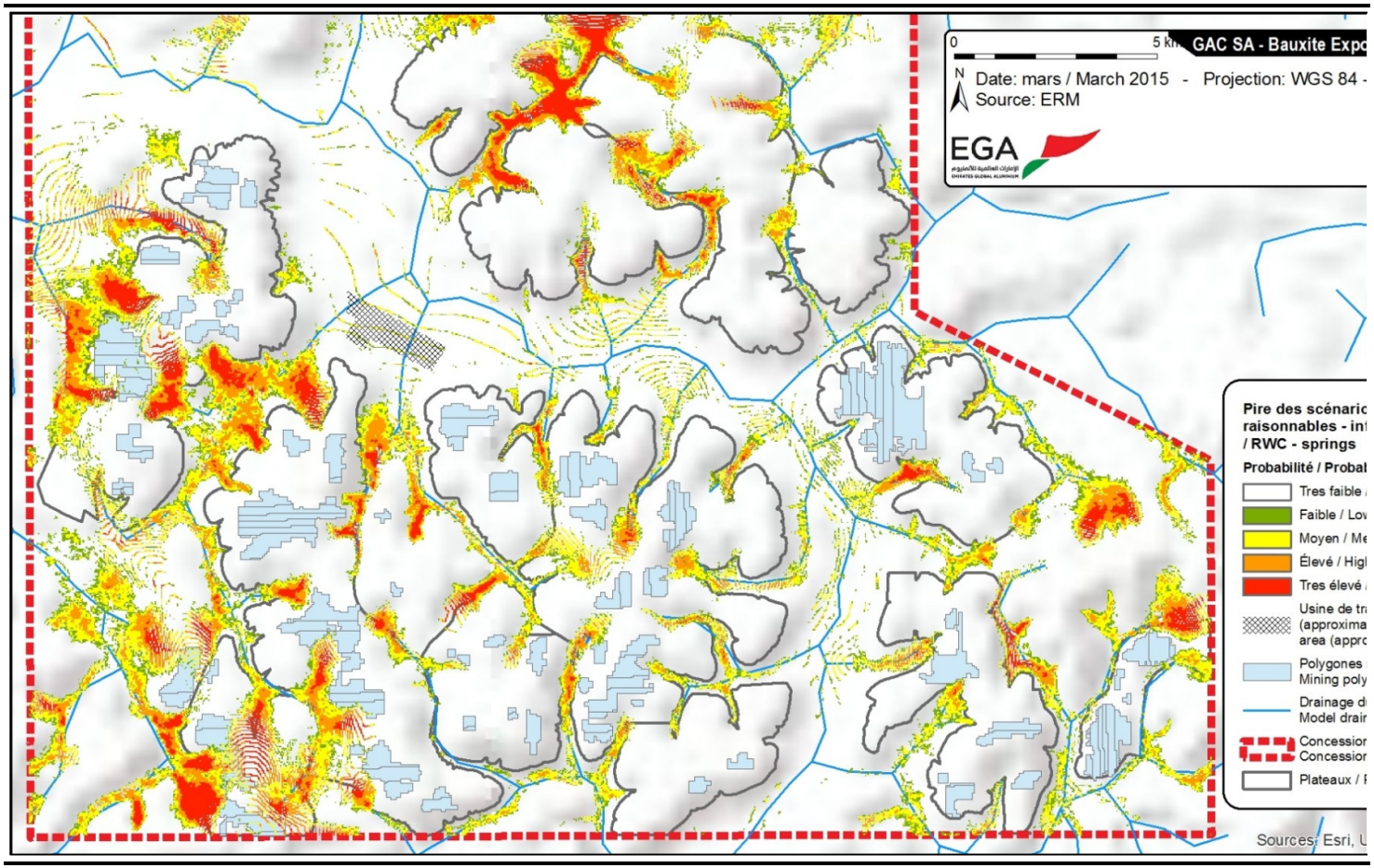


Figure 19.11 Proposed groundwater monitoring locations – eastern area

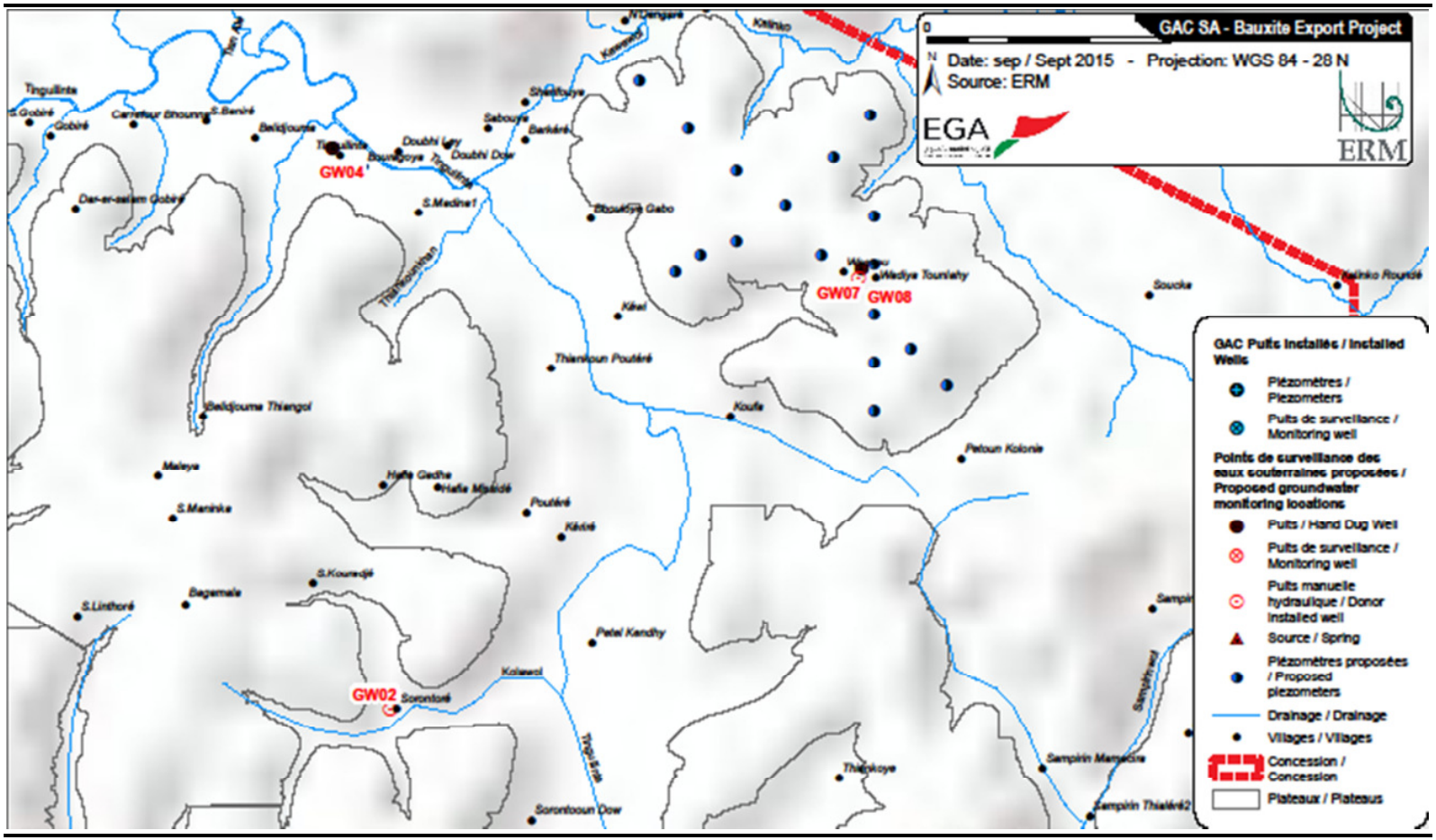
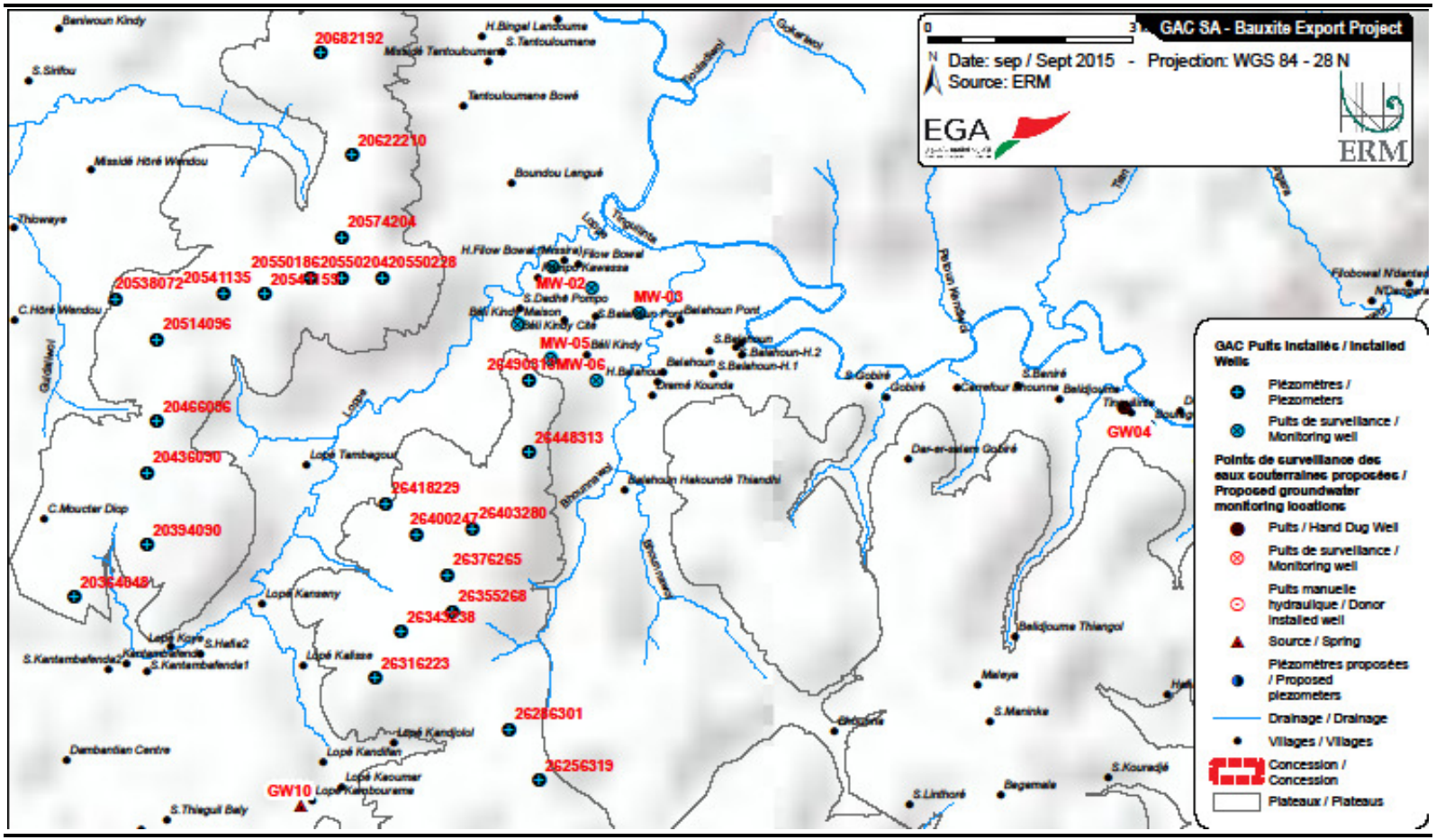


Figure 19.12 Proposed groundwater monitoring locations – western area



Monitoring stations Kamsar Port

Eleven monitoring wells are proposed for the port (*Table 19.15*) based on the planned location of infrastructure. The locations are preliminary (*Figure 19.13*) and will be finalized based on the final structure of the platform and the location of storage and maintenance areas. The wells are designed to monitor groundwater levels to demonstrate that the village wells in Daprass are upgradient of the platform and to monitor quality changes to ensure no potential contaminants reach the surface water receptors.

Table 19.15 Proposed groundwater sampling locations at the port

Well Number	Location	Justification	Monitoring Frequency		
			Water Level	Laboratory Parameters	Field Parameters
A	Close to the entrance to the GAC platform area	Upgradient calibration point	Q	Q	Q
B	Along the fenceline close to the rail yards	Upgradient calibration point, monitoring for contaminants from rail maintenance	Q	Q	Q
C	Downgradient of diesel storage area	Monitoring for contaminants from storage	Q	Q	Q
D	Downgradient of diesel storage area	Monitoring for contaminants from storage	Q	Q	Q
E	Downgradient of diesel storage area	Monitoring for contaminants from storage	Q	Q	Q
F	Downgradient of diesel storage area	Monitoring for contaminants from storage	Q	Q	Q
G	Centre of the platform	Platform calibration point	Q	Q	Q
H	Outer edge of the platform	Sentinel well	Q	Q	Q
I	Outer edge of the platform, downgradient of bauxite stockpile	Sentinel well, monitoring for contaminants from stockpile	Q	Q	Q
J	Outer edge of the platform, downgradient of bauxite stockpile	Sentinel well, monitoring for contaminants from stockpile	Q	Q	Q
K	Outer edge of the platform, downgradient of bauxite stockpile	Sentinel well, monitoring for contaminants from stockpile	Q	Q	Q

Notes:

Q Quarterly

Scheduling for monitoring is designed for baseline period. The frequency should be reviewed after 12 months of data collection.

Figure 19.13 Preliminary groundwater sampling locations at the port

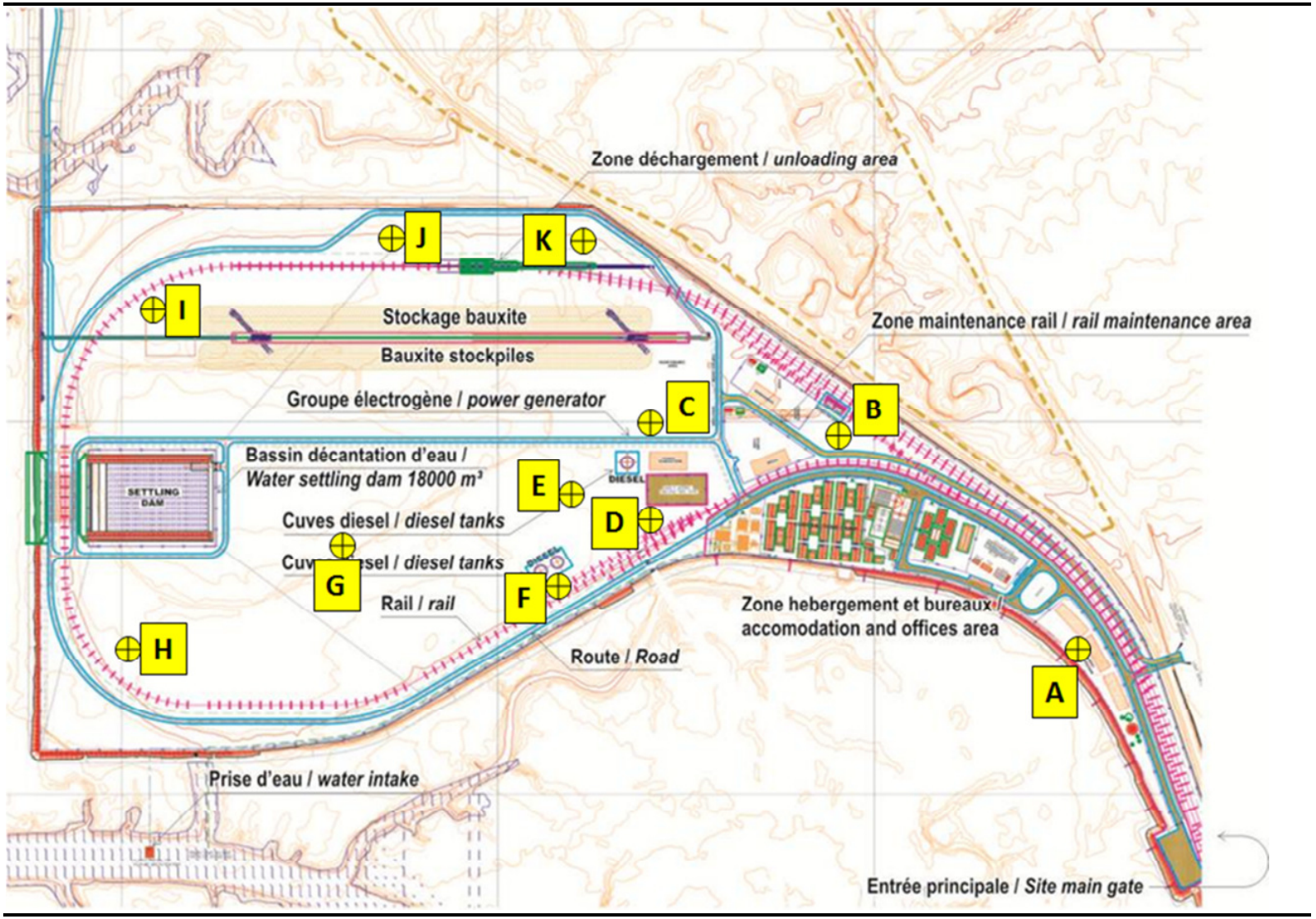


Table 19.16 Summary of ground water monitoring strategy in port and mine areas

Potential impact	Monitoring indicators	Parameters	Locations	Timing/frequency	Measuring Equipment	Responsible
Soil & groundwater contamination (port and mine) Water drainage into groundwater Change to water quality	Groundwater quality (*Table 19.12*) Number of findings during Environmental and H&S audits.	Laboratory Parameters Field Parameters	Port 11 sites (*Table 19.15)* Mine 11 sites (*Table 19.13*)	Quarterly (lab) / monthly (in situ)	See *Section 19.3.8.4*	GAC personnel / subcontractors
Reduced groundwater levels (port and mine)	Groundwater monitoring levels	Water Level	Port 11 sites (*Table 19.15*) Mine 8 sites (*Table 19.13*)	Quarterly	See *Section 19.3.8.4*	GAC personnel / subcontractors
Reduced soil permeability disruption of groundwater recharge (mine only)	Groundwater monitoring levels	Water Level	Mine 52 sites (*Table 19.14*)	Monthly	Piezometer (*Section 19.3.8.4*)	GAC personnel / subcontractors
Water drainage into groundwater Changes to water quality	Groundwater quality (*Table 19.12*) (incl. pH and mineral composition)	Laboratory Parameters Field Parameters	Port 11 sites (*Table 19.15*) Mine 11 sites (*Table 19.13*)	Quarterly (lab) / monthly (in situ)	See *Section 19.3.8.4*	GAC personnel / subcontractors

19.3.1.5 Seawater quality

The project will undertake a range of monitoring activities linked to the Social and Environmental Management Plan and mitigation measures proposed in the impact assessment. In the marine environment the principal project activities and issues identified which may require some form of monitoring are:

- dredging and disposal and associated plumes;
- confirmation of the final project footprint and any long-term changes to this; and
- the geomorphological stability of the channel and coastline.

Construction Phase

During the construction phase monitoring will be performed in association with dredging activities and associated vessel operations.

Prior to dredging, the project will perform additional geotechnical investigations via vibrocoring. Whilst not technically a monitoring activity, the findings of these investigations will be incorporated into the Dredging Environmental and Social Management Plan (DESMP), and so will inform the dredge design and any required mitigation and monitoring in relation to sediment and water quality and plume generation.

For dredging activities and specifically the generation of the plume, the monitoring will consist of measurement of water column levels of turbidity and suspended sediment. Measurements representative of the unaffected environment will be undertaken at a control location representative of the natural baseline conditions at the time of monitoring. In addition measurements will be made of the main plume and of the degradation of the plume downstream to demonstrate the point at which downstream (or downwind) turbidity and TSS return to levels comparable to baseline conditions. Monitoring will be undertaken in the field in real time using a multi-parameter probe which has been calibrated. Turbidity will be measured in NTU and taken at -1 m, mid water and +1 m above the bed in water > 10 m deep and at -1 and +1 m in water less than 10 m deep. The Turbidity monitoring data will be periodically calibrated to water samples analyzed for total suspended sediments to confirm that the calibration ratio used is accurate. To collect water samples, a Niskin or Van Dorn sampler or similar will be used to collect water samples from the same water depth as turbidity measurements are collected and at the same time. This will provide a direct calibration between the in-situ turbidity measurements in NTU and the lab analyzed total suspended sediment in mg/l. The collected water samples will be transferred to jars and transported to a certified laboratory for analysis for total suspended sediment in mg/l. There are typically no specific 'hold/ transit' requirements or times for TSS analysis but this should be confirmed by the laboratory conducting the analysis. All samples should be documented via chain of custody paperwork during transit. This monitoring should be

conducted for all dredging (capital and maintenance) and the results reviewed in line with the predictions of the modeling in order to update control measures in the DESMP should this be required, or to confirm the existing assumptions.

In addition to the plume monitoring, the final marine project footprint will be recorded including the bathymetry of the dredge channel and disposal sites. This will be recorded by the dredging contractor on completion of the dredge contract to demonstrate the completed work and will provide evidence of the final project footprint which will be recorded in the project monitoring records. Should any additional dredging or disposal be undertaken in future, e.g. maintenance dredging then the records should be updated to reflect the current project footprint and time period since areas were subject to disturbance; an indicator of the likely benthic community recovery.

Project Operations

During the operational phases of the port a range of monitoring will also be required. There will be continuity between the construction phase activities described above and operational activities. The following monitoring related activities, already described above, will be carried through from construction to operation:

- dredge plume monitoring during maintenance dredging; and
- confirmation of any evolution in the project footprint, e.g. additional disposal areas used to support maintenance dredging;

In addition to the above, the project will perform long-term verification of the findings of the SEIA, and specifically in relation to the geomorphological stability of the channel and coastline. The impact assessment outlines the assumptions that the project would have no significant impact on the geomorphology of the wider estuary and its banks or coastline. In order to confirm this assumption in the long-term it is proposed that a watching brief is in place and any evidence or stakeholder grievance related to potential bank or beach erosion for example if followed up and investigated by the environmental and social management team. In addition, periodic review of new versions of publically available satellite imagery would allow long-term monitoring of the channel and coastline stability and verification of the assumptions with regard project impacts. It is noted that the estuarine and coastline system is likely to exhibit some flux under natural geomorphological process and this and any implications for the project would also be identified by this activity.

Monitoring stations at Kamsar Port

The specific areas to be monitored will be confirmed as part of the development of DESMP which will be informed by ongoing computational modeling.

Table 19.17 Summary of seawater monitoring strategy in port area.

Potential impact	Monitoring indicators	Parameters	Locations	Timing/frequency	Measuring Equipment	Responsible
Increased water turbidity from suspension of sediment from dredging and construction.	Seawater quality at selected locations during dredging and dredge spoil disposal Turbidity (in-situ) plus standard in-situ parameters Total suspended sediment (water samples)	In-situ measurement of: -Turbidity -Salinity -Dissolved Oxygen -pH -depth Water samples for laboratory analysis: -Total Suspended Sediment (TSS mg/l) Periodic sampling and analysis to confirm assumptions on calibration of turbidity: TSS ratio, e.g. based on notable changes in grain size of dredged material -Metals	To be determined	Before, during and after dredging and other marine construction Specific information on timing to be confirmed in line with development of DESMP – to be representative of natural conditions – e.g. change sin tide and activity, e.g. dredging and disposal activities	Calibrated multi parameter probe for in-situ measurement Approved and certified laboratory for TSS analysis	Dredging contractor/ EPCM with periodic GAC audit
Impacts to Sediment Physico-chemistry from Dredging	Sediment metal concentrations of full sediment profile will be used to confirm baseline characterization in SEIA and then inform dredge plan and DESMP	Analysis of standard laboratory sediment metals suite as per baseline survey for samples through sediment profile via planned vibrocoring	As per planned vibrocoring locations	During vibrocoring, pre dredging	Subsamples of vibrocore to be sent for laboratory analysis by approved and certified lab	Geo-environmental contractor with GAC supervision/ audit
Impacts to seabed footprint,	Final post dredge footprint	Confirmation of completed dredge	Marine footprint	After capital dredging and any	Bathymetric survey vessel or	Dredging contractor

Potential impact	Monitoring indicators	Parameters	Locations	Timing/frequency	Measuring Equipment	Responsible
hydrodynamics and geomorphology from Dredging		channel and disposal site bathymetry		subsequent phases of capital dredge	other technique applied by dredging contractor	
	Channel and bank stability	Watching brief on channel and bank stability and response to any stakeholder concerns	Channel banks and coastline	Ongoing and periodic long term review of publically available aerial / satellite imagery when updated, e.g. new Google earth image	Site walk over, aerial or satellite imagery or liaison with stakeholders as appropriate	GAC environmental and social teams
	Stakeholder views			On receipt of any stakeholder feedback or grievances		

19.3.1.6 Waste

Waste monitoring program

The monitoring program for waste management will be implemented to ensure that all waste management actions are conducted in compliance with Guinean legislation, international guidelines and GAC standards in order to avoid and minimize the risk of pollution due to waste storage, transfer, treatment and final disposal activities. Waste monitoring covered in this section only applies to solid waste (liquid waste is dealt with under surface water).

The different types of waste to be monitored will follow waste streams that have been previously identified. Hazardous waste that cannot be recycled or disposed of in adequate facilities in Guinea will be stored on site to be sent abroad in adequate treatment and disposal facilities. Furthermore, current GAC standards and practices in waste segregation will be applied, which will allow separate records to be kept on all types of waste. Thus, this waste monitoring scheme will use existing reporting practices in order to centralize the system to enable to query the data and establish trends/patterns in waste generation and final destination. Given that a waste management area is being envisaged by GAC, it may be considered that this may be the central point for recording waste generation and final disposal.

Three basic types of waste-monitoring activities will be conducted, as reported below:

- A measurement of weight/volume of waste separated by type and final disposal, at source, onsite storage areas, transport vehicles and receptor facilities, using portable or fixed scales. Measurements will be taken every time waste is generated, collected and stored to be delivered onsite or to third party contractors for subsequent use, treatment or final disposal including where the final destination is abroad.
- The values to be specifically monitored and recorded are at least:
  - general waste volumes and type;
  - recycled waste volumes and type;
  - hazardous (solid) waste volumes and type;
  - organic food waste volumes.
- All designated waste storage areas will be audited / inspected regularly checking their quality status, in order to ensure the good condition of sites, containers and proper labeling. A check list will be completed for every inspection, and, for any criticalities that are found, corrective action will be designed and implemented, in order to control and minimize any risk of pollution. Furthermore each month a supervisor will check that the waste register is correctly compiled.

Internal waste treatment activities

Two main internal waste treatment facilities are envisaged by the Project:

- A landfill to dispose of the household type waste; and

- A small incinerator dedicated to medical waste.

The capacity and exact adequate locations of these two facilities are not yet decided. They will be installed within the GAC mining concession, and studies are still ongoing to design the facilities and define their locations.

The design of these facilities will comply with local regulation, IFC and AfDB guidelines, and international good practices. The management of these facilities will be described in the Waste Management Plan.

The monitoring program of the atmospheric emissions of the incinerator will be defined according to the size of the equipment and to the quantity of medical waste to be incinerated.

Depending on the topographic constraints and groundwater vulnerability, a number of piezometers will be installed around the landfill facility. A specific groundwater monitoring program will be established and included in the Integrated Water Management Plan.

Table 19.18 Summary of waste monitoring strategy in port and mine areas

Potential impact	Monitoring indicators	Parameters	Locations	Timing/frequency	Measuring Equipment	Responsible
Risk of pollution	Waste register Results of water quality monitoring	n.a. refer to water quality monitoring description	Mine concession and port	Continuous	Project register / management system	GAC personnel
Degradation of soils and water quality (mine only)	Waste register Results of water quality and suspended matter monitoring	n.a. refer to water quality monitoring description	Mine concession and port	Continuous	Project register / management system	GAC personnel

19.3.1.7 Hazardous materials

The main hazardous chemical used at the Project sites is the ANFO. ANFO stands for Ammonia Nitrate Fuel Oil, the explosive mixture used for the blasting of rock at the mine site. GAC intends to use its existing ANFO storage facility in the northern part of the concession, located 9 km to the north of Pioneer Camp. This facility is equipped to store explosives and detonators in dry and secure conditions. All quantities of chemicals stored and used will be recorded in a specific register.

Apart from the ANFO, the Project will employ hazardous substances in limited quantities throughout the mining operation: diesel to fuel power generators and vehicles, chemicals (acids, caustic soda, and solvents) used for water treatment and plant maintenance, lubricants for engines maintenance.

Basic consideration for the use of these substances will be:

- All chemical products will be stored together with their respective Material Safety Data Sheets (MSDS) and these MSDS will be available and accessible for consultation by all employees who could be affected as the result of their handling or use.
- Personnel working onsite will be familiar with the MSDS and the required safety and handling procedures.
- The direct supervisors of the personnel who are to handle the dangerous products and materials shall be responsible for the dissemination of this information and training.
- Eco toxicological information regarding the chemicals used will be included in the MSDS, or provided by vendors, together with environmentally-friendly handling procedures.
- Hazardous liquid chemicals will be stored on a paved or impermeable surface with the necessary secondary containment.
- Hazardous chemicals storage area will be visually inspected on a weekly basis for signs of spills and leaks.
- For any product considered sufficiently hazardous by the person in charge of the affected work area, safety information will be displayed in a visible place at that area, including data on the dangers derived from their handling and the immediate actions to be taken in case of accidents such as fire, spillage, contact, inhalation of the product, etc.
- The use of chemicals will be monitored. All quantities of chemicals onsite will be recorded in a Project register.

Table 19.19 Summary of hazardous materials monitoring strategy in port and mine areas

Potential impact	Monitoring indicators	Parameters	Locations	Timing/frequency	Measuring Equipment	Responsible
Hydrocarbons and chemicals products use Health & Safety risk Waste incineration Sewage treatment Project activities	Hazardous materials register ANFO explosive mixture register (mine only)	n.a.	Mine concession and port	Continuous	Project register / management system	GAC personnel

19.3.2 Biological monitoring

Baseline investigations have been carried out in the Project area through a number of field campaigns over the past several years. Changes in Project plans, the integration of new baseline information with existing data over time, and the presence of critical habitat for an internationally protected species suggest that a robust monitoring scheme be implemented to improve knowledge on biodiversity values and validate predicted Project impacts and inform biodiversity management plans.

19.3.2.1 Flora and vegetation

Flora monitoring will consider identifying seasonal variations to complement existing data which will allow for an integrated assessment of biodiversity. Monitoring frequency should consider the comparative data between the rainy season and dry season and may consider the following criteria:

- Establishing permanent transect/plot sites (dimensions may vary depending on the amount of sites to be visited) adjacent to areas projected to be disturbed and in control areas for each of the vegetation associations identified in the baseline. These should be used to characterize the flora species composition for each of the vegetation associations and establish monitoring points where impacts to flora diversity can be monitored during construction and operations; and
- Calculating diversity indices for each transect/plot to assist in determining effects to diversity during construction and operations.

The monitoring of impact to landscape for loss of forest coverage (e.g. critical habitats) can be undertaken by periodic evaluations of habitat status. With parameters such as percentage of vegetation cover and type.

Biological monitoring should follow the progression of the mining operation where established sites would be visited at least twice a year during construction-operations related to the particular plateaus that are being mined.

Table 19.20 Summary of flora monitoring strategy in port and mine areas

Potential impact	Monitoring indicators	Parameters	Locations	Timing/frequency	Measuring Equipment	Responsible
Loss of vegetation assemblages (all identified within concession and port)	Hectares of natural and agricultural land reclaimed and restored Cleared and revegetated hectares (e.g. mangrove) Number of people that have participated to awareness training TBMP monitoring results Vegetation cover /type	Diversity indices Plant cover (%)	Permanent transect/plot areas	Consider at least bi-yearly monitoring	Field equipment	GAC subcontractors
Loss of critical habitats	TBMP monitoring results (population reduction)	Monitoring landscape loss of forest Periodic evaluations of habitat status.	Permanent transect/plot areas	Consider at least bi-yearly monitoring	Field equipment	GAC subcontractors
Dust deposition on plants resulting in reduced evapotranspiration	Air quality monitoring results (dust deposition)	Periodic evaluations of habitat status. (vegetation cover and type)	Permanent transect/plot areas	Consider at least bi-yearly monitoring	Field equipment	GAC subcontractors
Invasive plant species (concession)	Number of employees trained	n.a.	Mine concession and port	Continuous	Project register / management	GAC personnel

Potential impact	Monitoring indicators	Parameters	Locations	Timing/frequency	Measuring Equipment	Responsible
					system	
Introduction of exotic / invasive species (port)	Monitoring to be aligned to wider and ongoing Kamsar Port authority monitoring activities in first instance GAC specific indicators: Establish ballast water management procedures for all project vessels and monitor compliance/ breaches of procedures Establish incident response procedure should any issues be identified	Record of compliance/ lack of compliance with procedures Record of any incidents recorded and action taken	n/a	Throughout port construction, maintenance dredging and operations	Project register / management system	GAC and associated project vessel operators

19.3.2.2 Terrestrial fauna

Fauna monitoring will consider identifying seasonal variations to complement existing data which will allow an integrated assessment of biodiversity. Monitoring frequency should consider the comparative data between the rainy season and dry season.

Studies in support of biodiversity determinations will be undertaken by qualified and experienced professionals using standard sampling programs and tools. Monitoring is envisaged to cover the following taxa:

- avifauna ;
- herpetofauna ; and
- large mammals.

Avifauna monitoring will focus on employing bird counts along transects, basic criteria will be:

- transects in control and impact areas;
- indices of diversity per transect, per habitat type and for the study area;
- determination of statistical power using species-area curves or Clench diagrams;
- determination of control area suitability (coefficient of similarity, Jaccard diagrams);
- inventories of migratory species and nocturnal species; and
- list of endemic species (nationally listed or listed by Birdlife International – Endemic Bird Areas, 2006).

Herpetofauna monitoring will focus on employing standard sampling techniques (plot counts, exhaustive plot surveys) within plots, basic criteria will be:

- surveys on land and in local watercourses; and
- interviews with local residents.

In the case for large mammals, GAC intends to commission the Wild Chimpanzee Foundation (WCF) to conduct yearly monitoring surveys using WCF´s established methodologies.

Other monitoring schemes account for the documentation of fauna interactions with the project through a Project register, as well as the Project Grievance mechanism.

Table 19.21 Summary of fauna monitoring strategy in mine areas

Potential impact	Monitoring indicators	Parameters	Locations	Timing/frequency	Measuring Equipment	Responsible
Loss of natural habitats Habitat fragmentation	Surface of Critical Habitats within development areas TBMP monitoring results CHMP monitoring results	Diversity Abundance Diversity Indices Identification of sensitive species (e.g. *Afrithelphusa monodosa*)	Avifauna / Herpetofauna Permanent transects and plots	At least twice a year	Field equipment	GAC subcontractors
Accidents and death of animals	Number of reported accidents Number of people that have participated to awareness training Register of sensitive species (e.g. *Hemidactylus kundaensis*)	n.a.	Mine concession and port	Continuous	Project register / management system	GAC personnel and subcontractors
Increase in hunting pressure for bush meat / fishing pressure	Number of people that have participated to awareness training BMP monitoring results	Market studies	Mine concession and port	Continuous	Project register / management system	GAC personnel and subcontractors
Loss of critical habitats Wildlife population reduction	WCF monitoring results Number of people that have participated to awareness training	Abundance of sensitive species (e.g. Chimpanzee)	See WCF-MP	See WCF-MP	See WCF-MP	GAC subcontractors (WCF)

19.3.2.3 Freshwater ecosystems

Fish presence in the study area has been based on the expected distribution of species as indicated by local fishermen and by direct sampling. Monitoring should account for the identification of species of concern as well as establish the natural variation in fish assemblages/habitats by conducting yearly sampling in at least two seasons (wet and dry season).

Monitoring techniques may include the following:

- capture and evaluation of fish using standard, non-lethal methodologies (e.g. seine netting, electro-fishing cannot be use due to the low water conductivity);
- determination of species (vouchers may be collected for laboratory identification if they cannot be identified in the field);
- biometrics of fish captured (weight, length); and
- diversity indices for ichthyofauna community at each site evaluated and for the study area as a whole.

Aquatic invertebrate studies should be designed to identify the presence or absence of larger invertebrates (e.g. crustaceans) within the aquatic ecosystem. There are several socioeconomically significant species included in this group and at least one species (*Afrithelphusa monodosa*), which is endemic to Guinea and may be present in the study area. Monitoring should be conducted yearly in at least two seasons (wet and dry season) and consider the following:

- standardized collection of samples for each site sampled; and
- count of total individuals, number of species, relative abundance and index of diversity.

It would be best to ensure that monitoring site locations coincide with those identified for surface water sampling in order to be able to relate physico-chemical parameters to biological features; provided they have water available all year round.

Table 19.22 Summary of freshwater biota monitoring strategy in port and mine areas

Potential impact	Monitoring indicators	Parameters	Locations	Timing/frequency	Measuring Equipment	Responsible
Deterioration of freshwater habitats	Suspended matters monitoring results Water quality monitoring results Results of fish biodiversity monitoring	Species richness and abundance Biometrics of fish captured Diversity indices For water quality refer to Section 19.3.1.3	Consider the same as surface water monitoring	Consider at least bi-yearly monitoring	Field equipment	GAC subcontractors
Changes in fish biodiversity	Water quality monitoring results Results of fish biodiversity monitoring	Fish monitoring see above Sensitive species (e.g. *Paramphilius teugelsi*)	Consider the same as surface water monitoring	Consider at least bi-yearly monitoring, and consider changes in fishing pressure if possible	Field equipment	GAC subcontractors
Decrease of fish stock due to overfishing	Collaboration with local authorities in charge of natural resources management.	n.a.	Mine concession	Continuous	Project register / management system	GAC personnel

19.3.2.4 Marine ecosystems

The project will undertake a range of monitoring activities linked to the Social and Environmental Management Plan. In the marine environment the principal project activities and issues identified which may require some form of monitoring are:

- assess presence of receptors sensitive to underwater noise generation of underwater noise;
- assess stakeholder perception of the project on marine ecosystem, particularly that of artisanal fishermen; and
- implement vessel port operations and control measures for potential alien and invasive species.

Construction phase

During the construction phase monitoring will be performed during piling activities and associated vessel operations.

For the piling, the purpose of the monitoring is to help prevent potential impacts to sensitive fauna as part of the mitigation strategy. The project will perform observation followed by a soft start/ ramp up for any piling. This is standard good international practice and consists of observation for sensitive fauna by trained observers for a defined period prior to the commencement of piling which could generate harmful levels of underwater noise. The monitoring consists of visual observation for target sensitive fauna in this case marine mammals and turtle prior to commencement of piling; monitoring is typically undertaken for 30 minutes, surveying a 500 m radius area prior to a gradual ramp up in noise over a further 20 minutes.

No project footprint from dredging is envisaged in mangrove areas and hence no specific monitoring proposed for these areas or associated species in the marine environment.

During construction and operation a range of vessels will enter the project area of interest; this is the operational purpose of the port project. In any port facility such as the operational GAC facility there is a risk of alien or invasive species being brought in from a different region, for example in ballast water. The project will adopt invasive species control measures in consultation with the Kamsar port authority, for example it is proposed that ballast water exchange will not take place in coastal waters. No physical monitoring will be undertaken, but as part of the environmental management system for the project, compliance with these control measures will be monitored in the long-term. This will apply in both the construction and operational phases of the project.

Population level impacts are not envisaged on sensitive marine fauna including mammals, turtle and fish. The disturbance associated with the project construction phases, most notably underwater noise and generation of dredge plumes, may however displace motile receptors from the immediate area of influence of the work. In time after disturbance ceases, any such marine fauna is expected to return to the project area. The actual or perceived impact of this potential temporary displacement may be an area of concern for local artisanal fisherman. The primary mechanism for monitoring will therefore be linked to the stakeholder engagement program and the project grievance mechanism which will allow the project to monitor and respond to stakeholder concerns with regards to impacts on the environment and associated fauna.

Project operations

During the operational phases of the port a range of monitoring activities will also be required. There will be continuity between the construction phase activities described above and operational activities. The following monitoring related activities, already described above, will be carried through operation:

- management system level monitoring of invasive species control measures; and
- maintenance of the project stakeholder engagement program and grievance mechanism specifically in relation to artisanal fishermen.

Table 19.23 Summary of fauna monitoring strategy in port areas

Potential impact	Monitoring indicators	Parameters	Locations	Timing/frequency	Measuring Equipment	Responsible
Mangrove dependent species (port)	No significant impacts to mangroves or associated marine dependent species are predicted by the impact assessment. The project will maintain ongoing stakeholder engagement with local artisanal fisheries communities and a grievance procedure. Any grievances or other feedback raised by stakeholders in relation to the local marine ecosystem and in partially fish will be recorded and follow up actions implemented as appropriate.	Grievances or stakeholder feedback Number of actions required vs implemented	Management system, grievance log	Continuous	Project register / management system	GAC
Collisions/ near misses with marine fauna (port)	Presence in area Number of reported near misses or accidents	Reported sightings, near misses and vessel strikes	Recorded throughout project port operational area	For all vessel operations	Observations of crew	Vessel crew, pilot, GAC environmental and social management function

Potential impact	Monitoring indicators	Parameters	Locations	Timing/frequency	Measuring Equipment	Responsible
Loss of habitat and benthic communities (port)	Confirmation of total project footprint and classification as ongoing loss e.g. channel, or areas where recovery is anticipated, e.g. full disposal sites and the borrow area	Total area affected	Project footprint	After Capital dredged and associated disposal campaign and record maintained throughout project and representing any significant changed e.g. expansion projects	Input from dredging and engineering teams	Dredging contractors and EPCM with GAC supervision/ audit
Introduction of exotic / invasive fauna species (port)	See above					
Generation of underwater noise	Marine mammals (cetacean and manatee) and turtle	Use of international protocols: Monitor for presence.	Within 500m observation zone	Prior to all piling activities during suitable visibility - daylight hours	Trained protected species/ marine mammal observer	EPCM with GAC audit

19.3.3 Closure and rehabilitation monitoring

The restoration and rehabilitation of land at closure of operation are addressed in *Chapter 18: Social and Environmental Management Plan*. .The decommissioning the mine facilities and the land rehabilitation will be addressed in the Mine Closure and Rehabilitation Plan, while it is anticipated that the port site and rail spurs will be handed over to the government of Guinea for their use. If needed, a specific Port Closure Plan will be developed before the closure of the Project in consultation with government authorities.

Across Project life, mining activities will progressively deplete the bauxite resources, and so the initial pits will progressively be closed and rehabilitated to allow for the opening of new pits. The estimated average mining life of one pit will be approximately two to four years. Once a pit becomes disused, initial mine closure and rehabilitation activities may start. These will follow the principles of the Mine Closure and Rehabilitation plan, particularly with regards to safety, drainage, and reinstatement of soils and ecosystems in a manner consistent with the natural environment, and land use plans agreed through the stakeholder engagement process.

The success of land restoration and rehabilitation will be monitored during and after the closure of the Mine. In addition, a specific monitoring program will be developed to monitor the effectiveness of the progressive pit closure and rehabilitation during the life of the mine. The results of these monitorings will be used to feed the flora and fauna biodiversity monitoring. The elements of monitoring programs will include the following:

- inspection of the overall stability of the rehabilitated areas for evidence of erosion, landslide, etc., following a major storm event and during and at the end of the rainy season;
- monitor for water quality upstream and downstream of rehabilitated areas (using baseline obtained for the SEIA and then semi-annual monitoring results);
- inspection of the re-vegetated areas after the first year;
- after two years, an evaluation of the effectiveness of the rehabilitation activities (number and type of plant species, plant heights, productivity, threatened species, eroded areas, etc.); and
- on year 5 and 10 after land restoration, investigate success of re-vegetation and conduct faunal surveys to assess use of rehabilitated areas
- demonstrate that water quality objectives are met; and
- assess the adequacy and performance of drainage structures and sediment control systems.

Monitoring will include field reconnaissance during the first growing season to evaluate revegetation success. The establishment of exotic plant species will also be monitored for at least a two-year period. In the case that exotic plants are observed, they will be physically, mechanically or chemically removed or treated to limit their establishment. Monitoring will also be used to identify areas that may require supplemental irrigation or nutrients.

Follow-up reports will be prepared, and the results will be shared with concerned parties and the local population. Sampling methods (parcels, techniques, etc.) for the monitoring program will be determined as the detailed closure plan is developed. Monitoring results will be used to revise the success of the Plan with regard to its original objectives. The Plan will be enhanced as needed and additional rehabilitation activities could be performed where needed.

19.3.4 Social monitoring

Social monitoring will be based on various source of information including:

- physical monitoring results informing on the level of nuisance (e.g. air quality, noise and vibration) generated for nearby residents;
- biological monitoring results informing on the status of natural resources and ecosystem provisioning services benefiting to the community;
- grievance monitoring to inform GAC on the number and origination of complaints received from third parties;
- monitoring of resettlements activities, including results of livelihood restoration and broad community support (this will be further refined in the resettlement action plan monitoring program);
- periodic (annual) social surveys to inform GAC on demographic and socioeconomic change, as well as stakeholder perception.

The social baseline described in the SEIA Addendum will be used as a reference in subsequent social monitoring. Proposed monitoring indicators are therefore similar to the ones used to develop the social baseline in order to allow for comparison. Additional indicators are proposed that allow for more impact specific analysis.

Social monitoring will take place during the entire Project life and will continue post-closure during a period of 10 years. During the first years, social post-closure monitoring will be similar in details and periodicity as during the Project lifetime. However, as the monitoring demonstrates that the development of the socioeconomic context is gradually less influenced by the the Project impacts, the monitoring may adapt and reduce its scope and regularity.

Sections 19.3.4.1 to *19.3.4.10* below further detail which information is to be collected, the source or methodologies to collect information and data gathering and reporting frequencies with the aim to support the Project's social performances.

19.3.4.1 Demographics, social dynamics, socioeconomic context

GAC will monitor changes in demographics at the mine area to assess general demographic indicators (population numbers, age distribution, gender, ethnic group, religious belonging etc.), as well as socioeconomic indicators (income,

livelihoods, etc.) that and will use results to monitor the effects of Project-induced change that may result from in-migration, resettlement, job creation (monitoring of Project related employment will also take place at the port), community investment programs.

The monitoring may consider collecting the following information:

- baseline indicators such as population size by locality and district including number of households, households size, age (>/< 15 years) and gender distribution, as well as religious and ethnic affiliation;
- efficiency of the local and preferential hiring program in terms of number and rates of Project Affected People (PAP) employed by the Project;
- trends in qualitative data from households survey such as family structures and dependency relationships and households negative opinions on the Project benefits or impacts; and
- grievance indicators (numbers, location and repetition) with regard to complaints related to Project benefits or impacts.

Specific socioeconomic indicators should comprise

- annual total households income (in Guinean Franc) per sector (agriculture, herding, fishing, property, material rents, mining, businesses and employment, entrepreneurship, retirement and cash transfers);
- average annual income per consumption unit (using Oxford equivalence scale);
- share of non-monetary income;
- population and project affected households habitat synthetic quality index (HSQI from baseline) based on *Table 19.24.*;

This social and socioeconomic surveying will occur on a yearly basis. During the construction and early operation phase, GAC (through its Communities team) will continuously monitor change through the stakeholder engagement program, and (if deemed needed) targeted surveys.

Table 19.24 Habitat synthetic quality index

	Type	Materials	Indices
Walls	Traditional	Wood, banco	0
	Half-hard	Backed or mud bricks	1
	Hard	Cement bricks	2
Roof		Straw	1
		Plastic or metal sheets	2
Floor		Earth floored	0
		Cement	1
		Tiles	2

19.3.4.2 Access to land

People ability to access land may be affected directly by the Project land take and indirectly from demand-pull inflation caused by resettlements and

population influx in search for land[1]. Inability to access land may at its turn cause social tensions and conflicts between locals and migrants and among communities.

Access to land monitoring will collect data to inform on the following:

- surface of land rehabilitated annually by the Project vs. annual land take by the Project;
- average land surface used and owned by households;
- baseline indicator such as mode of land acquisition (monetary/in kind exchange/family owned/gift/other)
- share of land and locations were land is managed traditionally vs. covered by official land titles;
- annual price inflation for land acquisition and rent vs. proxy for households average purchase power or poverty level;
- grievance indicators (numbers, location and repetition) with regard to complaints related to land take or access to land.

Monitoring and reporting will occur biennially. Monitoring results should inform the Project on the need for better implementation of foreseen mitigations or additional correction measures.

19.3.4.3 Agriculture and cattle

The Project footprint at the Mine area will temporary reduce land resources available for agriculture and herding. Demographic change may also modify livelihoods and income for households involved in agriculture or herding.

Indicators to monitor will include:

- income baseline indicators such as:
  - annual households income (in Guinean Franc) per sector of activity;
  - average annual income per consumption unit (using Oxford equivalence scale);
  - share of non-monetary income;
- project area households access to land (surface of land owned or rented);
- project area households standards of living assessed through proxies such as surface of agricultural land or size of cattle per family member, level of cash income, asset inventory, wellbeing indicator, etc.;
- investments from the LDP and Livelihood Resettlement and Restoration Framework (LRRF) in support to agriculture, herding and other income generating activities, including number of beneficiaries; and
- cost of farm labor.

[1] As for all monitoring themes, other factors external to Project may influence access to land (e.g. natural population growth in absence of Project). These will be taken into account to evaluate the Project influence on land access.

Additional monitoring requirements will be developed as part of the Project LFFR and specific monitoring plans will be developed as part of each Resettlement Action Plan.

Monitoring and reporting should occur annually from the start of Project development over third party land. Note that this can be undertaken in combination with the annual social / demographic survey.

19.3.4.4 Access to natural resources

The Project footprint will temporary reduce natural resources habitats available to local communities while it is likely that the increased populations will increase the pressure on remaining ones. Access to some water resources may also be affected by the Project footprint (albeit not in the Kéwéwol, Tinguilita and their main tributaries). Fishing at the Port area may be disrupted by dredging activities or industrial discharge incidents into the sea.

The monitoring of these potential impacts and of the effectiveness of mitigations in place will require the collection of the following information:

For access to water resources:

- distribution of type of water source (human powered wells, traditional wells, piping, source/river);
- average number of households per human powered pump
- satisfaction level on potable water source (1 to 5); and
- annual household income share from fishing (at the mine).

For access to NTFP: trends in results from regular households surveys in particular:

- energy source for cooking (wood, charcoal, gas, other
- number and distance to forests and other habitats provisioning natural resources;
- time dedicated to NTFP collection and opinion on availability;
- income (monetary and non-monetary) from hunting activities.;
- investments from the LDP and LRRF in provisioning support to agriculture, herding, and other income generating activities, including number of beneficiaries

For general closure / reclamation activities:

- results from the monitoring foreseen as part of the progressive pit closure and rehabilitation.

And throughout, during Project life, through the grievance mechanism:

- grievance indicators (numbers, location and repetition) with regard to complaints related to access to natural resources.

These indicators can be monitored annually – this can be undertaken in combination with the annual social / demographic survey.

19.3.4.5 Community health and safety

Health and safety of the local community (including those Project employees from within the community) may be affected by the Project trough changes, for example, in road and rail traffic, disease transmission from increased population density, insecurity from growing inequalities, poor hygiene, sanitation and living conditions, sexual interactions between workers and local people, reduced access to healthcare from increase in population pressure, accidents at work or major industrial accidents, etc.

The monitoring of local communities and workers health and safety will require the collection of the following data:

- Population health indicators such as:
  - individuals morbidity rate over 6 months
  - percentage of access to modern medicine and vaccination coverage of children under 15;
  - knowledge rate of AIDS from households heads and of routes of transmission (non-protected sexual intercourse, blood contact, mother-child, breastfeeding, wrong beliefs, no knowledge);
  - knowledge rate of Ebola from households heads and of routes of transmission (animals, contact with Ebola infected people, contact with Ebola deceased people , wrong beliefs, no knowledge).

- Indicators of access to health services, including:
  - rates of access to latrines (nature, traditional latrine, improved latrine, WC);
  - mapping of population centers together with demographic information and health centers location and capacities;
  - surveys to local health centers and hospitals requesting data on number of visitors, number and type of diseases or accidents, price of consultation and average queuing time.

- Other health, safety and security indicators, including
  - local authorities or police force statistics on criminality, if available;
  - number and type of near-misses and accidents at the Project sites;
  - grievance indicators (numbers, location and repetition) with regard to complaints related to Project related accidents (traffic accidents, conflict with workers, etc.); and
  - results from households surveys with regard to hygiene and sanitation (e.g. access to clean water).

Monitoring of health and safety should occur on an ongoing basis, as special events are reported, surveys at health centers should occur on a quarterly basis, especially with regard to the spreading of water borne diseases and epidemics. Monitoring results will support the Project and local authorities in fine-tuning mitigation measures, investment in healthcare services and to act as required to control the spread of a potentially threatening water-borne or other viral diseases.

19.3.4.6 Access to education

There could be some impacts from the Project on access to education in the mine area, largely due to (if not mitigated through access to employment and community investment) a decrease in income of Project Affected People.

However, it is expected that an increase of average household income thanks to Project-induced employment, and increase of public budget thanks to Project fiscal contributions, will lead to increased investments in education in terms of infrastructures and service quality.

For communities to be resettled, the resettlement process foresees that resettled and hosting communities will have access to the same level of education services in terms of quality and quantity. In addition, project mitigation will favor collective compensations to resettled households in the form of investments in education and monetary compensation during a transition period for livelihood restoration.

The monitoring of local communities access to education and of the effectiveness of the Project mitigation measures will require the collection of the following information:

- baseline indicators such as:
- number of schools in the study area, including number of students, gender rates, number of students per classroom and number of students per teacher;
- primary schooling rate;
- literacy rate of population over 15 year old, including by gender;
- graduation rate of population over 20 year old (none, CEP, BEPC, BAC, BTS, University).
- mapping of population centers together with demographic information and education infrastructures and capacities.

Monitoring on access to education should occur annually. Results should guide the Project in adapting its collective compensation investments as part of the LRRF and RAP and help the authorities to adapt the use of the LDF.

19.3.4.7 Mobility, flows and transport

The Project could affect local population mobility through its footprint on existing paths and increased Project vehicles movements. This said, alternative paths, roads and crossing points will be planned by the Project to mitigate these impacts. In addition, increased public budget is likely to lead to an improvement of public transport infrastructures.

Monitoring mobility will ensure that the access to main points of interest for the population is maintained. Monitoring will include the gathering of the following information:

- baseline indicators such as households repartition of own means of transport (none, motorcycle, car, truck);
- mapping of roads and paths by type and travel time from population centers to places of interests such as markets, schools, medical centers, agricultural areas, etc.; including closed and alternatives paths provided by the Project;
- results from households surveys and LRRF and RAP monitoring with regard to household opinion on mobility and travel time to main places of interest; and
- grievance indicators (numbers, location and repetition) with regard to complaints related to Project traffic disruption, blocking of paths, and reduced mobility following resettlement.

Monitoring results should inform the Project on the need to plan for the development of additional alternative paths and crossing points and/or to enable partial use of Project haul roads. Monitoring should focus on potentially affected communities and occur directly after each land take process (incl. development of new roads, etc.) and then annually for a period of 2 years.

19.3.4.8 Living conditions

Project construction and operational activities will generate an increase in dust, noise and vibrations as well as a change to the landscape. These changes may affect living conditions of the local population with the potential to lead to reduced wellbeing and health. A series of mitigation measures will be implemented by the Project to manage and reduce dust, noise and vibrations to acceptable levels.

Monitoring of the change to living conditions and effectiveness of mitigation measures will request the gathering and reporting of the following information:

- results from the physical monitoring in particular with regard to air quality, dust and vibration monitoring;
- grievance indicators (numbers, location and repetition) with regard to complaints related to Project emissions of dust, noise and vibration; and
- mapping of physical monitoring results including population centers and grievance indicators.

Monitoring results will highlight if there are areas of concerns requiring the Project to implement additional short or long-term mitigation or compensation measures. Living conditions monitoring should occur on an ongoing basis while reporting may occur annually.

19.3.4.9 Employment conditions

It is the Project responsibility to ensure employment conditions are in line with national legal requirements, international best industry practice and international financing standards such as IFC PS2 and AfDB OS5.

The monitoring of the Project performance with regard to employment conditions will include the collection of the following information:

- description of the Project human resources policy and management system in place to ensure its correct application;
- description of the health and safety procedures and management systems in place to ensure their correct application;
- a description of the working conditions, terms of employment, retrenchment plan and workers accommodation quality;
- management systems in place to ensure Project main contractor and subcontractors align to Project policies on hiring and employment conditions and health & safety procedures;
- management systems in place to prevent the use of child and forced labor from the Project, its subcontractors and along the Project supply chain;
- numbers of hours worked per week /Break time / Numbers of days worked per week and type of contracts;
- type of worker protection and budget associated;
- age of workers
- rates for gender and race employment, and local vs. national and international employment;
- grievance indicators (including number, type and repetition) from the workers grievance process;
- number and type of near-misses and accidents at the Project sites;
- main findings and corrective actions following internal and third party audits with regard to employment and working conditions; and
- number of communications, training and beneficiaries to disseminate information on workers' rights.

The monitoring and reporting of employment conditions should occur annually and trigger corrective actions if necessary from the Project and its main contractors.

19.3.4.10 Cultural heritage

The Project is expected to directly impact a few known cultural heritage sites while earthmoving activities may lead to the discovery and deterioration of sites or objects of potential cultural importance. Eventually Project activities, increase presence of workers and change to the landscape may change the setting of cultural heritage sites or lead to their degradation thereby reducing their perceived value by stakeholders. A series of mitigation measures have been developed to minimize the impact on cultural heritage, among which avoidance or relocation of sites and procedures in case of chance finds. These

measures include consultations with the local population to ensure solutions are adapted to their beliefs and requirements.

Monitoring of the Project impacts and effectiveness of the mitigation measures will require the collection and reporting of the following information:

- description of the field implementation of the cultural heritage management plan and related procedures;
- mapping of cultural heritage sites before the Project start and mitigations in place or foreseen (avoidance, relocation, destruction and compensation, etc.);
- outcomes of consultations with local communities with regard to the relocation of site cultural heritage and other mitigations (e.g. installation of fences, planting trees, etc.);
- number and type of chance finds and description the followed procedure and mitigations in place;
- number of trainings on cultural heritage management and procedures and numbers of beneficiaries (workers and managers); and
- grievance indicators (numbers, location and repetition) with regard to complaints related to Project impacts on cultural heritage sites.

Cultural heritage monitoring and reporting should occur annually taking into account the Project footprint evolution. Monitoring results should support the Project in reducing further its impact on cultural heritage.

19.3.4.11 Influx management

The Project is expected to induce an important increase in population around the Project caused by opportunity seeking immigration. Massive or uncontrolled influx may increase Project social impacts in terms of access to land, natural resources, education and health infrastructures, increased disease transmission or insecurity, etc. In order to manage influx, the Project will support local authorities in developing and implementing an In-migration management plan and support authorities with the implementation of urban planning and service provisioning measures.

The Project will carry out monitoring of settlements to determine patterns of in-migration, understand the origins, characteristics and motivations of in-migrants, and identify the impacts of in-migration. Among others the following information derived from the baseline indicators will be collected:

- duration from arrival of household's heads (<1year, >1 and <10 years, >10 years and forever);
- repartition of reasons for migration (work in mining, other work, family, based on ethnic or land ownership, support to others, other); and
- origin of migrants in percentage (Boké prefecture, Guinée Maritime, Haute Guinée, Moyenne Guinée, Guinée Forestière, Foreign country).

Social monitoring results will also be analyzed and used to understand the impacts of in-migration. Influx monitoring and social monitoring results will be used to evaluate the success of the Project In-Migration Plan and revise it as required. Monitoring, evaluation and plan updating will be undertaken in partnership with In-Migration Committees, local administrations, village leaders, and the community.

19.3.4.12 Stakeholder engagement plan monitoring and review

A Stakeholder Engagement Plan (SEP) has been developed to plan the Project engagement activities with its stakeholders to ensure a transparent and two-way dialogue. The SEP is a living document and it will be updated as the Project evolves and as new Project activities or impacts are foreseen. A quarterly internal and annual public reporting of stakeholder engagement activities will be performed.

A monitoring of stakeholder engagement activities will be performed with regard to those planned in the previous versions of the SEP and in the light of international best practice, international finance guidelines for stakeholder engagement, grievances from stakeholders and public opinion. Should Project engagement activities not be in line with the SEP or best international practice, the Project will adapt its planned engagement accordingly.

19.3.4.13 Grievance monitoring

In accordance with international good practice, GAC has established a specific mechanism for dealing with grievances that do not involve court action. It includes the following steps:

- receive and register the complaint or grievance;
- carry out a preliminary review and categorize the complaint;
- address the complaint; and
- close the complaint.

The Project uses a software application to register and monitor grievances. Grievance monitoring will include the following:

- type and number of grievances by Project location and activities;
- average time used to close grievances
- rate of closed and reoccurring grievances; and
- mapping of grievances including location, type and number of open and closed grievances.

Grievance management and monitoring is an ongoing process as grievances should be registered and addressed promptly. Grievance monitoring enables to highlight areas of concerns and seek long-term resolutions.

Table 19.25 Social monitoring strategy in port and mine areas

Potential impact	Monitoring indicators	Parameters	Locations	Timing/frequency	Measuring Equipment	Responsible
Demographics and social dynamics						
Change in social dynamics / Increase in social tensions / Change in the traditional family structure / Loss of cultural markers and identity	Population and PAP income baseline indicators such as: • Demographics (population numbers, gender, ethnicity, religion, place of origin etc) • Income (monetary and non-monetary) Employment Grievances Trends in qualitative data from households survey: family structure and links of dependency, households opinions on the Project	n.a.	Project wide	Annually	Grievance register / HR employment database and local population database / Annual households surveys	GAC personnel

Potential impact	Monitoring indicators	Parameters	Locations	Timing/frequency	Measuring Equipment	Responsible
Power, governance and civil society						
Weakening of methods of traditional governance / Risks of tension between communities and local administrative authorities	Baseline demographic indicators (see above) Grievances Amount of community investment Number and type of development projects supported and estimation of number of beneficiaries Number of media reports, demonstrations or legal complaints in relation to the negative opinions against the local official and/or traditional authorities	n.a.	Project wide	Continuous	Grievance register, LDP reporting and LDF investments; public information	GAC personnel
Increase in risks of corruption	Grievances					
Access to land						
Increase in land prices	Annual price inflation for land acquisition and rent vs. proxy for households average purchase power or poverty level	n.a.	Project wide	Continuous / Annually	Annual households survey / Grievance register / Public	GAC personnel

Potential impact	Monitoring indicators	Parameters	Locations	Timing/frequency	Measuring Equipment	Responsible
	Surface of land rehabilitated during every year in operation *vs.* annual land take by the Project Average land surface used and owned by households				information / Price survey / Project register & management system	
Severance of access to land	Baseline indicator such as mode of land acquisition (monetary/in kind exchange/family owned/gift/other) Share of land and locations were land is managed traditionally vs. covered by official land titles or has been acquired through financial means					
Increase in tensions on the land resource (inequality)	Number and type of grievance, repetition and resolution rate in relation to conflicts around land access Number of community incidents, demonstrations, media reports, or legal complaints due to conflicts around land access					

Potential impact	Monitoring indicators	Parameters	Locations	Timing/frequency	Measuring Equipment	Responsible
Agriculture and cattle herding						
Reduced access to agricultural or pasture land Fall in household income (food insecurity) Changes in practices (bovine, cattle herding, agriculture).	Average surface of agricultural or pasture land per household Number and type of grievance, repetition and resolution rate Surface of agricultural land or size of cattle per family member Income baseline indicators (see line 1) Investments from the LDP and LRRF in provisioning support to agriculture, herding and other income generating activities, including number of beneficiaries Cost of farm labor Change of the nature of source of household incomes	n.a.	Project wide	Continuous /Annually	Annual households survey / Grievance register / Public information / Price survey / LDP report & LRRF and RAP reports and monitoring results / Project register & management system	GAC personnel

Potential impact	Monitoring indicators	Parameters	Locations	Timing/frequency	Measuring Equipment	Responsible
Access to the natural resources						
Reduced quality and quantity of water and pressure on the resource Reduction in fishing (fall in income) Reduction in access to NTFP and pressure on resources	• Distribution of type of water source. • Average number of households per human powered pump • Satisfaction on potable water source (1 to 5). • Grievance in relation to water quality and access Baseline indicators such annual household income share from fishing. • Energy source for cooking. • Number and distance to NTFP • Time allocated to NTFP collection • Invested amounts from the LDP and LRRF in support to agriculture, herding, and other income generating activities.	See surface and groundwater physical monitoring parameters *Table 19.11.* See freshwater biota monitoring strategy *Table 19.22*	Project wide	Continuous /Annually	Annual households survey / Grievance register / LDP report & LRRF and RAP reports and monitoring results / Project register & management system	GAC personnel

Potential impact	Monitoring indicators	Parameters	Locations	Timing/frequency	Measuring Equipment	Responsible
Local socioeconomic context						
Changes of economic conditions (income, economic diversification, inequalities,) Increase in demand of resources (inflation) Increase in local capacities and local development initiatives	Population and project affected households habitat synthetic quality index (HSQI) Percentage of local employees vs. total Expenses in local supply vs. total Number and percentage of local subcontractors vs. total Economically displaced households (other than agricultural, herding and natural resources) access to alternative sources of income Poverty level and inequalities through proxies such as surface of agricultural land or size of cattle per family member, level of cash income per household, asset inventory Invested amounts from the LDP and LRRF in provisioning support for creation of alternative income generating activities	n.a.	Project wide	Continuous / Monthly or annually	HR database / Procurement data / Annual households survey / Market price survey / LDP report LDF investments / Project register & management system	GAC personnel

Potential impact	Monitoring indicators	Parameters	Locations	Timing/frequency	Measuring Equipment	Responsible
	Monthly local shopping basket price inflation from surveys in local markets vs. proxy for households minimum, average and maximum purchase power or for different poverty levels Number and average income of local workers Number and type of local development initiatives from local public initiatives and/or the Project.					
Health and safety						
Risks related to project activities as traffic increase, people interactions, population growth, etc. Improvement of health care services	Local authorities or police force statistics on criminality Number and type of near-misses and accidents at the Project sites Results from households surveys with regard to hygiene and sanitation (e.g. access to clean water) Number and type of grievance, repetition and resolution rate from Project related accidents Baseline indicators such as:	n.a.	Project wide	Continuous /Annually	Annual households survey / Public infrastructures survey / LDP report LDF investments / Grievance register / Project register & management system	GAC personnel

Potential impact	Monitoring indicators	Parameters	Locations	Timing/frequency	Measuring Equipment	Responsible
	• individuals morbidity rate over 6 months • percentage of access to modern medicine and vaccination coverage of children under 15; • knowledge rate of AIDS from households heads and of routes of transmission (non protected sexual intercourse, blood contact, mother-child, breastfeeding, wrong beliefs, no knowledge); • rates of access to latrines. Number and capacities of new health infrastructures resulting from the local authorities (LDF) or the Project. Mapping of population centers together with demographic information and health centers location and capacities Data on number of visitors, number and type of diseases or accidents, price of consultation and average queuing time					
Access to education						
Increase in	Number and capacities of	n.a.	Project wide	Continuous / Annually	Annual	GAC personnel

Potential impact	Monitoring indicators	Parameters	Locations	Timing/frequency	Measuring Equipment	Responsible
education infrastructures and improvement of services Access to education from decrease of households income or disrupted mobility	new education infrastructures resulting from the local authorities (LDF) or the Project. Mapping of population centers together with demographic information and education infrastructures and capacities Baseline indicators such as: • number of schools in the study area, including number of students, gender rates, number of students per classroom and number of students per teacher; • primary schooling rate; • graduation rate of population over 20 year old (none, CEP, BEPC, BAC, BTS, University); • literacy rate of population over 15 year old, including by gender				households survey / Public infrastructures survey / LDP report LDF investments / Project register & management system	

Potential impact	Monitoring indicators	Parameters	Locations	Timing/frequency	Measuring Equipment	Responsible
Mobility, flows and transport						
Isolation of settlements / Movement difficulties Improvement of infrastructures related to the displacements	Baseline indicators such as households repartition of own means of transport (none, motorcycle, car, truck) Mapping of roads and paths by type and travel time from population centers to places of interests such as markets, schools, medical centers, agricultural areas, etc. Number and mapping of incidents reported Number and type of grievance, repetition and resolution rate in relation to reduced mobility Results from households surveys and LRRF and RAP monitoring with regard to household opinion on mobility and travel time to main places of interest	n.a.	Project wide	Continuous / Annually	Annual households survey / LRRF and RAP monitoring results / Project register & management system	GAC personnel

Potential impact	Monitoring indicators	Parameters	Locations	Timing/frequency	Measuring Equipment	Responsible
Living conditions						
Disturbance / Degradation of air quality	Number and type of grievance, repetition and resolution rate in relation to disturbances and reduced air quality Results from the physical monitoring in particular with regard to air quality, dust and vibration monitoring Mapping of physical monitoring results including population centers and grievance indicators	See physical monitoring strategies *Table 19.2* and *Table 19.5.*	Project wide	Continuous / Annually	Grievance register / Project register / management system	GAC personnel
Changes to the landscape	Number and type of grievance, repetition and resolution rate in relation to changes to the landscape					
Employment conditions						
Employment conditions, contractual matters and safety at work	Numbers of hours worked per week /Break time / Numbers of days worked per week and type of contracts Type of worker protection and budget associated Age of workers Rates for gender and race employment, and local vs.	n.a.	Project employees and main (sub) contractor(s)	Annually	HR management systems and databases / Workers grievance register / H&S incidents tracker / Audits reports	GAC personnel

Potential impact	Monitoring indicators	Parameters	Locations	Timing/frequency	Measuring Equipment	Responsible
	national and international employment Number and type of near-misses and accidents at the Project sites (loss time injuries, frequency and gravity rates according to OHSAS definitions) Number and type of cares provided by the project doctor or nurses to workers Number of communications, training and beneficiaries to disseminate information on workers' rights. Number and category of findings from internal and third party social performance audits Grievance indicators (including number, type and repetition) from the workers grievance process.					
Cultural heritage						
Impacts on cultural heritage sites (discovery, degradation, loss of access, etc.)	Number and type of training provided related to cultural heritage management and procedures and numbers of beneficiaries Number and location of	n.a.	Project wide	Continuous / Annually	Grievance register / training database / SEP / CH management register / Project register / management system	GAC personnel

Potential impact	Monitoring indicators	Parameters	Locations	Timing/frequency	Measuring Equipment	Responsible
	cultural heritage sites avoided / relocated / destructed / compensated Number and type of chance finds and type of follow-up Number and outcomes of consultations with local communities with regard to the relocation of site cultural heritage and other mitigations Number and type of grievance, repetition and resolution rate in relation to cultural heritage impacts					
Influx						
Increase in population around the Project caused by opportunity seeking immigration	Baseline indicators such as: • duration from arrival of household's heads (<1year, >1 and <10 years, >10 years and forever); • repartition of reasons for migration (work in mining, other work, family, based on ethnic or land ownership, support to others, other); and • origin of migrants in percentage (Boké prefecture, Guinée	n.a.	Project wide	Annually	Households survey	GAC personnel

Potential impact	Monitoring indicators	Parameters	Locations	Timing/frequency	Measuring Equipment	Responsible
	Maritime, Haute Guinée, Moyenne Guinée, Guinée Forestière, Foreign country).					

19.3.5 Key performance indicators

GAC will continue to evaluate the performance of the controls and proposed mitigation measures throughout the mining and closure activities. Derived from the indicators proposed for the monitoring of the Project's potential impacts, Key performance indicators (KPIs) will be developed to evaluate the performance of the controls and proposed mitigation measures. KPIs are specific targets based on GAC's objectives or on the national regulation or international standards. Their aim is to offer a rapid highlight at the Project environmental and social performances. They will be used as decision helping tools for the management and will feed the environmental internal and external reporting.

A philosophy of adaptive management and continual improvement of the monitoring plan will be adopted by GAC to ensure that this Plan, embedded controls and proposed mitigation measures are consistently meeting project standards and KPIs. This will be achieved through periodic Plan reviews and the results of the monitoring.

Involved specialists of the different monitoring themes will be consulted, as necessary, to determine the most appropriate adaptive management strategy for a given context. Increased monitoring frequency, change to sampling methods, location and indicators would be incorporated into the adaptive management program.

GAC will track performance through a formal non-compliance and corrective action tracking procedure for investigating cause and identifying corrective actions in response to accidents or environmental or social non-compliances. This will ensure coordinated action between GAC and their contractors. The GAC HSSEC manager will be responsible for keeping records of corrective actions and for overseeing the modification of environmental or social protection procedures and/or training programs to avoid repeating non-conformances and non-compliances.

19.3.6 Roles and responsibilities

GAC is responsible to accomplish the required monitoring and will submit required reports to the Guinean authorities and financial institutions of its social and environmental performance and compliance with the permit and approval conditions.

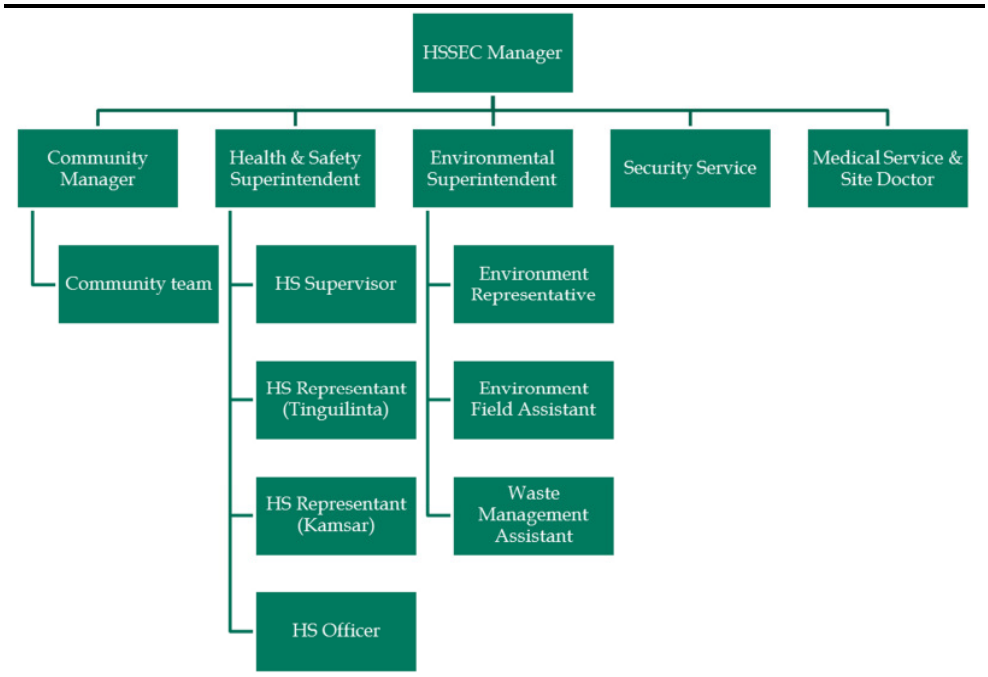
General roles and responsibilities for environmental and social monitoring of the Project involve the participation of GAC and GAC's designated contractors. During construction, GAC will require its EPCM contractor to accomplish some of the monitoring obligations specifically with regards to direct construction impacts, but GAC remains ultimately responsible for performance regardless of contractual relationships it may engage in with others.

GAC management team remains responsible to ensure that monitoring occurs following the requirements of the Monitoring Plan as it is ultimately responsible for the Project environmental and social performances. The Chief Executive Officer is ultimately responsible for all actions called for by this Plan since all senior management staff and Project contractors report directly to him.

The Environmental, Social and Health and Safety team members and the Site managers will be responsible for the monitoring activities at the Port and Mine area. They will report to the HSSEC Manager directly in line with the GAC CEO. GAC will ensure it has within its staff suitably qualified environmental and social managers and coordinators to oversee implementation of the monitoring plan. Specific monitoring activities may have to be subcontracted to specialists

The HSSEC Manager is responsible for all environment, health and safety management plans associated to the SEMP and for environmental awareness and training, health and safety training, security, waste management, regulatory compliance, compliance audits, stakeholder engagement, resettlement plan implementation, community training and capacity building, Local Development Plan, stakeholder engagement and grievance resolution. Therefore most of the monitoring activities and data collection will already be in hands of the HSSEC team. Specific monitoring responsibilities will be assigned to individual positions within the HSSEC team as appropriate (*Figure 19.14*), but the ultimate management responsibility lies with the GAC HSSEC Manager and CEO.

Figure 19.14 HSSEC management team



Key HSSEC Manager responsibilities include the following:

- acting as a point of contact with Project contractors and subcontractors with respect to environmental and social monitoring;
- documenting that monitoring procedures are followed as planned by GAC and its contractors;
- auditing the Project contractors with regard to the correct implementation of the monitoring requirements assigned to them;
- inform key Project staff and management of monitoring results especially with regards to areas where the Project underperforms and where changes requirement management approval are necessary; and
- reporting results of social and environmental monitoring activities and results to the Guinean authorities, project lenders, and other applicable parties.

This Monitoring Plan shall be updated as details of roles and responsibilities are defined and changed.

19.3.7 Training

All environmental officers in charge of monitoring will be trained in the sampling protocols, qualitative surveys protocol and quality assurance/quality control (QA/QC) procedures of this plan. Also, any laboratory used for the analyzing of samples must be accredited to international standards.

Training will include elements of appropriate cultural behavior and approach to social surveys and instructions in using measuring equipment, operating the facilities, sampling equipment and Personal Protective Equipment (PPE) maintenance and testing, recording results, completing chains of custody, following data collection protocols. Project health and safety procedures relevant to the task performed or area visited will be communicated as required.

19.3.8 Monitoring equipment and methods

19.3.8.1 Air quality

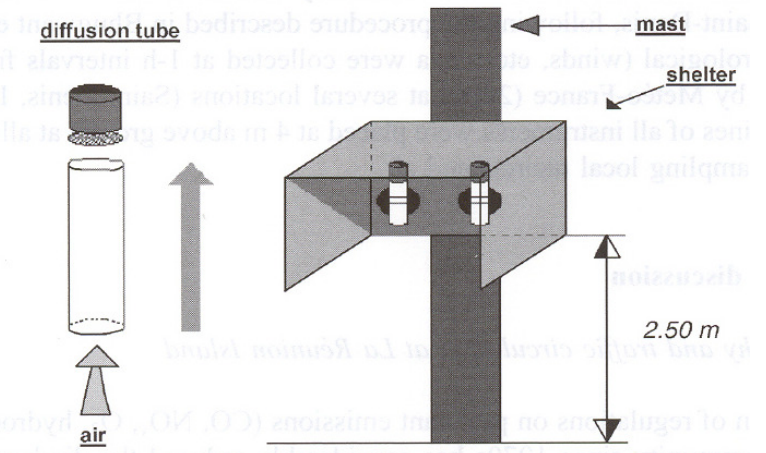
Diffusion tubes (monitoring of NOx and SO_2)

Diffusion samplers are designed for passively monitoring gaseous airborne pollutants, including SO_2 and NO_2, and consist of small plastic tubes containing a chemical which reacts with the pollutant present in the air. Once in place, diffusion tubes have one end left open to the atmosphere, and are retrieved after the exposure period and sent to a laboratory for the analysis.

Diffusion tubes are lightweight and portable and do not require a connection to an external power network; moreover they do not present any particular logistic issue and several sampling stations can be easily installed in order to

depict a overview mapping of baseline/background levels in the surveyed area. Thus diffusion tubes are particularly suitable for monitoring atmospheric pollutant concentrations in remote areas or locations where no permanent site has been established such as the Project area. Moreover they can be easily installed and remove on different type of supports easy to find in the monitored area (i.e. threes, light poles, electric post, external fence, low roofs) by mean of common plastic bands. To avoid potential damages to the diffusion tubes as a consequence of adverse meteorological conditions, the tubes can be protected with shelters or masts (*Figure 19.15*).

Figure 19.15 Schematic representation of shelter for protecting against meteorological conditions



Source: © Gradko International Ltd

Different types of diffusion tubes are available on the market. The diffusion tubes used to collect data during the environmental baseline survey were provided by *Gradko International Ltd*, and could be used also for this monitoring program implementation.

Diffusion tubes work by a process called molecular diffusion. During molecular diffusion, compounds will move from an area of high concentration to an area of low concentration. The compounds in the air are at a higher concentration than those in the tube, so the compounds diffuse into the tube and collect on the absorbent at the end of the tube. Because the compounds are absorbed, the low concentration in the tube is maintained, and therefore diffusion continues. The rate that the compounds move into the tube is called the uptake rate. This is a known rate and is used in the calculations during analysis.

Once the sampling period is over, the tubes are sealed and returned to the laboratory for analysis. The analysis needed for the present survey will be performed by a certified laboratory.

Various analysis techniques are used for the different diffusion tubes. The laboratory determines the concentration of compounds on the tube. This is then used in a calculation with the uptake rate to calculate the average concentration of compounds that were present in the air over the monitoring period.

The results are reported in parts per billion (ppb) and micrograms per cubic meter (μgm^{-3}) to allow comparison with health guideline levels.

Dust plates

Dust plates are suitable for outdoor monitoring of dust deposition; they enable to measure the deposition of dry dust according the French standard NF43-007 on Atmospheric Pollution/ Particulate Matter Deposition Measurements.

Dust plates (or similar devices such as dust jars) consist in a dust "trap" where particulate matter settling towards the ground under gravity deposits and becomes fixed.

In general while selecting the dust monitoring sites, steep areas have to be avoided as well as areas located in the proximity of roads and barriers (such as buildings, walls, trees, etc.) The distance to the first obstacle must be 10 times higher than the height of the obstacle.

The exposure period of the dust plates varies according to how polluted the investigated area is. The exposure period can last up to 14 days in scarcely polluted areas and only up to seven days in highly polluted areas.

After the exposure period dust plates are collected and sent to the laboratory for analysis. The analysis extracts the dust collected on the plates with a solvent (dichloromethane). After being washed with a solvent dust is dried and weighted.

Real-time particulate matter monitoring devices - portable devices

The real-time dust monitoring may be performed by mean of a battery operated, data-logging, light-scattering laser photometers. Various types of light-scattering laser photometers are currently available on the market.

Typical portable monitors provide real-time aerosol mass readings, measuring aerosol contaminants such as dust, smoke, fumes, and mists.

Figure 19.16 overleaf presents a picture of a typical portable device, the DustTrak™ DRX Aerosol Monitor 8533. If this specific brand and model is not available, GAC may opt to use a different one, documenting the reasons for the choice of equipment.

Figure 19.16 Typical portable aerosol monitor (DustTrak™ DRX Aerosol Monitor 8533)

Real-time particulate matter monitoring devices – fixed samplers

From the start of bauxite extraction, handling and transportation operations, GAC proposes monitoring particular matter using fixed continuous PM_{10} and $PM_{2.5}$ monitoring stations.

Figure 19.17 Typical fixed PM sampling station (MetOne™ Esampler®)

Photo: ERM, 2015

The final brand and model of devices to be used will depend on the outcome of GAC's procurement process for this equipment. Typically, these will consist in light-scattering photometers or beta attenuation monitors. Fixed stations will require:

- a secure site (fenced, protected from accidental damage and risks of theft or degradation);
- a reliable power supply (either solar panels or connection to the power network);
- regular servicing (daily to bi-weekly, depending on the choice of equipment); and
- periodic download and interpretation of results (typically, biweekly to monthly).

19.3.8.2 Noise and vibration

Sound level meter

Type 1 Sound Level Meters (SLM) are used to monitor the ambient noise levels. There are numerous reliable noise meters on offer commercially, offering simultaneous measurement of sound pressure levels using fast, slow, and impulse detectors, for A, C, and flat frequency weightings.

Vibration transducer

A vibration transducer is the instrument that measures or senses the vibration and is commonly referred to as a pickup or sensor. There are basically three types of transducers commonly used:

- accelerometer;
- velocity transducer; and
- displacement transducer.

Accelerometers are by far the most common and versatile types of transducers in use. The seismic, or piezoelectric, accelerometer produces an output charge when held against a vibrating surface due to the characteristics of the piezoelectric disks that are inside the transducer. These transducers contain no moving parts and as such are quite rugged. The charge that is generated through the compression and expansion of the piezoelectric disks is proportional to the amount of vibration acceleration (force).

Accelerometers are also useful because they are much more compact and lightweight than velocity transducers and therefore can be used in more environments and applications. A final advantage of using an accelerometer is the ability to integrate the results in order to obtain velocity readings and double integrate the results in order to obtain displacement readings. This ability means that a single transducer can be used to register and quantify all

three of the primary amplitude units of acceleration, velocity and displacement over a wide range of common frequencies.

19.3.8.3 Surface water

In situ testing

The in-situ testing at the GAC mining concession, will take place in the streams. The in-situ testing in the Kamsar port will be developed following confirmation of site discharge locations. Upstream control monitoring will need to be carefully sited so that it minimizes the potential for disturbance to mangrove areas and is suitably accessible for the monitoring team. The suite of parameters that will be collected in the field includes pH, temperature, turbidity, electrical conductivity (EC), and oxidation reduction potential (ORP). Total Suspended Solids (TSS) and Total Dissolved Solids (TDS) will be sampled if practicable, i.e. it may be difficult to collect and send samples on time and in the appropriate conditions to laboratory in field conditions in Guinea.

The typical procedure used in collecting water for water quality sampling consists of the following elements.

- Sample bottles with preservatives, coolers and cool boxes will be supplied by the laboratory. The number of quality control samples taken must correspond to a minimum of 10% of the total number of samples taken for all sampling events, and include duplicates and blanks.

In situ measurements will require the following equipment:

- Multi-parameter water quality probe (In Situ Troll 9500 is recommended) for the measurement of field parameters or individual handheld equipment such as turbidity meter, dissolved oxygen meter, pH meter etc.
- Calibration solutions for multi-parameter water quality probe or individual equipment.
- Water Quality Field Parameters Data Sheet, Water Quality Sampling Sheet for Laboratory Analysis.

Samples will be shipped to an internationally accredited laboratory for analysis of a suite of parameters based on the geology of the site and WHO, IFC and CCME guidelines. The required equipment for this sampling is specified in the Appendix to this plan.

Table 19.26 lists constituents that are proposed to be analyzed by an accredited laboratory, as well as recommended maximum holding times and required field filtering and sample preservation. For some analytes, maximum required delay before analysis (Holding Times) are not practically achievable (e.g. NO_3, PO_4); however, the results can still be interpreted qualitatively and indicate trends. This list should be reviewed annually by GAC Environmental Superintendent or an appointed water quality

consultant. Amendments may be made over the lifetime of the project if some parameters show no significant change over long time periods, are judged by trained specialists to be stable and any changes are agreed with national regulatory bodies.

For the baseline assessment, metals should be analyzed on both filtered and unfiltered samples where turbidity/suspended solids are noticeable.

Table 19.26 Analysis, recommended holding times and field filter/preservation

Analysis	Holding Times	Filter on Site/Preservation
(i) Physical Parameters		
pH	15 min*	Analysis on site*
Electrical Conductivity (as EC at 25°C)	28 days	Cool, 4 deg. C
Total Dissolved Solids	28 days	Cool, 4 deg. C
Total Suspended Solids	7 days	Cool, 4 deg. C
COD	7 days*	H2SO4 to pH<2 Cool, 4°C *
(ii) Organics		
Oils and grease	28 days*	Unfiltered/H_2SO_4 to pH below 2*
Phenols	28 days*	Unfiltered/H_2SO_4 to pH below 2*
(iii) Anions and Cations		
Na	6 months*	Cool, 4 deg. C*
K	6 months*	Filter on site/HNO_3 to pH below 2*
Ca	6 months*	Filter on site/HNO_3 to pH below 2*
Mg	6 months*	Filter on site/HNO_3 to pH below 2*
F	28 days	None
Cl	28 days	None
SO_4	28 days	Cool, 4 deg. C
Alkalinity ($CaCO_3$)	14 days	Cool, 4 deg. C
NO_3	48 hours	Cool, 4 deg. C
Total N (Kjeldahl)	7 days*	Cool, 4 deg. C/H_2SO_4 – pH below 2*
Ortho Phosphate (PO_4 as P)	48 hours	Filter on site/ Cool, 4 deg. C
Al	6 months	Filter on site/HNO_3 to pH below 2
Sb	6 months	Filter on site/HNO_3 to pH below 2
As	6 months	Filter on site/HNO_3 to pH below 2
Cd	6 months	Filter on site/HNO_3 to pH below 2
Cr (total)	6 months	Filter on site/HNO_3 to pH below 2
Cu	6 months	Filter on site/HNO_3 to pH below 2
Fe	6 months	Filter on site/HNO_3 to pH below 2
Pb	6 months	Filter on site/HNO_3 to pH below 2
Mn	6 months	Filter on site/HNO_3 to pH below 2
Hg	28 days	Filter on site/HNO_3 to pH below 2
Mo	6 months	Filter on site/HNO_3 to pH below 2
Ni	6 months	Filter on site/HNO_3 to pH below 2
Se	6 months	Filter on site/HNO_3 to pH below 2
U	6 months	Filter on site/HNO_3 to pH below 2
V	6 months	Filter on site/HNO_3 to pH below 2
Zn	6 months	Filter on site/HNO_3 to pH below 2

Flow gauging

Flow gauging consists of surveying cross sections, obtaining repeated velocity field profiles, and installing gauges with or without data loggers. All equipment should be obtained from reputable manufacturers and used or installed according to the manufacturer's recommendations. Where

applicable, replacement equipment, tools and supplies should be obtained and be available in the field. All equipment shall be installed by experienced field staff and all supplies (such as pipe, lumber, and tools) shall be in good condition.

Where proposed gauge locations are near monitoring locations that have been characterized for the baseline study for the SEIA, the location may be adjusted to conform to those known locations.

Survey the river cross section and measure flow velocity

At each flow gauging station, the river bed will be surveyed during the first year of monitoring. During the first year, monthly measurements of flow velocity will be also required. Stage-discharge relations are developed for stream gauges by physically measuring the flow of the river with a mechanical current meter or for the biggest streams an Acoustic Doppler Current Profiler (ADCP) at a wide range of stages; for each measurement of discharge there is a corresponding measurement of stage. For GAC, this will be completed when the tributaries are expected to have flow (June to November). For the stations on the Tinguilinta, some stations may have limited safe access during peak flow periods, so manual velocity data should be collected only when the river can be accessed safely. A minimum of six velocity sections are needed at each gauge station and must represent the range of flows.

To collect flow field data:

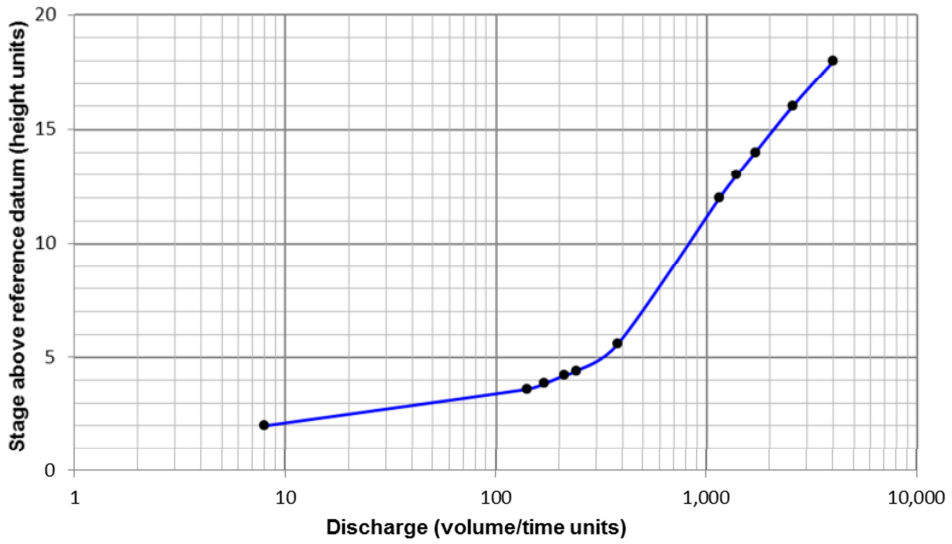
- apply the procedure outlined in *Section 4* for protecting the health and safety of persons working on or near to water;
- read the staff gauge value and record the value;
- measure the vertical distance between control (such as bridge deck or stake) and water level; record the value (applies when a reference elevation or benchmark is available at the site);
- begin the flow measurement at the first monitoring point;
- position the current meter sensor, to measure the velocity at ~0.5-0.6 m depth (approximately half depth) from the water surface;
- repeat the observations three times and record the values in field record sheet;
- move across the river to the next point along the section and repeat the observations;
- repeat as necessary until the entire river section is crossed. The number of stations along the section should be at least every five meters in most cases; and
- record the values in field record sheet.

The equipment required to measure the flow velocity is described in the appendix to this document. The bed survey and flow velocity will be used in

conjunction with the stage monitoring data to develop stage-discharge relationships.

Once the data are acquired, the stage/discharge relationship can be developed using the relationship Q=VA. The stage and velocities can be plotted and a curve developed for the gauge station. The stage-discharge curve can be read in the field to convert the gauge reading to a flow or applied to data-logger data in a spreadsheet calculation. *Figure 19.18* shows a generic stage-discharge curve.

Figure 19.18 Generic stage-discharge curve



Numerous other methods and types of equipment can be used to measure the river flows as follows.

- Propeller current meters use the simple premise of measuring the speed of rotation of a helix in the water. The reliability and accuracy of measurement with these current meters are easily assessed by checking mechanical parts for damage and using spin-time tests for excess change of bearing friction. This type of current meter does not sense direction of velocity but it is the most common type because of its simplicity, reliability and price.
- Acoustic Doppler Current Profiler (ADCP) uses the Doppler Effect to determine water velocity by sending a sound pulse into the water and measuring the change in frequency of that sound pulse reflected back to the ADCP by sediment or other particulates being transported in the water. It measures vertical current profiles and very convenient for large rivers. It also measures more than a single directional component of velocity at a time.
- Optical velocity meters use optical methods to determine surface velocities of streams. Mirrors are mounted around a polygon drum. Light coming from the water surface is reflected by the mirrors into a lens system. As no

parts are immersed in the flowing stream; the meter can able to measure even high flows from bridges. However, it measures only the water surface velocity and is very dependent upon the selection of the proper coefficient.

- Electromagnetic current meter measures the voltage generated as conductor (water) moves through an electromagnetic field (generated by the sensor). It produces voltage proportional to the velocity. One advantage of these current meters is direct readings of velocity components.

Installation of non-recording staff gauges

During dry season, non-recording staff gauges will be installed at OP2, OP3, OP8, OP9 and OP13. The staff gauges will be structurally sound and will not move in any direction. They will be stable against high flows and floating debris. Elevation of 0.0 m on the staff gauge will be relative to an arbitrary elevation assigned to a benchmark in the area. Staff gauges have been proposed for many sites because of the logistical problems in maintaining a fully automated network (see *Figure 19.19*). Simple staff gauges will allow simple collection of discrete readings at regular intervals with little added complexity or cost.

Figure 19.19 Typical staff gauges

Choose a specific location for the staff gauge. A good location is where the post will be in the water during lower water and where it will not be overtopped during high water. Avoid placing the staff gauge in a location where the water pools or is very slow moving, because sediments will collect around the base of the staff gauge and affect readings. If there is a permanent structure such as a dock or bridge near the desired staff gauge location, the

gauge can be attached to that structure instead of using a fence post driven into the stream bed. If it is desired to tie the staff gauge into a given elevation marker, place the staff gauge near the existing benchmark (place of established elevation) for ease of surveying.

The next step is setting the staff gauge. Drive the fence post or pipe into the ground so that it will stay stable through high water or bad weather. If using a fence post driver, only fasten the board to the post using one bolt and let the board rest perpendicular to the post. This will allow the top part of the post to be used with the fence post driver. Once the post is set, refasten the board onto the post.

If the gauge can be efficiently tied an existing benchmark, it can be used to find the water surface elevation. If a benchmark is available, use a construction level to run-in the elevation to the gauge.

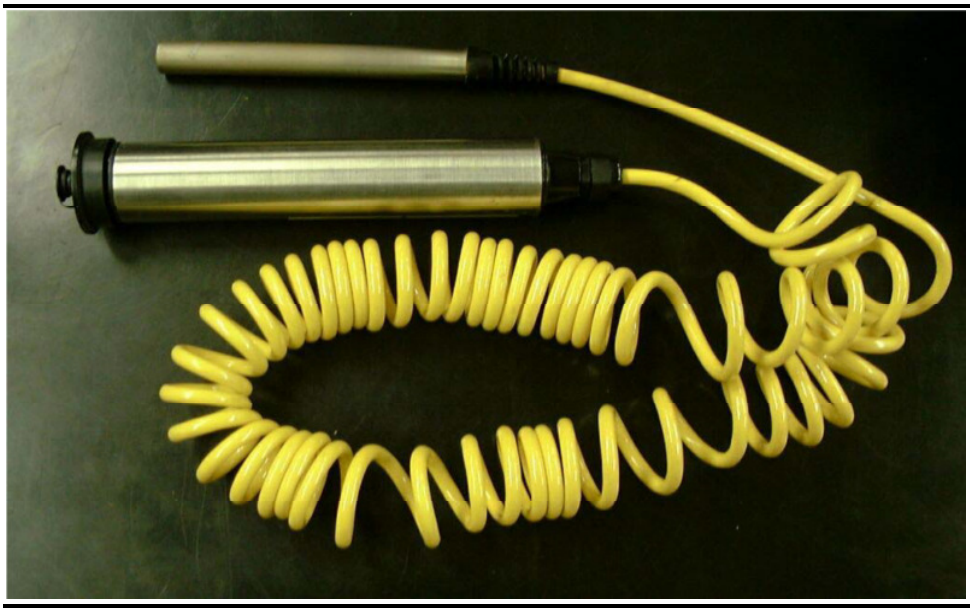
After installation, record the following information in field notes to allow development of a gauge station information sheet:

- a sketch of the installation including distances and dimensions that will assist in relocating the gauge; and
- photographs of the installation with adequate scale references.

Installation of continuous recording gauges

Four new sites (FLOW1, FLOW2, FLOW3 and FLOW4) were selected for installation of continuous data-logging equipment. For the continuous flow monitoring sites, the staff gauges will be outfitted with a data logger. A data logger is a transducer that automatically records the water depth by converting pressure to depth (see *Figure 19.20*).

Figure 19.20 Typical data logger and cable



While different methods can be used, a section of PVC pipe can be used to house data water level recorder. Secure the PVC to the post with hose clamps. Adjust the sensor cable as needed for the conditions. Use of smaller PVC pipe inserted into the larger PVC pipe can be used to wrap the cable if needed.

Follow the manufacturer's instructions for installation, setup, and data retrieval.

To reduce the risk of theft or vandalism, secure the PVC housing with cap and lock with a headless hexagonal screw. If vandalism or theft becomes a problem, more elaborate locking features may be required.

Monitor river stage

Once the gauges and equipment are installed Stage data can be read directly from the staff gauge and/or downloaded from the data loggers. Direct staff gauge reading should be taken at every water quality data collection event at OP2, OP3, OP8, OP9 and OP13.

Data-loggers at FLOW1, FLOW2, FLOW3 and FLOW 4 should be downloaded at least every 2 weeks.

Quality assurance and quality control

The collection of reliable surface water flow and stage data at GAC concession area can be accomplished by following the procedures described below:

- For current meter measurements, errors in the measurement of depth, and velocity reduce the accuracy of water quantity data. Human errors can be avoided by careful attention to detail. Systematic errors can be reduced significantly by proper maintenance and calibration of instruments and equipment, and by adequate training.

Quality assurance includes the procedures that provide a check on the quality of the data produced. Examination and evaluation of field data and data entry is an integral part of quality control. All data will be reviewed to determine if it is comparable to past recordings for similar stage heights. A review of work procedures and data collection methods may identify potential sources of error. All water flow and stage data will be stored to develop the stage-discharge curve. Long term river flows can be derived from stage measurements to develop flow duration analysis, which is useful for planning water use.

19.3.8.4 Groundwater

This Section provides detail on the required monitoring equipment, methodologies, maintenance and calibration.

Piezometers installation

Piezometers have been, and will be installed across the operational mining plateaus in order to gain an understanding of groundwater elevation (within the weathered crust aquifer) across the region and any immediate effects from Project activities.

The following Section summarizes how piezometers can be constructed and installed.

Piezometer installation diagrams will be kept recording the date(s) of drilling, the depth to first intersection of groundwater, the total depth, the screened interval, the static water level and the details of the construction elements below (Section 3.1).

Figure 19.21 sets out the general designed installation details for the piezometers to be installed for groundwater elevation monitoring.

Specific features of the piezometers to be installed are as follows:

- **Well Screen.** The slotted part of the PVC pipe. The well screen is usually the bottom 30 cm of the pipe.

- **Riser.** The riser is the unslotted PVC pipe that extends from the top of the well screen to above the ground surface.

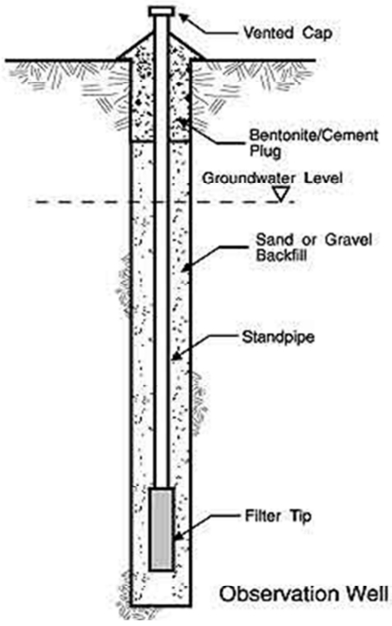
- **Well Cap.** Well caps protect wells from contamination and rainfall.

- **Well Point.** Commercial PVC well points are not needed if the bottom of the screen is capped.

- **Sand Pack.** Sand is placed around the slotted interval to filter out silts and clays. If sand is not available, backfill with drill cuttings, not bentonite.

- **Bentonite Sealant.** Bentonite is used to form a tight seal around the riser to prevent water from running down the pipe to the well screen.

Figure 19.21 Construction and installation of a piezometer



The following steps describe how to install a piezometer:

1. Scarify the sides of the auger hole (if smeared during drilling).
2. Place 5 cm of clean sand in the bottom of the hole.
3. Insert the PVC into the hole but not through the sand
4. Pour and gently tamp more sand in the annular space around the slotted part of the PVC and 5 cm above the slotted part.
5. Pour and gently tamp 30 cm of bentonite above the sand
6. Backfill and tamp soil into the auger hole from the top of the bentonite plug to within 15 cm of the soil surface
7. Place a second plug of bentonite at the ground surface
8. Add water to expand the clay and form a seal.
9. Form a mound of a soil/bentonite mixture at the top of the ground around the base of the riser to direct surface water flow away from the pipe.
10. Cap the PVC pipe with an end cap or wooden plug through which a small hole has be drilled or notch cut to allow air into the pipe thus allowing the water level to reach its natural head.
11. Leave the well for 24 hours before taking the first depth reading.
12. Survey the elevation of the reference point; most probably the top of the riser pipe. Measure the distance from the top of the riser pipe to the ground surface. Record the height of the riser above the ground surface at the time of installation and every few months thereafter. Pipes tend to move upward during cycles of wetting and drying.

Monitoring well installation

Six project specific monitoring wells will be installed within the mining plateaus as part of the network of eleven monitoring wells that will be used to collect water samples in order to gain an understanding of groundwater quality (within the weathered crust aquifer and the alluvial deposits aquifer nearer the Tinguilinta) and any immediate effects from Project activities.

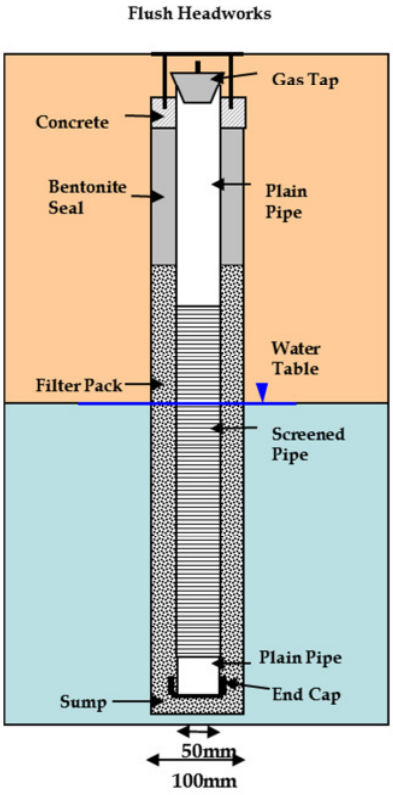
The following Section describes how these monitoring wells should be installed prior to sampling activities (see *Table 19.14* for proposed borehole locations).

Monitoring well installation diagrams will be kept recording the date(s) of drilling, the depth to first intersection of groundwater, the total depth, the screened interval, the static water level and the details of the construction elements below.

Well design and installation

Figure 19.22 presents a typical well design and installation procedure for wells installed for groundwater quality and monitoring purposes in unconsolidated and consolidated materials. The exact depth of the wells will be confirmed once they have been installed on site.

Figure 19.22 Typical well design



Well Installation Procedure

- All materials should be checked to ensure they are new and appropriate for use (e.g. proper screen slot for the filter pack).
- The borehole should be dipped to determine the presence of water, the standing water level (for well screen location purposes) and that the base of the bore is at the required depth/lithological unit for installation.
- A record of all materials and their quantities used should be kept and checked against expected amounts to ensure that materials are not bridging or being lost into the formation.
- It is advised that sand is placed at the bottom of the borehole to present direct contact with the formation.
- Well screen should only be installed across one water bearing unit to prevent preferential migration of contaminant between water bearing units.
- A well cap should be placed on the well top to prevent gravel pack from falling in the well and then centred within the borehole. The gravel pack should be slowly poured into the borehole at different locations around the well to prevent the gravel pack from building up on one side of the screen. The depth to the gravel should be checked regularly with the dip meter to ensure that the gravel pack reaches a depth 0.5m above the well screen.
- The thickness of the bentonite plug should also be confirmed while pouring.
- The cement/bentonite should then be placed to 0.5m below ground surface. The grout should be allowed to set prior to installing the headworks to allow for any settlement.
- A concrete mix should be used in the upper 0.5m of the borehole to set the surface completion.
- Slope the concrete to encourage surface water to run away from the well.
- The well casing should then be trimmed to the desired height and re-capped. Ideally you should place a mark from which all future water level readings are to be measured.

Well development

The main purpose of developing new monitoring wells is to remove the fine-grained materials or drilling fluids introduced into the well during installation, and to improve hydraulic connectivity between the immediate vicinity of the well and the surrounding formation.

A new monitoring well should ideally be developed until the column of water in the well is free of visible sediment, or at a minimum until further improvement in water clarity is not observed with continued groundwater removal. Development of a well should occur as soon as it is practical after installation, allowing for sufficient time for the annular materials and the surface completion to cure. Typically the development can take place around 48 hours after installation.

Well development generally involves surging using a purpose-built surge block or (if a surge block is not available) a bailer rapidly raised and lowered to induce water flow into and out of the well screen (to flush fine particles/mud from the filter pack and screen and into suspension where they can be removed from the well).

It is considered best practice to monitor groundwater quality parameters (e.g., temperature, conductivity, ORP and pH, if available) and to make an

assessment of water clarity (either visually or using a turbidity meter where available) during purging activities. It is also considered best practice that monitoring wells are not sampled on the same day as they are developed.

Manual groundwater level measurement methodology

- Prior to visiting the site, check that the Water Level meter is functioning properly.
- The depth to water should be measured from the same reference point (top of casing, lowest point if uneven) every time.
- Record the difference in height between ground level and top of casing (or reference level that is used for measuring groundwater level).
- To measure the depth to water, slowly lower the probe into the well until a signal (intermittent or constant beep depending on meter used) is heard. Repeat the recording three times by raising/lowering the probe across the water table. Record the depth to water in meters to three decimal places (i.e., to the closest millimeter level).
- If appropriate, the total depth of the well should be measured to determine if the well is silting or damaged.

Groundwater quality sampling SOP

The sampling methodology described in this section is broadly based on TT 303/07 (2007): Groundwater Sampling (Second Edition) – A Comprehensive Guide for Sampling Methods and USGS National Field Manual for the Collection of Water-Quality Data (USGS, 2006). These should be consulted alongside this monitoring plan. The sampling should be carried out on all of the boreholes, wells and the spring defined in this document.

Borehole sampling

i. Pre-Sampling Activities

The following tasks should be completed prior to commencement of borehole purging or sampling:

- Check the condition of the borehole(s) and/or hand-dug wells upon arrival, and make a note in the field notebook of any observed damage, water in well box, potential surface-based contamination. If there is water in the well head, remove all water to below the top of well casing before removing the well cap (using a syringe/sponge etc.) to avoid potentially contaminated surface water entering the well (**safety note**: it is not uncommon to encounter spiders, snakes and wasps in well boxes, be careful when removing lids). Take a photograph for objective evidence of the site condition prior to sampling;
- Measure the depth to water and total depth of the monitoring boreholes using a dip meter (see *Section 19.3.8.4)*.
- Lower the sampling pump into the borehole, ideally located in the middle of the screened section of the borehole.

ii. Purging and Sampling Methodology

The field procedures for traditional volume-based purging are described in this section. The methodologies for sampling equipped boreholes (i.e. water supply wells) and sampling using bailers are also included.

iii. Volumetric Purging Methodology

The volumetric purging method is to remove three well volumes of water prior to sample collection. The rationale is to ensure that all the stagnant water within the casing and filter pack is removed and replaced with fresh formation water.

Before purging, the purge volume is calculated as three times the volume of standing water in the well and pore space of the filter pack [(1)].

The pump shall be lowered to beneath the water level and the borehole shall be purged at a rate of between 0.2 and 0.5 l/s. The pumping rate can be increased during purging, although care should be taken to avoid dropping the water level below the top of the screened section of the borehole and pumping the borehole dry.

However, the pumping rate should be between 0.2 and 0.5 l/s during sampling. Note the pump can be damaged if the water level falls below the position of the pump. If no pump is available, purging can also be carried out using an open-ended bailer.

The purged water shall be pumped into a clean container (e.g. bucket) where field parameters (pH, temperature, dissolved oxygen (DO), oxidation – reduction potential (ORP) and electrical conductivity (EC)) are monitored on a regular basis (e.g. every 3 minutes). The boreholes shall be purged until field parameters have stabilized, i.e. three consecutive readings of pH, temperature, DO, ORP and EC are within following stabilization criteria, or until at least three times the volume of standing water in the well and pore space of the filter pack have been removed whichever occurs first[(2)]:

- +/- 0.2 pH units;
- +/- 1°C of average temperature readings;
- +/- 10% for DO;
- +/- 10% for ORP; and
- +/- 3% for EC.

Once the purging of the borehole is complete, groundwater sampling shall be conducted. Samples should be collected directly from the

(1) A formula to calculate this is provided in the example fieldsheet, or see the USGS sampling guide for a full description.

[2] Make sure that at least one well volume is purged before sample is collected

pump with the groundwater being discharged directly into the appropriate sample container.

Note that for trace elements (metals), samples need to be field filtered before discharging into sample container. Filtering is a critical step in preparing these samples, and omitting this step will result in extremely misleading results from the laboratory.

Analysis and required filtering procedure are detailed in *Section 7*.

A final set of stabilized field parameters shall be recorded on the sampling fieldsheet including pH, temperature, DO, ORP, EC and turbidity.

iv. Purging Method – Using Bailers

If for any reason no pump can be used to purge the borehole, an open-ended bailer can be used. The bailer is lowered into the top of the water column, allowed to fill, and removed. This process is repeated until the appropriate volume of water has been removed from the well. It is critical that bailers be slowly and gently immersed into the top of the water column, particularly during final stages of purging, to minimize turbidity. The use of bailers for purging and sampling is discouraged because the correct technique is highly operator dependent and improper use may result in an unrepresentative sample.

v. Sample Collection

Once the field parameters have stabilized the sample(s) can be collected. Maintain or slightly reduce the pumping rate to minimize disturbance to the water column, put on fresh disposable gloves, and fill sample bottles directly from the discharge tube.

The pumping rate should be adjusted to provide a laminar (non-turbulent) flow into the sample bottles to minimize aeration of the sample, and the water should be allowed to run smoothly down the side of the bottle.

Additional requirement for sample collection are:

- Unless specified otherwise (ask the laboratory if in doubt), sample bottles should be filled with a meniscus above the rim of the vial to eliminate the formation of bubbles and headspace before capping (once the cap is screwed on, turn the vial upside down and gently tap the side of the bottle to see if any air bubbles are present. If they are, remove the cap, top off the vial and try again).

- Be careful not to let the water in acidified sample bottles overflow during sample collection as the acid preservative may be washed out.

- If the samples are required to be frozen following collection (very unusual), then only fill the bottles ¾ full to allow for expansion of the ice without breaking the bottle.

- Label the sample bottles with station name, date and keep them in cool box with sufficient ice packs.

- Review field water quality data on site during sample collection and re-measured suspicious readings to prevent the recording of false information.

- Fill in the field data sheets before leaving the site.

Groundwater must be field filtered if the laboratory has supplied you with an acid preservative bottle. If there is no acid do not filter the groundwater and instruct the laboratory to filter prior to analysis for metals.

If unfiltered groundwater is placed in a bottle with acid preservative the acid will strip all the metals off the sediments and the concentration will not be representative of the groundwater. Dissolved metals must be preserved especially manganese 2+ and ferrous iron.

If in doubt, always ask the laboratory before sampling.

Hand dug well and donor-installed (PMH) sampling

These wells cannot be purged in a similar manner, however if they are in regular use they will be being purged to a certain degree by abstraction by the local communities.

If they are not in use on arrival to the sampling site, pump two buckets full of water from the PMH wells and sample from the third bucket.

It is very difficult to purge a hand dug well, particularly in the dry seasons when it may take several hours to recharge. If water in the well is plentiful it may be possible to apply the three bucket technique above.

In both cases, make a note in the field sampling sheet of local abstraction on the day of sampling and the method used (if applicable) to purge the well.

i. Sample collection
Collect a sample of the well water in a clean (note the bucket will also have been rinsed with the purged water from the well) 20 l bucket and measure field parameters directly in the bucket. Wait until these

parameters have stabilized before recording them or taking the laboratory sample. Then put on fresh disposable gloves and fill sample bottles directly from the bucket.

Additional requirement for sample collection are:

- Unless specified otherwise (ask the laboratory if in doubt), sample bottles should be filled with a meniscus above the rim of the vial to eliminate the formation of bubbles and headspace before capping (once the cap is screwed on, turn the vial upside down and gently tap the side of the bottle to see if any air bubbles are present. If they are, remove the cap, top off the vial and try again).

- Be careful not to let the water in acidified sample bottles overflow during sample collection as the acid preservative may be washed out.

- If the samples are required to be frozen following collection (very unusual), then only fill the bottles ¾ full to allow for expansion of the ice without breaking the bottle.

- Label the sample bottles with station name, date and keep them in cool box with sufficient ice packs.

- Review field water quality data on site during sample collection and re-measured suspicious readings to prevent the recording of false information.

- Fill in the field data sheets before leaving the site.

Groundwater must be field filtered if the laboratory has supplied you with an acid preservative bottle. If there is no acid do not filter the groundwater and instruct the laboratory to filter prior to analysis for metals.

If unfiltered groundwater is placed in a bottle with acid preservative the acid will strip all the metals off the sediments and the concentration will not be representative of the groundwater. Dissolved metals must be preserved especially manganese 2+ and ferrous iron.

If in doubt, always ask the laboratory before sampling.

Spring water quality sampling

Water sampling in springs is essentially similar to sampling in surface water and hence health and safety concerns around sampling near open water may need to be considered (*Section 9*).

Try to sample from the area of the spring which you can see flowing out of the ground if possible.

The procedures for sampling springs are:

- Measure the field parameters using multi-parameter probe. Field measurements are always made in situ (in the flowing spring) or using a sub-sample taken in a separate container. Instrumentation must display stable in-situ parameters before parameters are recorded.

- Fill the sample bottles full before removing from the water. Immediately cap the sample bottles to avoid contamination

- Label the sample bottles with station name, date and keep them in cool box with sufficient ice packs.

- Water quality data is screened on site during sample collection and suspicious readings are re-measured to prevent the recording of false information.

- Fill the field data sheets

Sampling equipment decontamination procedure

Sampling equipment (excluding bottles which shall be kept clean with lids on prior to sampling) shall be rinsed three times with the water being sampled prior to collecting the sample to ensure no residual from the previous sample is present.

If hydrocarbons are suspected or have previously been detected at a location, stringent sampling equipment decontamination procedures shall be followed for non-disposable equipment such as sampling pump and tubing, water quality meters etc. as described in this section. In addition, wells with highly contaminated water should be sampled last.

During sampling and decontamination activities, disposable nitrile gloves shall be worn to minimize transfer of contaminants. Any disposable equipment, such as gloves, will be dedicated to each sampling location and disposed of after use.

Spring flow estimation

During the initial characterization period of spring identification and flow monitoring a simple method will be applied of measuring the time it takes to fill a container of known volume. This should be done quarterly timed to match the beginning of the dry and wet seasons and two shoulder seasons in between (i.e. approximately March, June, September, and December).

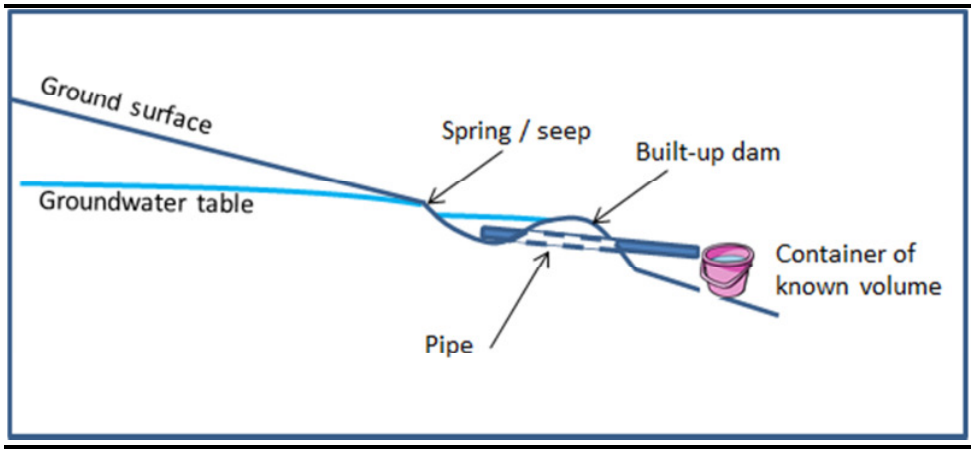
Depending on the location and flow of the spring two simple methods are recommended:

- If it is possible to directly fill the container of known volume from the spring this can be done and the time taken measured.

- If the above is not possible then build a small earth dam around the spring to create a pool. Feed a length of pipe through the dam from the pool to the container of known volume and measure the length of time the container takes to fill. Figure 19.23 illustrates this system.

For each measurement, make three recordings, documenting each of them and taking the average of all three to calculate the flow in convenient (documented) units of volume/time.

Figure 19.23 Illustration of spring flow monitoring system



Groundwater Level Measurement Equipment

Groundwater levels are measured manually by means of an electronic water level gauge *dipmeter*.

An example of a dipmeter (or water level meter) is presented in Figure 19.24. Dipmeters are used to manually measure depth to water in monitoring wells or boreholes.

Figure 19.24 Sample dipmeter

To ensure proper functioning of the dipmeter, the probe should be kept clean (i.e. free from mud or contamination – refer to decontamination procedures). Most dipmeters operate using a 9V battery.

Calibration of this equipment is usually not necessary; though functioning can be checked by placing the probe into a bucket of water, which should result in either a beep or a flashing control light, depending on the specific equipment.

Sampling pump

A sampling pump will be required to perform purging and sampling of groundwater for this project. The pump type is dependent on borehole casing diameter, depth to water level, permeability of formation, and purging/sampling methodology.

The preferred pumping equipment is the SDEC France PowerPump 24 – 61 range (see *Figure 19.25*, though this will be confirmed prior to commencement of field works. The SDEC pumps contain a 240 – 480W battery with a maximum depth of 64 meters below ground level (m bgl).

Figure 19.25 SDEC France PowerPump range

Multi-parameter field meter

A portable field water quality meter is required that can measure the following field parameters:

- pH;
- Temperature (T);
- Electrical conductivity (EC);
- Dissolved oxygen (DO); and
- Oxidation – Reduction Potential (ORP).

An example of a multi-parameter field water quality meter is presented in *Figure 19.26*.

Figure 19.26 Multi-parameter field meter

Field meters need to be properly maintained, and calibrated before every single sampling event. For specific maintenance and calibration procedure refer to the user manual of the unit.

Analytical schedule

This Section details the analytical schedule, sample holding times for the different analysis and specific sampling and preservation requirements. Water samples will be sent to an internationally accredited laboratory.

Table 19.27 lists constituents that are proposed to be analyzed by an accredited laboratory, as well as recommended maximum holding times and required field filtering and sample preservation.

For some analysis, holding times are not practically achievable (e.g. NO_3, PO_4), however, the results can still be interpreted qualitatively and indicate trends. This list should be reviewed annually by the appointed water quality consultant.

For the baseline assessment, metals should be analyzed on both filtered and unfiltered samples where turbidity/suspended solids are noticeable.

Table 19.27 Analysis, recommended holding times and field filter/preservation

Analysis	Holding Times	Filter on Site/Preservation
(i) Physical Parameters		
pH	15 min*	Analysis on site*
Electrical Conductivity (as EC at 25°C)	28 days	Cool, 4 deg. C
Total Dissolved Solids	28 days	Cool, 4 deg. C

Analysis	Holding Times	Filter on Site/Preservation
Total Suspended Solids	7 days	Cool, 4 deg. C
COD	7 days*	H2SO4 to pH<2 Cool, 4°C *
(ii) Organics		
Oils and grease	28 days*	Unfiltered/H_2SO_4 to pH below 2*
Phenols	28 days*	Unfiltered/H_2SO_4 to pH below 2*
(iii) Anions and cations		
Na	6 months*	Cool, 4 deg. C*
K	6 months*	Filter on site/HNO_3 to pH below 2*
Ca	6 months*	Filter on site/HNO_3 to pH below 2*
Mg	6 months*	Filter on site/HNO_3 to pH below 2*
F	28 days	None
Cl	28 days	None
SO_4	28 days	Cool, 4 deg. C
Alkalinity ($CaCO_3$)	14 days	Cool, 4 deg. C
NO_3	48 hours	Cool, 4 deg. C
Total N (Kjieldal)	7 days*	Cool, 4 deg. C/H_2SO_4 – pH below 2*
Ortho Phosphate (PO_4 as P)	48 hours	Filter on site/ Cool, 4 deg. C
Al	6 months	Filter on site/HNO_3 to pH below 2
Sb	6 months	Filter on site/HNO_3 to pH below 2
As	6 months	Filter on site/HNO_3 to pH below 2
Cd	6 months	Filter on site/HNO_3 to pH below 2
Cr (total)	6 months	Filter on site/HNO_3 to pH below 2
Cu	6 months	Filter on site/HNO_3 to pH below 2
Fe	6 months	Filter on site/HNO_3 to pH below 2
Pb	6 months	Filter on site/HNO_3 to pH below 2
Mn	6 months	Filter on site/HNO_3 to pH below 2
Hg	28 days	Filter on site/HNO_3 to pH below 2
Mo	6 months	Filter on site/HNO_3 to pH below 2
Ni	6 months	Filter on site/HNO_3 to pH below 2
Se	6 months	Filter on site/HNO_3 to pH below 2
U	6 months	Filter on site/HNO_3 to pH below 2
V	6 months	Filter on site/HNO_3 to pH below 2
Zn	6 months	Filter on site/HNO_3 to pH below 2

Notes: Sample recommended holding times and field filtering/preservation is based on US EPA (1983) unless otherwise stated
*Sample recommended holding times and field filtering/preservation is based on Weaver (2007)

19.3.8.5 Social

The Project will have to undertake further studies to monitor social mitigation measures identified in this report. These activities will include:

- annual socioeconomic surveys based on sampling, for example underway through the Reinstallation Action Plan to be implemented, to collect

detailed information on households and settlements anticipated to be affected by the Project;
- directed interviews with selected stakeholders and public infrastructures (health care centers, schools, local authorities, etc.) ;
- local market studies and evolution of local prices of goods, services and lands;
- in-migration studies to collect socioeconomic data within settlements anticipated to experience high levels of influx and focused on mitigating impacts on land, land-based resources, water, and infrastructure;
- records and analysis of trends of grievances; and
- external factors review based on review of public available data and media (*e.g*. public opinion).

Development of programs and plans will also require continuing stakeholder engagement to ensure mitigation is designed and implemented taking into account the view of affected people and other interested parties.

Data collection and stakeholder engagement activities will enable adjustments and development of appropriate mitigation measures and the updating of programs and plans.

Collected data, questions during directed interviews, design of surveys will seek to the extent feasible to capture impacts from the Project only. Some indicators will however cover socioeconomic trends that may also be influenced by factors external to the Project (e.g. inflation can be influenced by other projects in the area or by national macro-economic policies). This type of information will be used with precaution by the Project and will be analyzed based on good common sense and a high level analysis of external factors at work. The Project may decide not to adapt its mitigations, programs and plans based on their results.

Should the activities reveal distinct differences between communities the Project will also consider the development of community specific impact management plans.

Audit and inspection programs will be developed and applied throughout the Project lifetime mainly to ensure that the RAP, LRP and other mitigation measures have effectively been implemented or need updates. External audits will be required for the RAP and LRP.

The objective of this is to:

- check that practices conform with planned arrangements including implementation of mitigation and
- management measures and compliance with legal and Project commitments;
- identify where existing planned arrangements do not meet the needs of the Project or can be improved; and

- establish information which can be used by management to continually improve performance.

Site audits will use appropriate protocols (according to the type / phase of operation) prepared by relevant personnel.

Inspection and audit frequencies will be established, and may be increased or decreased according to the findings and degree of confidence arising from the on-going programs.

19.3.9 Schedule

Monitoring will commence as soon as a monitoring sites are established, 12 months prior to construction activities commencing. The implementation of the proposed monitoring sites at the GAC concession will be as described in the monitoring program (see *Section 19.3.1 to 19.3.4*). The implementation of the proposed monitoring sites at the Kamsar port will be constant for the entire duration of the project.

19.3.10 Quality assurance and quality control

A number of quality control procedures will be incorporated into the monitoring and sampling program in order to ensure that there is a high level of confidence in the results obtained.

Mislabeling, improper storage of bottles and sample contamination from sampling equipment or other sources are the possible data quality issues. Samples will be handled carefully at all times to prevent damage, potential sample loss and contamination. Samples will be transported from the sites to laboratory in cool boxes with sufficient ice packs.

Examination and evaluation of field data and data entry is an important part of quality control. Inconsistences will be checked and further investigation will be performed using field record sheets and laboratory result files.

A chain of custody form will be completed. It will allow the samples to be tracked through the system, from collection in the field, transport to the laboratory and on through the laboratory. The chain of custody form includes details of site address, date of sampling, number and name of samples, preservatives, storage conditions and the analyses required. Three copies of chain of custody form will be prepared: one for these will be kept with GAC and other two will be retained with sample courier and the laboratory.

Quality control samples will be collected and analyzed to verify the integrity of testing samples, detect errors introduced during sampling. Quality control samples are duplicate and blank samples (distilled/de-ionized water). They will represent 10% of the total number of samples collected. Both duplicate and blank samples will be labeled with a similar but different name to the

actual sample site and thus the laboratory will not able to identify them as duplicate, blank samples.

19.3.11 Reporting

Monitoring results will be provided to regulators in accordance with the requirements of the concession mining license. These results are likely to include the following:

- all collected data, including dates, locations, laboratory results and water level measurements;
- photographs and field condition notes including weather, flow, flood, quality observations and any evidence of damage or tampering or potentially unsafe conditions;
- methodologies used for data collection and analysis, including quality control and quality assurance measures and equipment calibration logs;
- comparisons between measurements and performance objectives;
- statistical spatial and temporal trend analysis as appropriate for certain parameters;
- assessment of seasonal or other trends and differences;
- identification and connection to specific events that may be responsible for transient or short-term effects;
- assessment of the relationship between water quality and the data collected at receptors; and
- mitigation measures performance assessment.

In addition, tailored and fit for purpose environmental and social monitoring results will be incorporated into the following reports:

- Stakeholder Engagement Plan updates;
- annual Environmental, Social and Health & Safety Report to corporate owners, lenders and employees;
- other reports to Project lenders, corporate owners or other stakeholders as required;
- public annual sustainability report;
- Community Information Bulletin distributed approximately on a quarterly basis;
- internal quarterly report on Project's social and environmental performances; and
- internal monthly grievances monitoring report.

19.3.12 Revisions and adjustments to the monitoring plan

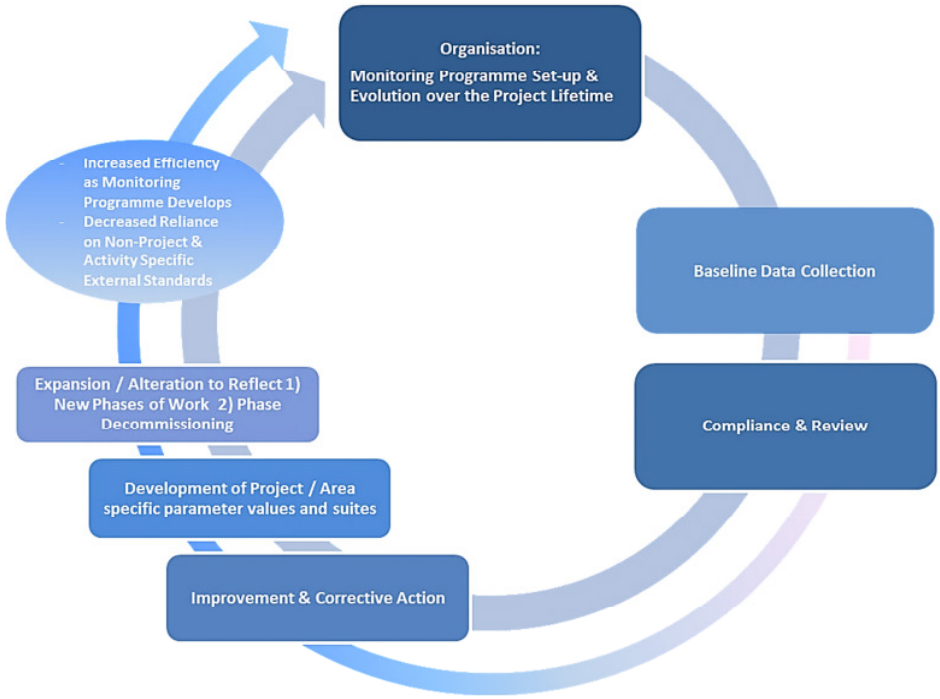
A philosophy of adaptive management and continual improvement of the monitoring plan will be adopted by GAC to ensure that this Plan, embedded controls and proposed mitigation measures are consistently meeting project standards and KPIs. This will be achieved through periodic Plan reviews and

the results of the monitoring. A typical adaptive management cycle is shown in *Figure 3.5*.

Adaptive management will be initiated under the following conditions when a scientifically defensible relation exists between the Project and the performance indicator:

- when design and mine plan alterations are confirmed at detailed design stages and through the lifetime of the project;
- in the event that performance objectives are not being met;
- when monitored emissions or receptors (e.g. air emissions & air quality or water effluents and surface water) exceeds permissible levels, or may exceed permissible levels if the detected trends presents this as a future possibility;
- if opportunities for improvements, additions and / or simplifications are recognized; and
- when local community, any third party or other external factors are considered to have the potential to affect results.

Figure 19.27 Adaptive management cycle



Professional specialists relevant to the type of impacts monitored (e.g. ecologist, hydrogeologist, biodiversity expert, sociologist, etc.) will be consulted, as necessary, to determine the most appropriate adaptive management strategy for a given context. These changes may include changes to or additional mitigation measures, changes of indicators or monitoring protocols (incl. increased frequency and additional locations as needed).

19.4 HEALTH AND SAFETY

The potential exists for health and safety risks associated with monitoring activities. Collection of field data, requires for GAC or contracted personnel to walk in active mine site areas, natural habitats, human settlements and along watercourses.

Natural hazards in Guinea include extreme weather conditions such as storms, humidity, heat, dryness and dusty Harmattan haze; and potentially dangerous flora and fauna such as mosquitoes (and other biting insects), crocodiles, snakes, spiders and certain forms of vegetation. A Job Safety Analysis (JSA) and a related Health and Safety Plan (HASP) will need to be developed to address appropriately the common natural hazards , with input from ecological specialists or survey reviews

19.4.1 Procedures

Project and site HSSEC requirements should be checked to ensure that specific guidance relating to work in Project sites, natural environment, human settlements and in, or close to water are incorporated, including the following:

- the monitoring team and other relevant personnel are equipped with appropriate, tested Personal Protective Equipment (PPE) and follow procedures under all circumstances that appropriately minimize risks;
- all work on active Project sites shall be preceded by an appropriate H&S induction on site related risks and procedures;
- all work in natural habitats shall be preceded by an appropriate H&S induction, including relevant PPE, materials and procedures to follow to ensure safety of work;
- all work in human settlements shall be preceded by an induction on Local communities, cultural sensitivities and workers appropriate behavior;
- all field teams shall consist of at least two persons;
- all field staff shall carry communication devices, GPS' and cameras;
- a daily HSSEC discussion will be conducted at the beginning of each day prior to starting field work. Site specific and condition specific conditions shall be discussed in addition to reviewing the basic HSSEC plan for monitoring. Input to these meetings from the community liaison lead at the mine site would be advised in order to provide updates on socially sensitive areas;
- any member of the field staff of monitoring team shall have the authority to halt work when unsafe activities are observed;
- a first aid kit shall be with the field team at all times;
- all cuts and broken skin should be covered with waterproof plasters and suitable protective equipment should be worn; and
- for water monitoring, where conditions are not considered to be suitable, the need to enter the water should be avoided or minimized and controls

should be implemented to include provision of fall protection devices, tethering, and personal flotation devices (PFDs) where there is a risk of falling into the water;

- for water monitoring, all operatives who use automatically inflated PFDs need to be trained and competent in their care and use including pre-wear checks and inspection procedures. PFDs are to be serviced by a competent person regularly. Operatives are not to work alone, and are to be tied off when at heights and in the water.

GAC will implement a formal non-compliance and corrective action tracking procedure for investigating cause and identifying corrective actions in response to accidents or environmental or social non-compliances related to environmental and social monitoring. The appropriate GAC HSSEC manager will be responsible for keeping records of corrective actions and for overseeing the modification of environmental or social protection procedures and/or training programs to avoid repeating accidents, non-conformances and non-compliances.

19.4.2 Stakeholder engagement

Monitoring activities should be communicated to relevant stakeholders such as local authorities and communities prior to the start of work. An appropriate procedure or plan should be developed to ensure information on monitoring activities is communicated on time and adequately. The Community team will be the point of contact for communicating with local communities.

19.5 REFERENCES

HATCH, 2014. *Guinea Alumina Corporation-GAC FEL 2 Study*

HATCH, 2015. *Guinea Bauxite Export Project Plateau 33/ Plateau 26 Location Trade Off Study.* ERM, 2015. *Guinea Alumina Corporation SEIA Report*

UNEP/WHO, 1996. *Water Quality Monitoring - A Practical Guide to the Design and Implementation of Freshwater Quality Studies and Monitoring Programs*

Norme Guinéenne NG 09-01-010:2012 / CNQ:2004 *(as finalized and updated in the future):* draft Guinean water quality standards and regulations for waste, surface, sea and ground water

International guidance including relevant mining sector and surface water monitoring guidance from IFC, WHO, UNEP, EBRD and CCME

19.6 APPENDICES

19.6.1 Sample field spreadsheet for surface water quality

River Stage and Discharge Data Sheet					
Technician:			Controller:		
Weather Condition:			Date		
Distance between bridge deck and water surface (m)	Stage (m)	Monitoring Point	Velocity (m/sec)		
			1st Reading	2nd Reading	3rd Reading
		1			
		2			
		3			
		4			
		5			
		6			
		7			

Surface Water Quality Field Parameters Data Sheet	
Technician:	Controller:
Weather Condition: e.g.: Rainy, Hazy, Dry	Notes on River Flows and Water Quality: e.g.: Traces of Detergent on water surface, high sedimentation
Sampling Location:	
Date of Calibration:	Equipment Status:

Water Temperature (^{0}C)	pH	Dissolved Oxygen	Conductivity	Turbidity	TDS	TSS	Oxidation Reduction Potential

Surface Water Quality Sampling Sheet for Laboratory Analysis	
Technician:	Controller:
Weather Condition: e.g.: Rainy, Hazy, Dry	Date:
Sampling Location ID	Site Notes
	Ex: Traces of Detergent on water surface, high sedimentation, pooling etc.

Chain of Custody Form																				
Laboratory:				Controller:																
Courier:				Date																
Sample ID	Bottles	Sampling		Sample Parameters																
		Date	Time																	

19.6.2 Example Field sheets for groundwater quality

Monitoring Well data sheet														
Name	Date	Time	Measurement reference	Reference point altitude (masl[1])	Initial water level (mbrp[2])	Initial water level (masl)	MW depth (mbgs)	MW inner diameter (mm)	Water height within MW (m)	Purge volume (l)	Type of pump	Pump position in MW	Flow rate (l/min)	Comments
Variables for calculations:				*a*	*b*		*c*	*d*	*e*					
Example rows:														
BH1	*01/12/2015*	*14h30*	*TOC (top of casing)*	*120.52*	*6.08*	*= a – b*	*10.00*	*50.2*	*= c – b*	*= 3 x π x (0.5d)² x e x 1000*	*12V*	*1 m above well bottom*	*10.00*	*Evidence of animals in immediate area of sample location, weather dry for several weeks.*
Spring	*01/12/2015*	*15h00*	*na*	*na*	*na*	*na*	*na*	*na*	*na*	*na*	*na*	*na*	*na*	*Sample taken from recently dug area of flowing spring*

1. masl = meters above sea level *2. mbgs = meters below reference point*

Groundwater Sampling data sheet														
Site Name	Date	Time	Sample number	Conductivity (µS/cm)	pH	Temp (°C)	DO (mg/l)	ORP (mV)	Turbidity	Colour	Smell	Sample bottles	Duplicate? (Y/N)	Comments
Example row: *BH1*	*01/12/2015*	*14h30*	*supplied by laboratory*	*from field meter*					*observation – clear/slightly cloudy/cloudy/very cloudy*	*descriptive*	*descriptive*	*2 x 500 ml glass, 2 x 40 ml plastic*	*N*	*Field probe took 5 minutes to stabilise. Filtered and unfiltered samples collected.*

19.6.3 *Example Chain of custody form*

CHAIN OF CUSTODY

CLIENT: GAC	If Electronic File Required please select file format below	SAMPLER:	
ADDRESS:		MOBILE:	
	EQUIS	EMAIL REPORT TO:	
PROJECT MANAGER (PM):	CROSSTAB	cc REPORT TO:	
MOBILE:	CLIENT	INVOICE TO: (if different to report)	
PROJECT ID:	AGS (please also fill in AGS SAMP_TYPE & SAMP_REF below)	QUOTE NUMBER: P.O No:	Chain of Custody sheet page ..... of ....
SITE:		ANALYSIS REQUIRED including SUITE names	

TURNAROUND - please tick			All waters - tick for samples to be tested shaken or settled	FOR LABORATORY USE ONLY
10 DAY	4 DAY	Other		AVERAGE COOL BOX TEMP.(if required):
5 DAY	3 DAY			SAMPLE RECEIPT CONDITION:

MATRIX:- GW=GroundWater, SW=SurfaceWater, L/E=Leachate/Effluent, OW=OtherWater

Sample ID	AGS SAMP TYPE	AGS SAMP REF	Shaken	Settled	S/GW/SW/L/E/OW/P	Date	Time	Depth in Metres	Preservation	Asbestos risk: High	Medium	Low

RELINQUISHED BY:		RECIEVED BY:		METHOD of SHIPMENT
Name:	Date:	Name:	Date:	Consignment note No:
Of:	Time:	Of:	Time:	Courier Company:

Health & Safety instructions including known hazards (eg suspected asbestos). Please let us know if samples are heavily contaminated, high PAHs expected, provide PID readings if available

19.6.4 Drinking water standards

Guinean standards (where applicable) will be updated following the finalization of legislation currently under development.

Parameter	Units	Value	Value	Remarks
		Guinea	WHO	
Bacteriological				
Fecal Coliforms	MPN		Not detected in 100 mL of sample	All types of drinking water
Organoleptic				
Color	mg/L (Pt-Co)		-	
Turbidity	NTU		1-5	
Physicochemical				
Temperature	°C		-	
Hydrogen Ion	Potential Hydrogen			
Residual chlorine	mg/L		-	
Chloride	mg/L		-	
Conductivity	µS/cm		-	
Hardness	mg/L $CaCO_3$		-	
Sulfate	mg/L		-	
Aluminum	mg/L		-	
Calcium	mg/L $CaCO_3$		-	
Copper	mg/L		2	
Magnesium	mg/L $CaCO_3$		-	
Sodium	mg/L		-	
Potassium	mg/L		-	
Total Suspended Solids	mg/L		-	
Zinc	mg/L		-	
Parameters for undesirable substances				
Nitrates	mg/L		-	
Nitrites	mg/L		-	
Iron	mg/L		-	
Manganese	mg/L		-	
Fluoride	mg/L		1.5	1.5 mg/L for water temperatures = 8-12 °C; 0.7 mg/L for water temperatures = 25-30 °C
Parameters for inorganic substances with meaning in health				
Arsenic	mg/L		0.01 (A,T) (1)	
Cadmium	mg/L		0.003	
Cyanide	mg/L		-	
Chromium	mg/L		0.05 (total) (P) (1)	
Mercury	mg/L		0.006	For inorganic mercury
Nickel	mg/L		0.07	
Lead	mg/L		0.01 (A,T)	
Selenium	mg/L		0.04 (P)	

(1) Provisional guideline values - situations where a provisional guideline value applies include the following. A: Calculated guideline value is below the practical quantification level, T: calculated guideline value is below the level that can be achieved through practical treatment methods, P: Significant scientific uncertainties regarding derivation of health-based guideline value, D: Calculated guideline value is likely to be exceeded as a result of disinfection procedures.

19.6.5 Field spreadsheet for noise monitoring

Noise Measurement ID		
Survey Point		
Project Features		
Date		
Time		
Weather Conditions *(note wind conditions)*		
Equipment Characteristics	**Model**	
	Type	
	Calibration date	
	Microphone height	
Site Description		
Noise Sources		
Receptors		

Noise Measurement									
Start time			**End time**			**Period**			
Leq dB(A)	**Lmax dB(A)**	**Lmin dB(A)**	**L1 dB(A)**	**L5 dB(A)**	**L10 dB(A)**	**L50 dB(A)**	**L90 dB(A)**	**L95 dB(A)**	**L99 dB(A)**

ID Photos	**Description**