



EEM

SUSTAINABLE MANAGEMENT

4115 Sherbrooke Street West, Suite 310

Westmount, Québec H3Z 1K9

Tel.: 514.481.3401

Fax.: 514.481.4679

eem.ca

Supplementary Information Package (SIP) to the ESIA of the CBG Expansion Project

Third Release

COMPAGNIE DES BAUXITES DE GUINÉE

OCTOBER 5, 2015

PROJECT NUMBER: 150TH076

PREPARED FOR:

Xavier van Lierde, Responsable Approvisionnement – Projet Extension

Compagnie des Bauxites de Guinée

Note: This document is to be read in conjunction with the 2014 EEM ESIA and is not a standalone document. It provides additional information requested by the IFC, OPIC and others from June to September of 2015.

TABLE OF CONTENTS

1 Introduction	17
1.1 Background	17
1.2 Objectives of the Supplementary information package (SIP)	18
1.3 Structure of the SIP.....	19
1.4 Study Team	20
2 Physical environment	23
2.1 Monitoring program.....	23
2.1.1 Status of the program.....	23
2.1.2 Meteorology	23
2.1.3 Air quality	23
2.1.4 Noise.....	23
2.1.5 Surface water discharge.....	24
2.1.6 Surface water quality	24
2.1.7 Sediments.....	24
2.1.8 Dredging.....	24
2.1.9 Groundwater	28
2.2 Responses to air quality questions	29
2.2.1 Baseline Monitoring	29
2.2.2 Mitigation.....	37
2.2.3 The plume from the stack.....	39
2.2.4 Additional Information	40
2.3 Additional air quality modelling.....	45
2.3.1 Baseline Conditions	45
2.3.2 Revised Blasting Assessment	46
2.3.3 Additional Sensitive Receptors.....	50
2.4 Responses to noise and vibrations questions.....	53
2.5 Additional noise modelling	53
2.5.1 Summary of Previous Modelling.....	53
2.5.2 Additional Modelling Results.....	57
2.6 Responses to surface water questions.....	58
2.6.1 Baseline Data and Future Monitoring Plans.....	58
2.6.2 Mine Water Balance	58

2.6.3 Assessment of Surface Water Quality Impacts	59
2.6.4 Aluminum Toxicity	59
2.7 Responses to dredging questions	60
2.8 Waste management plan	63
3 Biology	64
3.1 Introduction	64
3.2 Biology data maps	64
3.3 Additional data from original version of theBAF.....	64
3.4 Critical habitat assessment.....	64
3.5 Primate assessment	65
3.6 Ecosystem Services Review	66
3.6.1 Introduction	66
3.6.2 Methods.....	66
3.6.3 Results	68
3.6.4 Screening.....	72
3.7 Benthic invertebrate survey of dredging area.....	107
3.8 Biodiversity Action Framework (BAF).....	107
4 Social	108
4.1 Introduction	108
4.2 Responses to questions regarding past grievances.....	108
4.3 Stakeholder Engagement.....	109
5 Closure	110
6 Environmental and Social Management Plan (ESMP).....	111
7 Cumulative impact assessment	112
8 List of References.....	113

LIST OF APPENDICES

Volume I

- 9.1 Air quality and noise monitoring plan**
- 9.2 Surface water & sediment monitoring plan**
- 9.3 Summary dredging and sediment disposal plan**
- 9.4 Groundwater sampling plan**
- 9.5 Water Management Framework**
- 9.6 Waste management**

Volume II

- 9.7 Biology maps**

Volume III

- 9.8 Framework for conserving biodiversity**
- 9.9 Review of selected impacts**
- 9.10 Summary of commitments and mitigation**
- 9.11 Critical Habitat Assessment (CHA)**
- 9.12 Biodiversity Action Framework (BAF)**
- 9.13 BAF Appendices**

Volume IV

- 9.14 Resettlement and Livelihoods Restoration Policy Framework**
- 9.15 Grievance management**
- 9.16 Stakeholder engagement**
- 9.17 Environmental and Social Management Plan (ESMP)**

LIST OF FIGURES

Figure 1 Wind Rose from ANNEXES FEL-3 ESIA Oct 2011.pdf (AECOM 2011)	36
Figure 2 Wind Rose from the CBG Expansion Project Air Quality Technical Report	37
Figure 3 Change in Concentration of NO ₂ with Distance from Edge of a Blast	48
Figure 4 Maximum Allowable Charge Mass per Delay by Distance (Ground Vibration)	55
Figure 5 Maximum Allowable Charge Mass per Delay by Distance (Airblast)	56

LIST OF TABLES

Table 1 Assumptions Used in the Original Blasting Assessment	41
Table 2 Comparison of Blasting Set-Back Distances	48
Table 3 Revised 1-hour NO ₂ Concentrations at Villages Exceeding WHO Guidelines	49
Table 4 Characteristics of potential resettlement locations	51
Table 6 Noise assessment resettlement locations	57
Table 7 Initial checklist of ecosystem services, ecological benefits and values of biodiversity	69
Table 8 Grouping of some of the Social ecosystem services	74
Table 9 Type 1 Locally benefitted ecosystem services	75
Table 10 Type 2 Locally benefitted ecosystem services	79
Table 11 Main table of ecosystem services	80

LIST OF MAPS

Map 1 Map of Expansion Project	18
Map 2 Dredging sampling area (light gray).....	26
Map 3 Dredge material deposition area.....	27
Map 4 Existing operations TSP annual deposition	42
Map 5 18.5 MTPA TSP annual deposition	43
Map 6 22.5 MTPA TSP annual deposition	44
Map 7 27.5 MTPA TSP annual deposition	45
Map 8 Location of potential resettlement locations	50
Map 9 2014 Sediment sampling stations	61
Map 10 2011 (AECOM) Sediment sampling stations.....	62
Map 11 Proposed WCF survey design for a rapid assessment of the CBG South Cogon concession	65

LIST OF PHOTOGRAPHS

Photo 1 Example of sediment sample from the on-going dredging survey	28
Photo 2 AQ-1 Alcoa station	31
Photo 3 AQ-2 Ecole.....	31
Photo 4 AQ-10 Kourawel looking north	32
Photo 5 AQ-11 Kourawel looking northeast.....	32
Photo 7 AQ-13 Paravi.....	33
Photo 8 Plume from stack in older pictures.....	39
Photo 9 Recent photograph of plume.....	39

ABBREVIATIONS AND ACRONYMS

(Note: Text in square brackets [] is a translation of a French term for which there is no official English version.)

°C:	Degrees Celsius
AFD	Agence Française de Développement [French development agency]
AIDS:	Acquired immune deficiency syndrome
AIP:	Annual investment plan
AMC:	Alliance Mining Commodities Ltd.
ANAİM:	Agence Nationale d'Aménagement des Infrastructures Minières [national agency for mining infrastructure development]
APA:	Laboratoire Archéologie et Peuplement de l'Afrique [African archeology and settlement laboratory]
APAÉ:	Association des parents et amis d'élèves [parents and friends of students]
ARV:	Antiretroviral
BAF:	Biodiversity Action Framework
BAP:	Biodiversity Action Plan
BEPC:	<i>Brevet d'études du premier cycle du second degré</i> [middle-school leaving certificate]
BGÉEÉ:	Bureau Guinéen d'Études et d'Évaluation Environnementale [Guinean bureau of environmental studies and assessment]
BM:	Banque Mondiale / World Bank (WB)
BPII:	<i>Bonnes pratiques industrielles internationales</i> / Industrial international best practices

- C/P:** Frontline fishing camps and ports
- CA:** *Chiffre d'affaires* [revenues]
- CBG:** Compagnie des Bauxites de Guinée
- CCME:** Canadian Council of Ministers of the Environment
- CCNUCC:** *Convention-cadre des Nations Unies sur le changement climatique* / World Bank United Nations Framework Convention on Climate Change (UNFCCC)
- CDD:** *Contrat de durée déterminée* [contract of defined length]
- CDI:** *Contrat de durée indéterminée* [contract of indefinite length]
- CÉCI:** *Centre d'études et de coopération internationale* / Centre for international Studies and Cooperation
- CECIDE:** Centre du Commerce International pour le Développement [international trade center for development]
- CEDEAO:** Communauté économique des États de l'Afrique de l'Ouest / United Nations Economic Commission for Africa (UNECA)
- CFB:** Chemin de Fer de Boké [Boké railroad]
- CITES:** Convention on International Trade in Endangered Species
- CMG:** Chambre des Mines de Guinée [Guinean chamber of mines]
- COD:** Chemical oxygen demand
- COPC:** Contaminant of potential concern
- CoPSAM:** Comité Préfectoral de Suivi des Activités des Miniers [prefectoral mining activity monitoring committee]
- CPC:** *Contaminant potentiellement préoccupant* / contaminant of potential concern (COPC)
- CPD:** Comité Préfectoral de Développement [prefectoral development committee]

CPÉ:	<i>Consultation et participation éclairées</i> / informed prior consent (IPC)
CR:	<i>Commune rurale</i> [rural commune]
CRD:	<i>Commune rurale de développement</i> [rural development commune]
CSA:	Centre de santé amélioré [improved health center]
CSO:	Civil society organizations
CSR:	Corporate social responsibility
CU:	<i>Commune urbaine</i> [urban commune]
CVÉ:	<i>Composante valorisée de l'écosystème</i> / valued ecosystem component (VEC)
dB:	Decibel
dB(A):	A-weighted decibel
dBZ:	Decibel relative to Z
DEP	Direction Préfectorale de l'Éducation [prefectoral directorate for education]
DPUHC:	Direction préfectorale de l'urbanisme de l'habitat et de la construction [prefectoral directorate for housing and construction]
DUDH:	<i>Déclaration universelle des droits de l'homme</i> / Universal Declaration of Human Rights (UDHR)
ÉDG:	Électricité de Guinée
EIA:	Environmental impact assessment
ÉIE:	<i>Étude d'impact environnemental</i> / environmental impact assessment
ÉIS:	<i>Étude d'impact social</i> / social impact assessment
EITI:	Extractive Industries Transparency Initiative
EPA:	Environmental Protection Agency (United States)

EPI:	Extended Program on Immunization
EPT:	Ephemeroptera, Plecoptera and Trichoptera (types of aquatic insects)
ESCOMB:	<i>Enquête de surveillance comportementale et biologique sur le VIH/SIDA</i> [HIV/AIDS behavioral and biological surveillance survey]
ESIA:	Environmental and social impact assessment
ESMP:	Environmental and social management plan
ETAE:	<i>Eaux tropicales de l'Atlantique Est</i> [tropical waters of the Eastern Atlantic]
FEL 1:	Front-end loading – preliminary economic assessment
FEL 2:	Front-end loading – prefeasibility study
FEL 3:	Front-end loading – detailed engineering study
FPIC:	Free prior and informed consent
GAC:	Guinea Alumina Corporation
GdG:	<i>Gouvernement de la Guinée</i> / Government of Guinea (GoG)
GDP:	Gross domestic product
GES:	<i>Gaz à effet de serre</i> / greenhouse gas (GHG)
GHG:	Greenhouse gas
GIEC:	Groupe d'experts intergouvernemental sur l'évolution du climat / Intergovernmental Panel on Climate Change (IPCC)
GIS:	Geographic information system
GNF:	Guinean franc
GoG:	Government of Guinea
GPS:	Global positioning system
GRI:	Global Reporting Initiative

GTP:	Ground truth point methodology
Ha:	Hectare
HAP:	<i>Hydrocarbure aromatique polycyclique</i> / polycyclic aromatic hydrocarbon (PAH)
HFO:	Heavy fuel oil
HP:	Horsepower
HSE:	Health, safety and environment
IBA:	Important bird area
ICCPR:	International Covenant on Civil and Political Rights
ICESCR:	International Covenant on Economic, Social and Cultural Rights
ICMM:	International Council on Mining and Metals / Conseil International des Mines et des Métaux
IFC:	International Finance Corporation / <i>Société Financière Internationale</i> (SFI)
IFI:	International finance institutions / <i>institutions financières internationales</i>
ILO:	International Labor Organization
IPCC:	Intergovernmental Panel on Climate Change
ISQG:	CCME Interim Sediment Quality Guideline
IST:	<i>Infections sexuellement transmissibles</i> / sexually transmitted infections (STIs)
ITIE:	Initiative pour la Transparence des Industries Extractives / Extractive Industries Transparency Initiative (EITI)
IUCN:	International Union for Conservation of Nature / Union internationale pour la conservation de la nature (UICN)
km:	Kilometer

km²:	Square kilometer
LA_{eq}:	Equivalent sound level (dBA)
LDIQS:	CCME Interim Sediment Quality Guideline
L_{eq}:	Equivalent sound level (dB)
m:	Meter
m²:	Square meter
m³:	Cubic meter
m³/h:	Cubic meters per hour
MDDEP:	Ministère du Développement durable, de l'Environnement et des Parcs du Québec, now called the Ministère du Développement durable, de l'Environnement et de la Lutte contre les changements climatiques [Quebec ministry of sustainable development, environment and parks, now called the ministry of sustainable development, environment and the fight against climate change]
MDT:	<i>Matières dissoutes totales</i> / total dissolved solids (TDS)
ml:	Milliliter
mm:	Millimeter
MME:	Ministère des Mines et de l'Énergie / Ministry of Mines and Energy
MTPA:	Million tonnes per annum
MW:	Megawatt
N/A:	Not applicable
NEP:	<i>Niveau d'effet probable du CCME</i> / CCME probable effects level (PEL)
NGO:	Nongovernmental organization
NP:	<i>Norme de performance de la SFI</i> / IFC Performance Standard (PS)
NSP:	<i>Ne s'applique pas</i> / not applicable (N/A)

OAU:	Organization of African Unity
OCDE:	Organisation de Coopération et de Développement Économique / Organization for Economic Cooperation and Development (OECD)
OECD:	Organization for Economic Cooperation and Development
OIT:	Organisation internationale du Travail / International Labor Organization (ILO)
OMS:	Organisation mondiale de la Santé / World Health Organization
ONG:	<i>Organisme non-gouvernemental</i> / nongovernmental organization
ONU:	Organisation des Nations-Unies / United Nations
OSC:	<i>Organisations de la société civile</i> / civil society organizations
OUA:	Organisation de l'unité africaine / Organization of African Unity
OWINFS:	Our World Is Not for Sale
PACV:	<i>Programme d'appui aux organisations villageoises</i> [village support program]
PAH	Polycyclic aromatic hydrocarbon
PAI:	<i>Plan annuel d'investissement</i> / annual investment plan
PARC:	<i>Plan d'action de réinstallation et de compensation</i> / resettlement and compensation action plan (RAP)
PCB:	<i>Plan de conservation de la biodiversité</i> / biodiversity action plan (BAP)
PCS:	<i>Partenaires contre le SIDA</i> [AIDS prevention group]
PDL:	<i>Plan de développement local</i> [local development plan]
PEL:	CCME probable effects level
PEPP:	<i>Plan d'engagement des parties prenantes</i> / stakeholder engagement plan (SEP)

PÉV:	<i>Programme élargi de vaccination / Expanded Programme on Immunization (EPI)</i>
PGES:	<i>Plan de gestion environnementale et sociale / environmental and social management plan (ESMP)</i>
PIB:	<i>Produit intérieur brut / gross domestic product (GDP)</i>
PIDCP:	<i>Pacte international relatif aux droits civils et politiques / International Covenant on Civil and Political Rights (ICCPR)</i>
PIDESC:	<i>Pacte international relatif aux droits économiques, sociaux et culturels / International Covenant on Economic, Social and Cultural Rights (ICESCR)</i>
PK:	Point kilométrique / kilometer point
PM₁₀:	Particulate matter in air up to 10 micrometers in size
PM_{2.5}:	Particulate matter in air up to 2.5 micrometers in size
PMH:	<i>Pompe à motricité humaine / manually operated pump</i>
PNUD:	Programme des Nations-Unies pour le Développement / United Nations Development Program (UNDP)
PP:	<i>Parties prenantes / stakeholders</i>
PPV:	Peak particle velocity
PRCB:	Projet de renforcement des capacités de Boké [Boké rural community development project]
PS:	IFC Performance Standard
QSE:	Quality, safety and environment
RAP:	Resettlement and compensation action plan
RAP:	Rapid assessment program / rapid biological assessment
RSE:	<i>Responsabilité sociale des entreprises / corporate social responsibility (CSR)</i>

RTA:	Rio Tinto Alcan
SAG:	Société Aurifère de Guinée [Guinea gold corporation]
SDT:	<i>Solides dissous totaux</i> / total dissolved solids (TDS)
SEG:	Société des Eaux de Guinée [Guinea water corporation]
SEP:	Stakeholder engagement plan
SFI:	Société Financière Internationale / International Finance Corporation (IFC)
SIA:	Social impact assessment
SIDA:	<i>Syndrome d'immunodéficience acquise</i> / acquired immune deficiency syndrome (AIDS)
SIG:	<i>Système d'information géographique</i> / geographic information system (GIS)
SNAPE:	Service national des points d'eau [national water supply points service]
SO_x:	Sulphur oxides
SP:	<i>Sous-préfecture</i> [subprefecture]
SSC:	Species Survival Commission
SSE:	<i>Santé, sécurité, environnement</i> / health, safety and environment (HSE)
SST:	<i>Solides en suspension totaux</i> / total suspended solids (TSS)
STI:	Sexually transmitted infections
TDR:	<i>Termes de référence</i> / terms of reference (TOR)
TDS:	Total dissolved solids
TOR:	Terms of reference
TPE:	<i>Très petite entreprise</i> / very small business
TPH:	Tonnes per hour

TSP:	Total suspended particulates
TSS:	Total suspended solids
UDHR:	Universal Declaration of Human Rights
UICN:	<u>Union internationale pour la conservation de la nature</u> / International Union for Conservation of Nature (IUCN)
UN:	United Nations
UNDP:	United Nations Development Program
UNECA:	United Nations Economic Commission for Africa
UNESCO:	United Nations Organization for Education, Science and Culture / Organisation des Nations unies pour l'éducation, la science et la culture
UNFCC:	United Nations Framework Convention on Climate Change
UniGE:	Université de Genève / University of Geneva
UTM:	Universal Transverse Mercator
VEC:	Valued ecosystem component
VIH:	<i>Virus de l'immunodéficience humaine</i> / human immunodeficiency virus (HIV)
WB:	World Bank / Banque Mondiale (BM)
WHO:	World Health Organization / Organisation mondiale de la Santé (OMS)
ZÉE:	<i>Zone économique exclusive de la Guinée</i> [Guinea economic exclusive zone]
ZICO:	<i>Zone importante pour la conservation des oiseaux</i> / important bird area (IBA)

1 INTRODUCTION

1.1 Background

Compagnie des Bauxites de Guinée (CBG) is a mining company owned jointly by the Government of Guinea (GoG) and Halco Mining (Alcoa, Rio Tinto Alcan and Dadco). CBG currently mines, transports by railroad, treats and ships about 13.5 million tonnes per annum (MTPA) of bauxite at 3% humidity (nominal capacity of the treatment plant) at facilities in Kamsar and Sangarédi in northwest Guinea. CBG has been in existence since 1963, and its facilities have been in operation since 1973. The company operates three sites:

- the Sangarédi mining area (plateaus of N'Dangara, Sangarédi, Boundou Wandé, Bidikoum, Parawi and Silidara);
- the railroad network; and
- the treatment plant at Kamsar (including the port).

CBG is considering increasing its bauxite production by 9 MTPA of shipped material to a production capacity of 22.5 MTPA (at 3% humidity) by the last trimester of 2017 with another increase of 5 MTPA, to a production capacity of 27.5 MTPA around 2022. An intermediate step is planned at 18.5 MTPA. The CBG Expansion Project (the Project) includes an increase in the rate of bauxite extraction, transport and treatment, and includes construction and modifications to CBG's infrastructure, equipment and operations.

In 2013, CBG mandated ÉEM to conduct an environmental and social impact assessment (ESIA) of the Expansion Project.

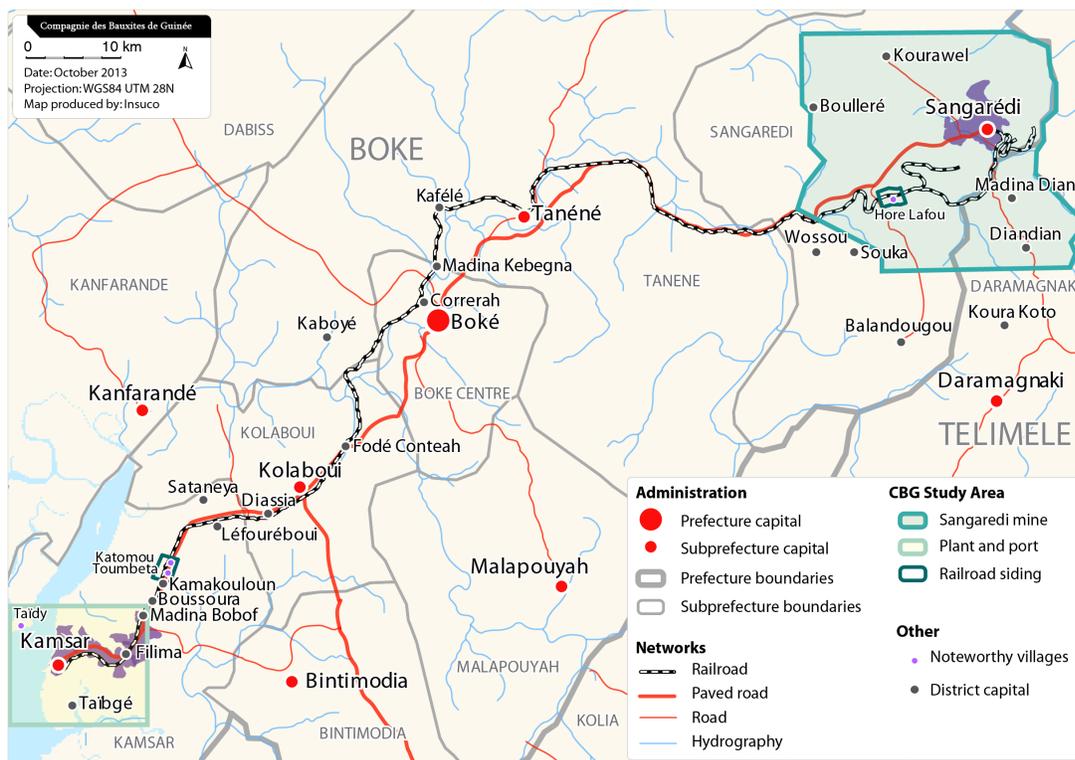
To conduct the Expansion Project ESIA and to participate as a consultant in the feasibility study, ÉEM assembled a group of experts specializing in environmental and social sciences and appropriate knowledge of the geographical area, as well as Guinea's government structure and environmental legal framework, to form an optimal team to carry out the studies.

This study was conducted according to legal and regulatory requirements at the national level as well as the performance standards of the International Finance Corporation (IFC). The terms of reference were approved by the Guinean Ministère de l'Environnement, des Eaux et Forêts on November 8, 2013, and the final scoping

report was submitted to the Bureau Guinéen d'Études et d'Évaluation Environnementale (BGÉÉE) on December 5, 2013.

The final French version of the ESIA was submitted to CBG on January 10, 2015. The BGÉÉE organized a meeting of interested agencies in Conakry on May 18, 2015 at the conclusion of which it was unanimously decided to accept the ESIA (with some points requiring clarification or elaboration, which are addressed in a separate document).

Map 1 Map of Expansion Project



1.2 Objectives of the Supplementary information package (SIP)

The concept of a SIP came about following review and commentary on the ESIA by the IFC and others from June to August of 2015 during the Environmental and

Social (E&S) Due Diligence of the Expansion Project. Essentially, the SIP aims to complete the ESIA by addressing information gaps and providing clarification on issues that were not understood by the audiences responsible for review and acceptance of the ESIA for financing approval. The ESIA, including its numerous Annexes, is a stand-alone series of documents that reflects information and analysis of environmental and social impacts arising from the CBG Expansion Project as they were understood in December of 2014, as well as commitments to mitigate these impacts by the CBG. The SIP serves to complement these analyses and commitments with responses to questions and additional information which have arisen since the ESIA's submission to the authorities. Readers must have both the ESIA and the SIP to fully grasp the state of knowledge of the Project's impacts.

The E&S Due Diligence reports, meetings and ongoing commentary since June 2015 have generated a series of short and medium term actions that are being tracked by the IFC and its consultants to ensure the adequacy of the additional information required for financial disclosure. The SIP includes most of the items required by the finance agencies, in addition to the ESIA, its Annexes and free-standing reports such as the Biodiversity Action Plan (BAP – under development) and the Resettlement and Compensation Action Plan (PARC –under development).

There are a number of additional data collection and analysis activities underway for which it was agreed that later release dates would be acceptable. These will be completed in the coming weeks and reporting on them will be the subject of updates to the present document.

1.3 Structure of the SIP

The SIP was agreed upon as a suitable structure for additional information and analyses with the IFC and its consultants, OPIC and others and the CBG in August of 2015. The structure reflects what are considered the top priority environmental and social topics in need of clarification or further data and analysis.

The SIP is divided into three main sections dealing with the physical environment, biodiversity and social aspects. Where there are associated large documents submitted as part of the SIP, these are included in appendices at the end of the report.

This is the third release of the SIP and contains the documents of the first SIP release on September 21, 2015, the second release on October 1, plus responses to

comments and questions made by reviewers in the interim. This release also contains English translations of documents which had been submitted in French in the first SIP, as well as new Appendices. Some of the new Appendices contain reports which had been issued as standalone documents, such as the Critical Habitat Assessment (CHA) and the Resettlement and Livelihoods Restoration Policy Framework.

1.4 Study Team

In order to produce the ESIA, ÉEM assembled a group of experts in the environmental and social spheres, with appropriate knowledge of Guinea's geography, government structure and environmental legal framework, to form an optimal team for the studies. Many of the same persons were retained to conduct the supplementary studies and or provide additional information.

The major persons involved in the production of this third release of the SIP are:

For CBG

- Mohamed Talhaoui, Director HSEC.
- Stéphane Dallaire, responsible for the *Hygiène, Sécurité, Environnement, Relations communautaires du Projet d'extension de la CBG*, principal client contact for the ÉEM study team (now retired from CBG)

For EEM

ÉEM had the overall responsibility for the studies, the reports and the management of the SIP.

- Eric Muller, in charge of the environmental studies for the ESIA and responsible for the overall production of the SIP.
- Paul MacLean, ESIA Project Director.
- Robert Cole, in charge of the social studies for the ESIA and RAP Project Director.
- Jean-Philippe Roux-Groleau, Manager of CBG projects,

- Andrew Sanford, in charge of producing the biodiversity maps.
- Juan Buzzetti, responsible for producing the biodiversity maps.
- Gail Amyot, input to the Water Management Framework

For ARCADIS

ARCADIS Canada inc. (formerly SENES Consulting Ltd.) had the specific responsibility of the questions relating to air quality, noise and vibrations, water and sediments.

- Jennifer Kirkaldy – responsible at ARCADIS for the Expansion Project.

Air Quality:

- Kim Theobald; and
- James Fletcher

Noise and vibrations:

- Nick Shinbin; and
- Paul Kirby

Water and sediments:

- Stacey Fernandes;
- Helen Manolopoulos; and
- Craig Kelly.

For Sylvatrop Consulting

Sylvatrop Consulting SARL supplied additional biodiversity and physical monitoring expertise.

- Sylvain Dufour – in overall charge of the Sylvatrop component.
- Michel Bureau – in charge of field programs in Guinea.
- Benoit Limoges – contributed to the Ecosystem Services Review.
- Nik Borrow – ornithology input.
- Nicolas Granier – primates input.

For TBC

The Biodiversity Consultancy produced a report on critical habitat assessment.

- Malcolm Starkey – project director
- Jan-Willem van Bochove – primary author
- Hugo Rainey – ornithology input

For WCF

The Wild Chimpanzee Foundation Guinée is doing field work and is producing a report on the chimpanzees in the concession.

- Virginie Vergnes
- Christophe Boesch

2 PHYSICAL ENVIRONMENT

2.1 Monitoring program

2.1.1 Status of the program

A revised and amplified physical monitoring program started in September 2015. As of September 8, a senior environmental specialist has been in Guinea to help initiate new aspects of the program and ensure the continuation of past sampling programs.

The following subsections describe the monitoring program.

2.1.2 Meteorology

Two meteorological stations (one for Kamsar and one for Sangaredi) will collect continuous weather data. Please refer to attached "*Ambient Air Quality and Noise Monitoring Plan*" prepared by ARCADIS Canada in September 2015 (Appendix 9.1).

2.1.3 Air quality

The air quality program employed for the ESIA will resume but with added stations to monitor areas of ecological sensitivity. In addition a fixed air quality monitoring station will be installed in Kamsar as recommended in the ESIA. Please refer to attached "*Ambient Air Quality and Noise Monitoring Plan*" prepared by ARCADIS Canada in September 2015 (Appendix 9.1).

2.1.4 Noise

The noise program employed for the ESIA will resume but with added stations to monitor areas of ecological sensitivity. Please refer to attached "*Ambient Air Quality*

and Noise Monitoring Plan” prepared by ARCADIS Canada in September 2015 (Appendix 9.1).

2.1.5 Surface water discharge

A new surface water discharge monitoring program is being implemented with the aim to monitor discharge rates at eight of the main watercourses in the Sangarédi study area. Please refer to attached *“Surface Water and Sediment Monitoring Plan”* prepared by ARCADIS Canada in September 2015 (Appendix 9.2).

2.1.6 Surface water quality

The surface water quality program employed for the ESIA will resume but with added stations to monitor areas of ecological sensitivity and areas adjacent to the Bendougou landfill. Please refer to attached *“Surface Water and Sediment Monitoring Plan”* prepared by ARCADIS Canada in September 2015 (Appendix 9.2).

2.1.7 Sediments

The sediment quality program employed for the ESIA will resume. Please refer to attached *“Surface Water and Sediment Monitoring Plan”* prepared by ARCADIS Canada in September 2015 (Appendix 9.2).

2.1.8 Dredging

CBG has proposed a sampling program for sediments in the dredging area (expanded turning basin adjacent to the quay) and the proposed deposition area (at sea at the mouth of the estuary in an area authorized by the Government of Guinea and where prior deposition from maintenance of the access channel has taken place): CBG, July 2015, *Summary dredging and sediment disposal plan*. This report has been included as Appendix 9.3.

In addition to the 12 sediment samples from the dredging area mentioned in the report, 10 sediment samples will also be taken from the proposed deposition area.

The collection of samples and the analyses will follow the protocols established in the ESIA and follow the recommendations of the *Revised OSPAR Guidelines for the Management of Dredged Material* and the *OSPAR Convention for the protection of the marine environment of the North-east Atlantic*.

Analyses will include:

Physical parameters:

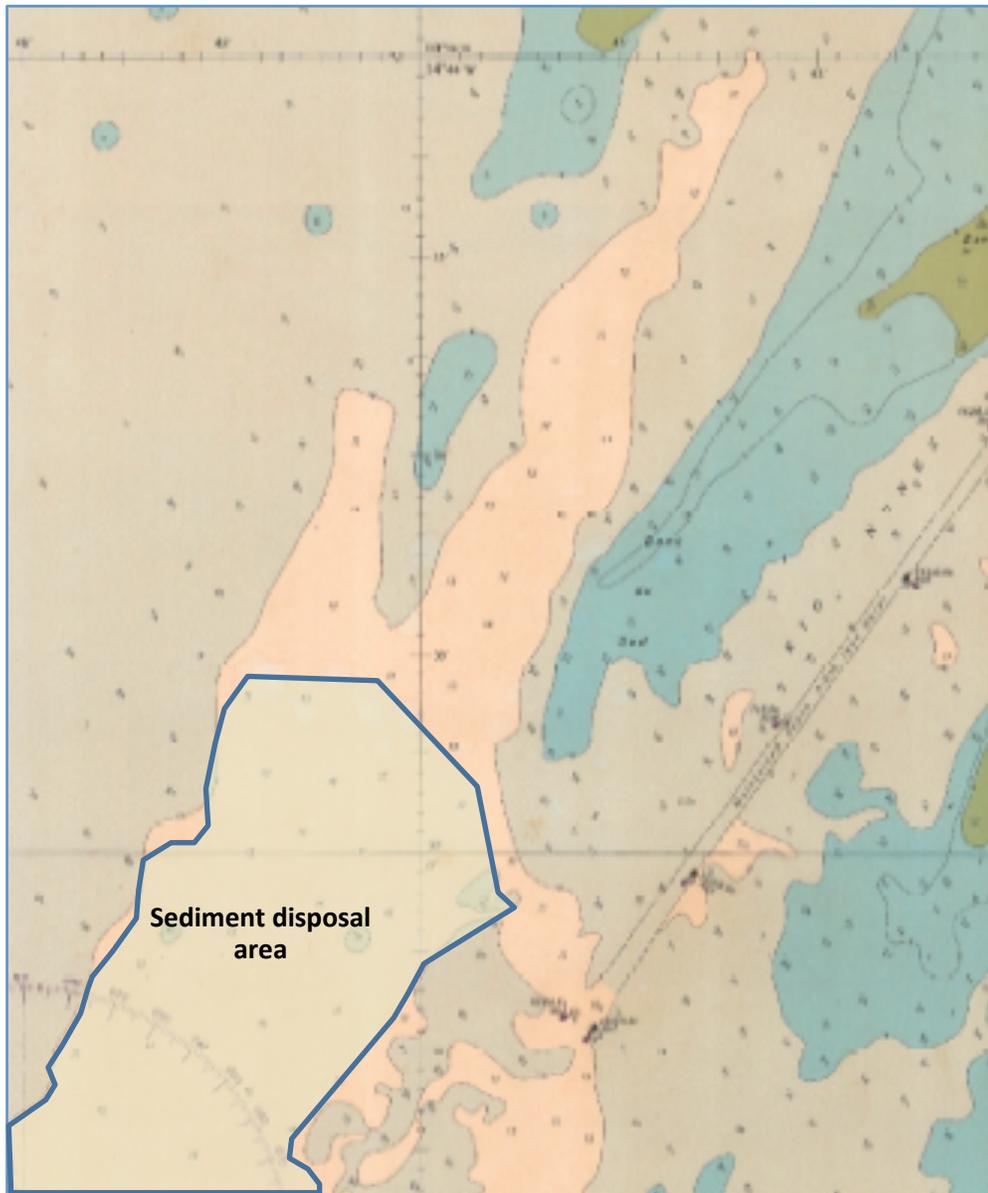
- Grain size analysis
- Percent solids (Dry matter)
- Density
- Organic matter

Chemical parameters :

- Metals: Cd, Cu, Hg, Zn, Al, Cr, Pb, Ni
- Arsenic
- Petroleum Hydrocarbons

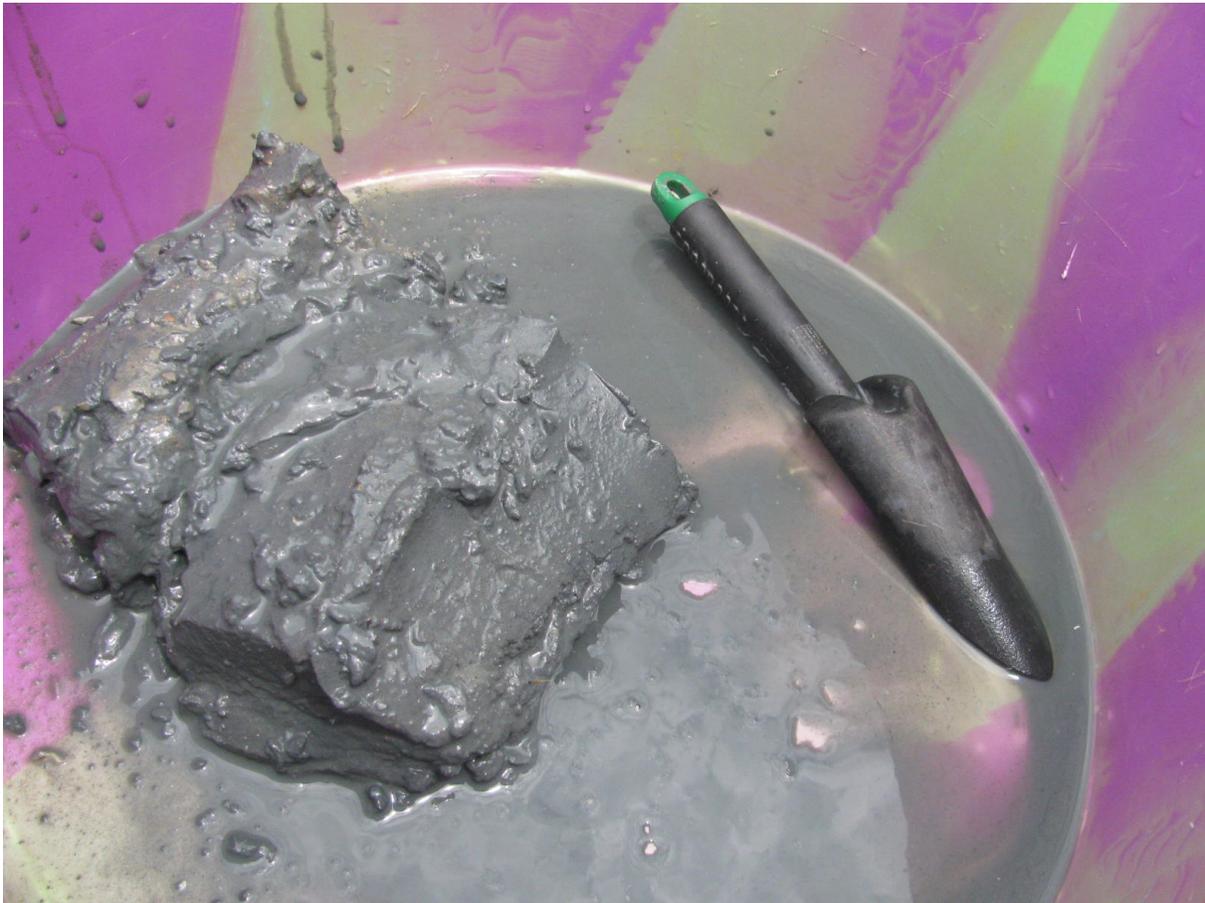
The sampling areas are shown in Maps 2 and 3.

Map 3 Dredge material deposition area



The results of the sampling campaign will be summarized in a report to be produced soon after the completion of the laboratory analyses.

Photo 1 Example of sediment sample from the on-going dredging survey



2.1.9 Groundwater

A groundwater quality and level monitoring program is being implemented with wells around areas to be mined (24), in reference areas (2), around the Kamsar and Sangaredi landfills (13) and 8 around the plant in Kamsar. Please refer to attached "*Proposed Monitoring Well Network and Monitoring Plan – CGB Guinea 2015 to*

2019, Sangaredi and Kamsar Landfills” prepared by ARCADIS Canada in September 2015 (Appendix 9.4).

2.2 Responses to air quality questions

A series of questions and comments related to the air quality impact assessment were outlined in the interim due diligence report prepared by Ramboll Environ (Ramboll), dated May 2015. Additional comments and questions were also received during the workshops held on August 11th and 12th, 2015. This section summarizes the questions/comments received and provides a response to each. The comments are grouped into common themes: baseline monitoring; significance determination; mitigation; and additional information.

2.2.1 Baseline Monitoring

1. **Question/Comment:** Baseline monitoring was not long enough. At least 3 months of data is needed to adequately represent baseline conditions.

Response: During the preparation of the ESIA, monitoring was limited due to security concerns, as well as accessibility issues for some of the more remote sites. Also, later in the season, field staff could no longer safely conduct sampling due to concerns in the area with the Ebola virus. To address the lack of monitoring data, CBG has committed to completing additional air quality and meteorological monitoring (see Section 2.1.2).

2. **Question/Comment:** No textual description of the monitoring sites was included to support that they are influenced by other sources.

Response: During the preparation of the ESIA, a request for this information was put in by ARCADIS to CBG who provided some description and a selection of photographs of the monitoring locations. Where possible, ARCADIS used this information in the interpretation of the monitoring results. It was noted by CBG field staff that the stations in Kamsar (AQ-1 and AQ-2) were located within approximately 20 m of a road. No specific comments regarding other sources of

air contaminants were identified for Sangaredi (AQ-10, AQ-11, AQ-12 and AQ-13). The photographs of the stations are provided below.

3. **Question/Comment:** Baseline monitoring was not long enough. At least 3 months of data is needed to adequately represent baseline conditions.

Response: During the preparation of the ESIA, monitoring was limited due to security concerns, as well as accessibility issues for some of the more remote sites. Also, later in the season, field staff could no longer safely conduct sampling due to concerns in the area with the Ebola virus. To address the lack of monitoring data, CBG has committed to completing additional air quality and meteorological monitoring (see Section 2.1.2).

4. **Question/Comment:** No textual description of the monitoring sites was included to support that they are influenced by other sources.

Response: During the preparation of the ESIA, a request for this information was put in by ARCADIS to CBG who provided some description and a selection of photographs of the monitoring locations. Where possible, ARCADIS used this information in the interpretation of the monitoring results. It was noted by CBG field staff that the stations in Kamsar (AQ-1 and AQ-2) were located within approximately 20 m of a road. No specific comments regarding other sources of air contaminants were identified for Sangaredi (AQ-10, AQ-11, AQ-12 and AQ-13). The photographs of the stations are provided below.

Photo 2 AQ-1 Alcoa station



Photo 3 AQ-2 Ecole



Photo 4 AQ-10 Kourawel looking north



Photo 5 AQ-11 Kourawel looking northeast



Photo 6 AQ-12 Petoun Boundou Wadé



Photo 7 AQ-13 Paravi



5. **Question/Comment:** It is unclear as to whether background concentrations were added to model predictions. It is surprising that the monitoring data from ALCOA was not used as background concentrations in Kamsar.

Response: As described in Section 3.3.5 of the Air Quality Technical Report, baseline or background concentrations were not added to model predicted concentrations.

Since the Kamsar air quality model predictions were in quite good agreement with the maximum baseline concentrations, it suggests that the processing facility is the primary source of fine particulate at AQ-1 and AQ-2. However, it is likely that other local sources of particulate are contributing to the baseline totals and only a portion of the measurements can be attributed to emissions from the Kamsar processing facility. Therefore, the model predictions for the facility are likely overestimated and can be considered to represent both emissions from the Kamsar facility and from local (i.e., background) sources at locations in close proximity to the Kamsar facility. Further afield from the Kamsar facility, other sources such as local traffic, and other industry as well as local fuel combustion may dominate concentrations. However, due to the limited number of measurements collected, the assessment did not attempt to quantify the contribution from these other local sources.

The data from AQ-1 (Alcoa) and AQ-2 (Ecole) collected for the CBG Project in 2014, are both located in close proximity to the CBG processing facility and are considered to be very influenced by CBG operations. Consequently, the data from these stations would not be considered representative of background conditions in the Kamsar area. Data collected by AECOM in 2011 (AA1 – North Kamsar), though further afield from the facility, is a very limited data set (2 measurements). Because the quality and validity of the data could not be determined, and the limited data set, no attempt was made to include the AECOM measurements as background concentrations.

6. **Question/Comment:** Background annual average concentrations appear to be very low in Sangarédi (e.g., at AQ-10).

Response: As previously mentioned, background concentrations were not added to model predicted concentrations in Kamsar or Sangarédi. The average annual baseline concentrations presented in Table 3.10 of the Air Quality Technical Report only include the contribution of mining activities. Therefore, at receptor

locations like AQ-10 (which is currently far removed from the mine), predicted concentrations are relatively low compared to the monitoring data. However, it is important to note that monitoring occurred over a very limited period and during the dry season, therefore, particulate measurements are likely higher than average annual conditions.

In Sangarédi, when mining activities are occurring in close proximity to a village, the modelling approach used (see Section 6.2.2.4 of the Air Quality Technical Report) is considered conservative enough such that model predicted concentrations capture both the contribution from mining activities as well as local sources. Since short-term model predictions were based on a generic model using the shortest distance between a village and extraction area/road (regardless of the operating scenario), the model results can be considered representative of worst-case 1-hour or 24-hour concentrations, including background.

Unlike short-term predictions, annual particulate concentrations were based on actual planned extraction as shown in Figure 3 of the Air Quality Technical Report. In other words, a consecutive progression through the mining plan was assumed for the annual assessment scenarios. In a given scenario, for villages close to extraction areas or roads, it is likely that the model predicted annual concentrations are conservative enough that they can be considered to include background.

For villages located far from a modelled extraction area or road (e.g., Kourawel in the 18.5 MTPA and 22.5 MTPA scenarios), it is likely that the annual particulate concentrations presented in our reports are underestimated since they do not include any additional background. That being said, ARCADIS is reluctant to add in a constant background concentration to the annual modelling results since it is known that the monitoring data is influenced by local sources, and was collected during the dry season only. As a result, the measured particulate data that was available during the preparation of the ESIA is likely biased high and would likely grossly overestimate annual concentrations in the unpopulated areas of the modelling domain.

- 7. Question/Comment:** No comparison was made between WRF-NMM wind data to local meteorological stations.

Response: Local meteorological data was very limited and the closest station with the most complete record is Conakry Airport, located approximately 160 km south of Kamsar. As a result, it was not considered suitable for comparison to WRF-NMM. A previous modelling assessment completed by AECOM in 2011, used a different meteorological model (MM5) which produced similar results in Kamsar. The wind rose from the AECOM report is provided below and compared to the wind rose presented in the Air Quality Technical Report.

Figure 1 Wind Rose from ANNEXES FEL-3 ESIA Oct 2011.pdf (AECOM 2011)

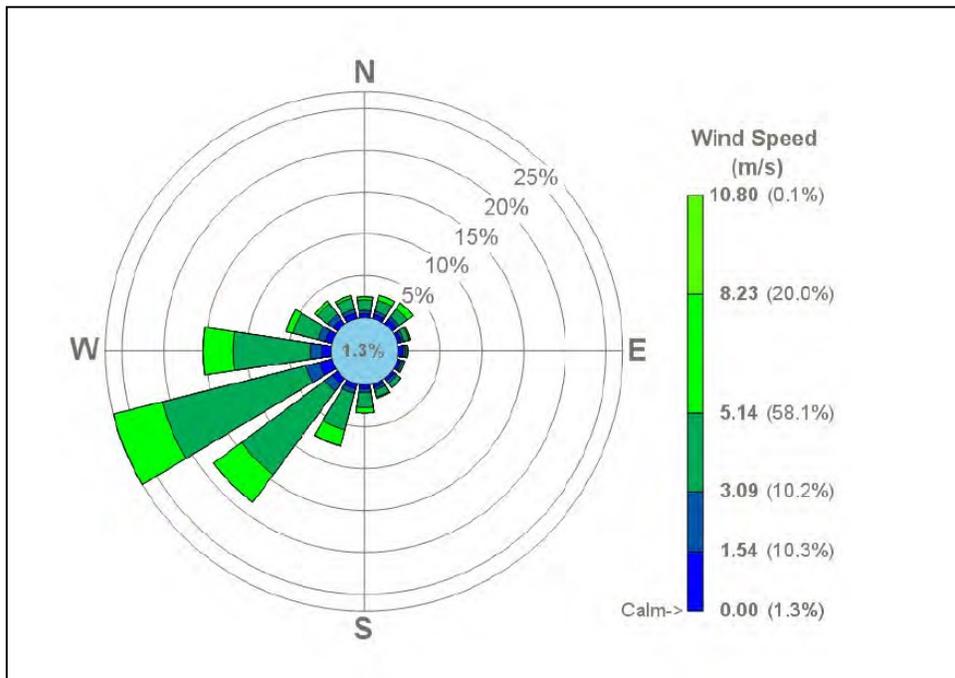
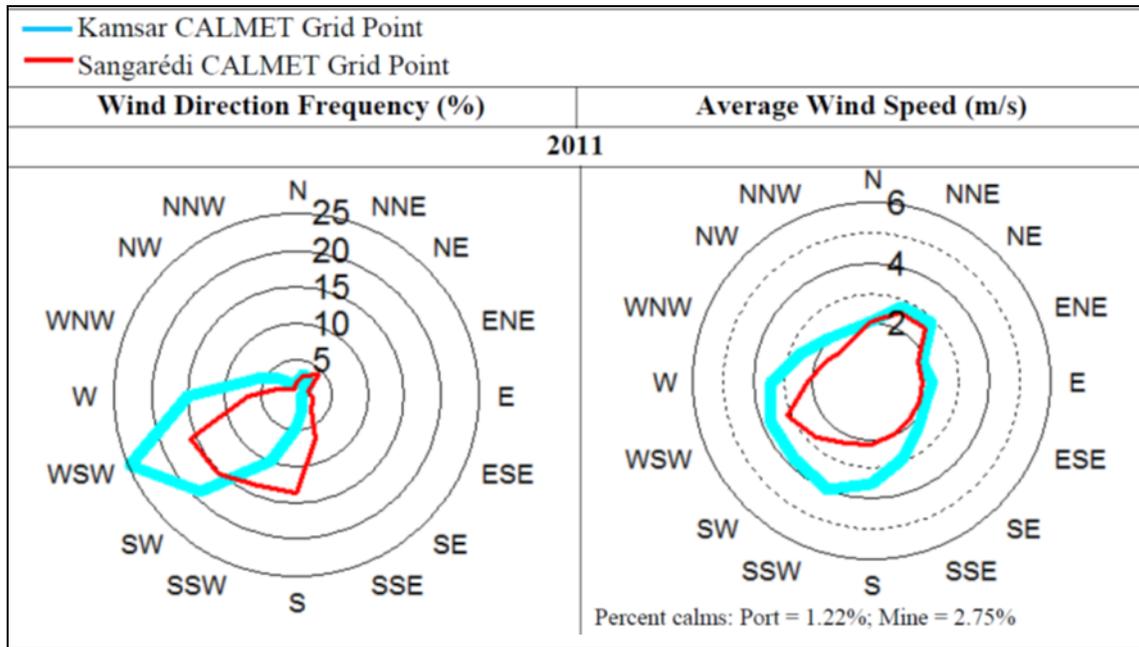


Figure 2 Wind Rose from the CBG Expansion Project Air Quality Technical Report



2.2.2 Mitigation

8. **Question/Comment:** Mitigation measures outlined in the air quality impact assessment are non-committal and there was no consideration of post-mitigation impacts. Only generic mitigation has been considered within the prediction of emissions.

Response: The wording in Chapter 2 of the ESIA is quite specific:

“In order to reduce off site concentrations of particulate matter and gaseous COPCs in the future, the following measures **will be applied**:

- implement planned dust management systems during material processing;
- reduce or eliminate the use of Bunker C fuel in favor of diesel; and
- ensure dryer scrubbers are in good working order.

....

In order to reduce off site concentrations of PM₁₀, PM_{2.5} and NO₂ from haul roads and blasting activities in the future, the following measures **will be applied**:

- commit to achieve at least 80% control of road dust via watering, or through the application of a chemical dust suppressant (e.g., calcium chloride);

etc.....”

Post-mitigation impacts are understood to mean the same thing as “residual impacts” (i.e., impacts after mitigation has been applied). Since mitigation was considered within the air quality assessment (e.g., dust suppression on haul roads, limiting vehicle speeds, re-vegetation of exposed soils), “post-mitigation” or residual impacts have already been assessed.

9. **Question/Comment:** The separation distances outlined in the air quality report were not taken into account within the ESMP.

Response: The ESMP identifies villages where the 2014 SENES reports indicated that air quality guidelines would be exceeded based on modeling. The ESMP commits to meeting guidelines: “During the detailed engineering and construction phases, engineering controls for atmospheric emissions as identified in the deliverables from the feasibility study will be developed and implemented in order to meet the first intermediate targets or IFC guidelines.” The ESMP stresses increased baseline monitoring, refinement of modeling with better baseline and mitigation measures to meet the guidelines.

2.2.3 The plume from the stack

A question was asked about the red plume often seen on older photographs of the stack at Kamsar (Photo 8). This is in contrast to the lighter colored plume typically seen now (Photo 9).

Photo 8 Plume from stack in older pictures



Photo 9 Recent photograph of plume



CBG attributes this change from the installation of scrubbers on the ore dryers in 2005, under the management of Hatch Associates, Pittsburg USA. For the bauxite ore to be shippable, its moisture content must be reduced to 6.7% through a drying process. The effluent from the wet scrubbers is currently being discharged into a settling pond. The solids at the bottom of the pond (mainly bauxite) are removed, dried and returned to the process as raw material. Based on the current sludge production rate, the quantity of sludge produced by the wet scrubbers after the Expansion Project will be about 68,000 tonnes a year, leading to retaining the equivalent of an ore ship worth of bauxite a year. The efficiency of the scrubber system is dependent on ensuring that the scrubbers are well-maintained.

2.2.4 Additional Information

1. **Question/Comment:** Provide more information on assumptions used in the blasting assessment.

Response: Section 5.1.5 in the Air Quality Technical Report, and Table B.10 in Attachment B of the same report outline the assumptions used to estimate emissions from blasting which are reproduced in Table 1 below. Note that as a conservative measure, the frequency of blasting was assumed to be the same for each of the annual production levels. Consequently, the size of the blast increased relative to the increase in production. Also, since a blast will occur 6 days per week on average, it was assumed that one blast occurred per day to capture the worst-case day and hour. This was the best information available at the time the assessment was undertaken.

It was also conservatively assumed that that total annual amount of material extracted would be blasted (i.e., only explosives would be used for extraction, and no other equipment). In addition, it was assumed that 100% ANFO is the explosive used. Therefore, NO_x emissions were based on the emission factor for ANFO explosives from US EPA AP-42 Chapter 13.1 - Explosives Detonation, Table 13.1-1. The emission factor is 8 kg of NO_x per tonne of ANFO explosive.

Table 1 Assumptions Used in the Original Blasting Assessment

	Units	Existing	18.5 MTPA	22.5 MTPA	27.5 MTPA	Comments
Drilling & Blasting						
Average size of blast	tonnes of ore per blast	48,609	67,136	81,637	99,804	Based on total annual production.
Average horizontal blast area	m ² per blast	4,340	5,994	7,289	8,911	Assumes:
Blasts per day	# per day	1	1	1	1	<ul style="list-style-type: none"> ▪ 6.11 blasts per week (from AECOM 2011, Annex F) ▪ material density of 1.4 tonnes/m³ (from Fluor 2014) ▪ ore depth of 8 m ▪ hole spacing of 5 m
Quantity of ANFO	tonnes per blast	9	12	15	18	

Following the August workshops, the above approach was discussed further with CBG mining staff and was determined to be overly conservative. As a result, the assumptions were refined and the blasting assessment was revised. The revised blasting assessment is discussed below in Section 2.3.

2. **Question/Comment:** Provide graphics of deposition. Was deposition to vegetation species considered?

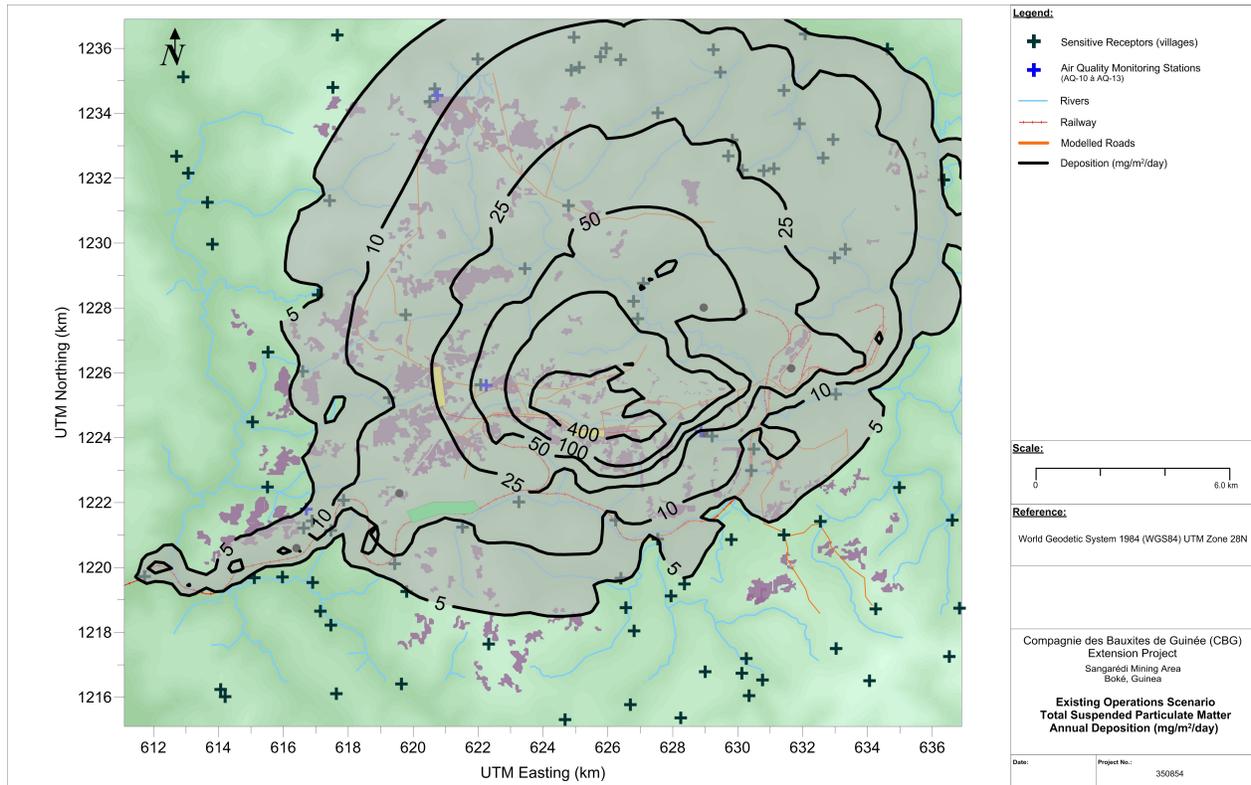
Response: Tabular results of deposition were outlined in Attachment D of the Air Quality Technical Report. As stated in Attachment D, deposition results were not presented in the air quality reports, but rather provided to and discussed within the water and terrestrial impact assessments.

Due to the modeling approach used, the CALPUFF model was configured to not consider dry or wet deposition. Rather, a deposition rate of 3 cm/s was applied to resulting annual TSP concentrations in order to predict an average annual deposition rate. This is also outlined in Attachment D of the Air Quality Technical Report.

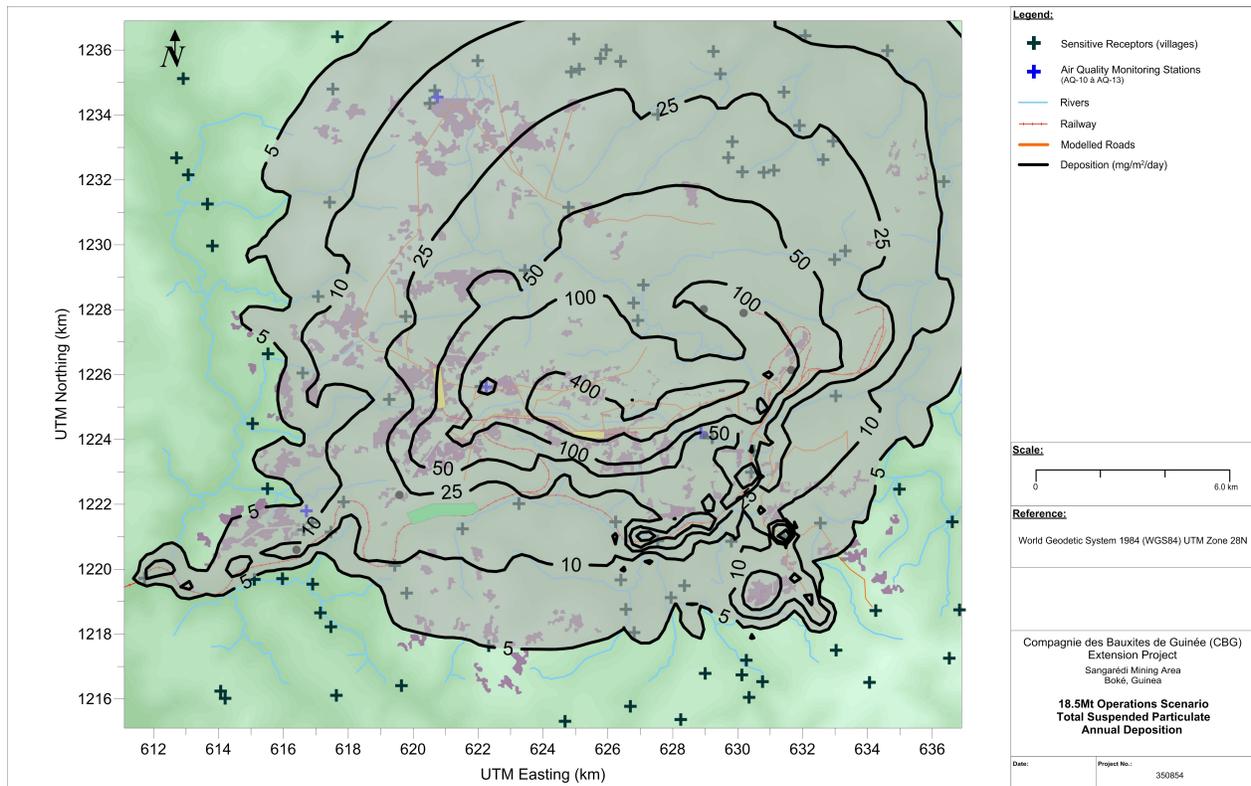
Deposition contours of total TSP for each production scenario for Sangarédi are provided below. In addition deposition maps overlaid on vegetation types and

using deposition rates isopleths related to vegetation impacts are presented in Section 3.2.

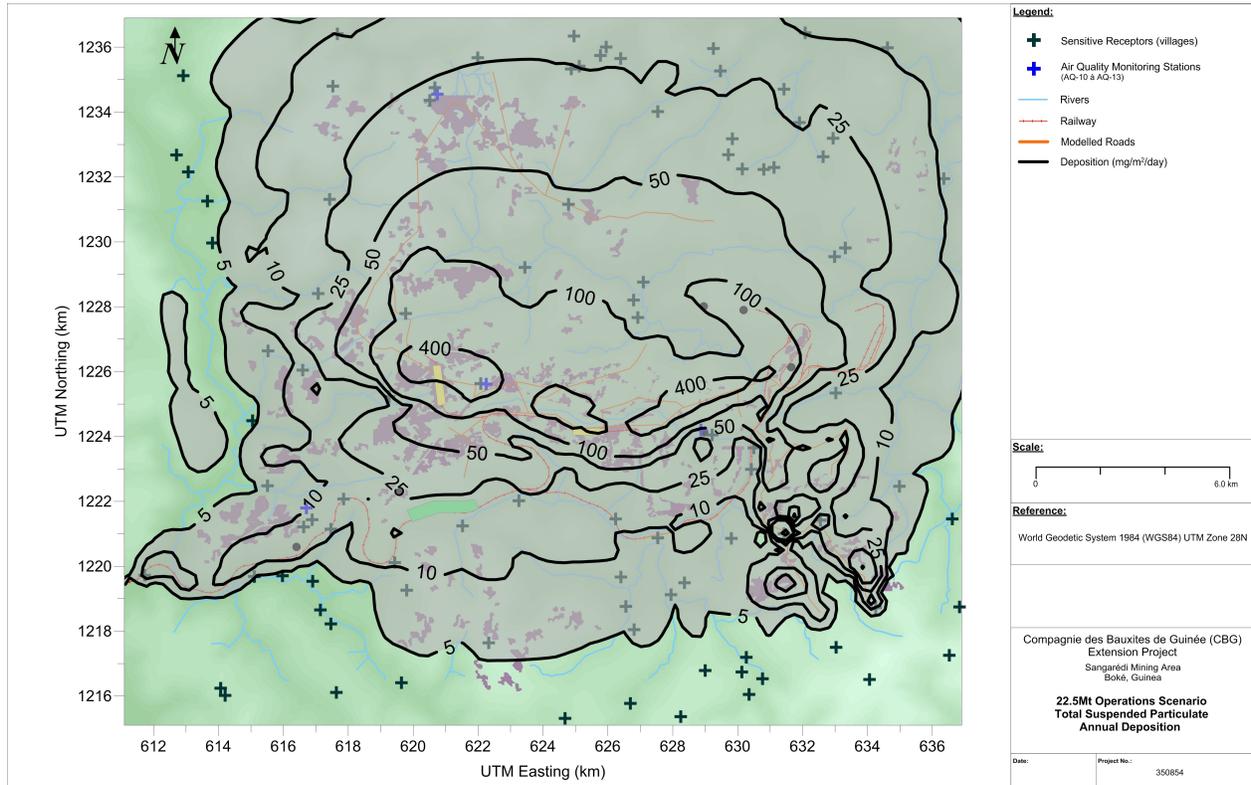
Map 4 Existing operations TSP annual deposition



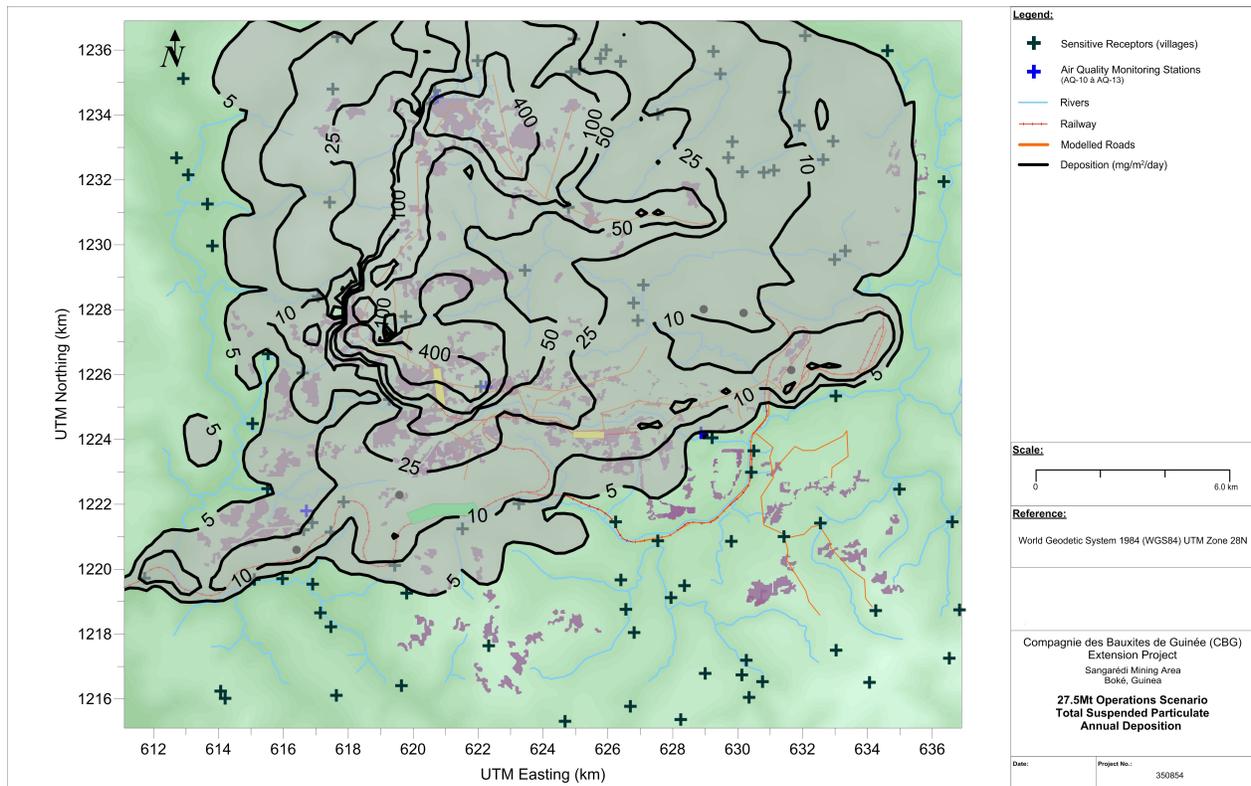
Map 5 18.5 MTPA TSP annual deposition



Map 6 22.5 MTPA TSP annual deposition



Map 7 27.5 MTPA TSP annual deposition



2.3 Additional air quality modelling

2.3.1 Baseline Conditions

As outlined above, CBG has committed to completing additional baseline air quality monitoring. Once a sufficient amount of additional data has been collected (i.e., greater than 3 months), the results of the baseline/existing conditions modelling assessments for Kamsar and Sangarédi will be re-evaluated. With the assistance of additional air quality and meteorological monitoring data, a background concentration may also be established which can be added to model predictions in Kamsar and Sangarédi.

2.3.2 Revised Blasting Assessment

As previously discussed, the assumptions used to complete the blasting assessment were re-visited following the IFC workshops. The blast size, type of explosive and the explosive powder factor were updated based on information provided by CBG mining staff. The frequency of blasting was kept at one blast per day as per the original assessment.

According to CBG mining staff, a typical blast size is 16,646 m³ (or 23,050 tonnes based on a density of 1.4 tonnes/m³), which is about 2 to 4 times the blast size used in the original assessment, depending on the scenario considered (see Section 2.2). The powder factor provided by CBG mining staff (600 g/m³) is about twice the powder factor used in the original assessment (250 g/m³). Therefore, the amount of explosive used per blast is typically around 10 tonnes. This is similar to the amount originally assumed for baseline or existing conditions (9 tonnes). However, the type of explosive used is actually heavy ANFO, which is an ANFO emulsion blend. 100% ANFO was assumed in the original assessment.

Even though the amount of explosive remains relatively unchanged from the original assessment, the emissions were revised using a more appropriate emission factor to reflect the use of heavy ANFO, instead of 100% ANFO. According to the Australia NPI Emissions Estimation Technique Manual for Explosives Detonation and Firing Ranges (Australian Government. 2012. National Pollutant Inventory Emissions Estimation Technique Manual for Explosives Detonation and Firing Ranges, Version 3.0. Department of Sustainability, Environment, Water, Population and Communities. January), 2 kg of NO_x is emitted per tonne of heavy ANFO. This is 4 times lower than the emission factor used in the original assessment.

As discussed in Section 6.2.2.4 of the Air Quality Technical Report, the impact of blasting on short-term NO₂ concentrations was assessed using a separate generic model run which used a volume source to parameterize the initial dimensions of a blast. The horizontal dimension of a blast was revised from 70 m down to 45 m wide to reflect the reduction in blast size. The blast was assumed to be 20 m tall, with a release height of 10 m. Since the emissions from a blast are relatively instantaneous, CALPUFF was run used a 10-minute calculation time step, rather than a 1-hour time step in order to simulate such an event. In other words, for each blast it was assumed that all of the explosive was detonated within 10 minutes, and that only one blast occurs per hour at a particular location. Therefore, the revised emission rate of NO_x per blast is as follows:

$$\begin{aligned}\text{NOx (g/s)} &= 2 \text{ kg NOx/tonne heavy ANFO} \times 10 \text{ tonnes heavy ANFO per blast} \times 1000 \text{ g/kg} \div 600 \text{ s/blast} \\ &= 33 \text{ g/s of NOx per blast}\end{aligned}$$

Recall that as a conservative measure, the frequency of blasting was assumed to be the same for each of the annual production levels. Consequently, the size of the blast increased relative to the increase in production. However, in this revised assessment, the size of the blast was assumed to be the same regardless of the production scenario. Therefore, the emission rate of 33 g/s was applied to each scenario.

The model was run using a unit emission rate of 1 g/s in order to develop a unit concentration curve in the direction of maximum predicted incremental concentration (i.e., the change in concentration with distance). The unit concentration curve was then scaled using the NOx emission rate from blasting. The resulting concentration curve is provided in Figure 3 that shows that concentrations decrease exponentially with distance from a source(s) according to the following relationship:

$$C(x) = C_0 * e^{-a * x}$$

Where:

$C(x)$ = Total concentration at distance x

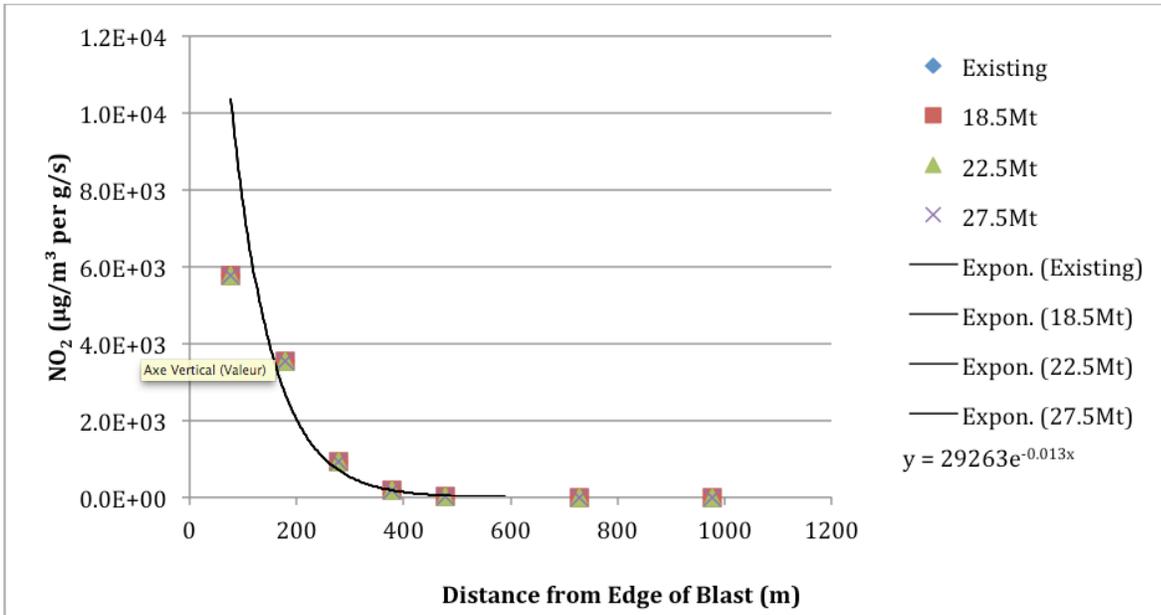
x = distance in metres

C_0 = constant

$-a$ = constant

See section 6.2.2.4 of the Air Quality Technical Report for additional detail on the blasting assessment methodology.

Figure 3 Change in Concentration of NO₂ with Distance from Edge of a Blast



The revised mathematical relationship for the blasting assessment is: $C(x) = 29,263 \times e^{-0.013x}$.

Therefore, in order to meet the 1-hour WHO Guideline for NO₂ of 200 µg/m³, a set-back distance of 370 m is required for a blast that is 16,646 m³ in size. A comparison to the set-back distances calculated in the original assessment is outlined in Table 2 below.

Table 2 Comparison of Blasting Set-Back Distances

Assessment	Criteria	Value	Existing	18.5Mt	22.5Mt	27.5Mt
Original	1-hour NO ₂ WHO Guideline	200	525	555	575	595
Revised			370	370	370	370

As shown in Table 2 above, the revisions to the blasting assessment have reduced the set-back distance from a blast by about 150 to 200 m, depending on the assessment scenario. As previously mentioned, the set-back distance is the same

for each production scenario assuming that the blast size remains the same regardless of the annual production rate.

Using the revised concentration curve, 1-hour NO₂ concentrations for each village location were re-calculated based on the minimum separation distance between a village and a working area. Table 3 presents the maximum predicted 1-hour NO₂ concentrations resulting from blasting for those villages where an exceedance is predicted (i.e., villages less than 370 m from a working area). As mentioned above, the concentrations presented in the table are independent of the production scenario since the blast size has been assumed to be the same amongst the scenarios.

Table 3 Revised 1-hour NO₂ Concentrations at Villages Exceeding WHO Guidelines

ID	Description	UTM Easting (km)	UTM Northing (km)	Distance to Nearest Working Area (m)	1h NO ₂ (µg/m ³)
SR7	Daara	617.521	1234.795	298	621
SR9	Kourawel	620.668	1234.753	232	1,287
SR10	Sintiourou Kourawel	620.513	1234.36	100	5,498
SR14	Gueguere	616.594	1226.045	246	1,100
SR16	Parawi	615.513	1222.477	303	591
SR17	Fassely Fouta Be	619.263	1225.23	204	1,754
SR21	Kankalare	616.622	1221.213	191	2,018
SR22	Kankalare Hacoude	616.889	1221.438	353	341
SR35	Kagneka	622.325	1217.638	172	2,483
SR46	Hamdalaye	622.082	1225.627	185	2,157
SR50	Boundou Wandé	629.21	1224.05	336	410
SR57	Daroul	630.497	1223.646	286	712
SR58	Pora PK130	630.42	1222.985	302	597
SR76	Parawol Aliou	624.789	1231.158	183	2,195
SR77	Paragogo	623.443	1229.209	374	270
WHO Guideline					200

2.3.3 Additional Sensitive Receptors

In addition to the village locations already included in the air quality impact assessment, three additional sensitive locations have been assessed for the 18.5 MTPA scenario as part of this supplement. The additional locations assessed include three potential resettlement areas that are shown in Map 8. Only short-term air quality effects have been assessed as they represent the worst-case possible impacts.

Map 8 Location of potential resettlement locations

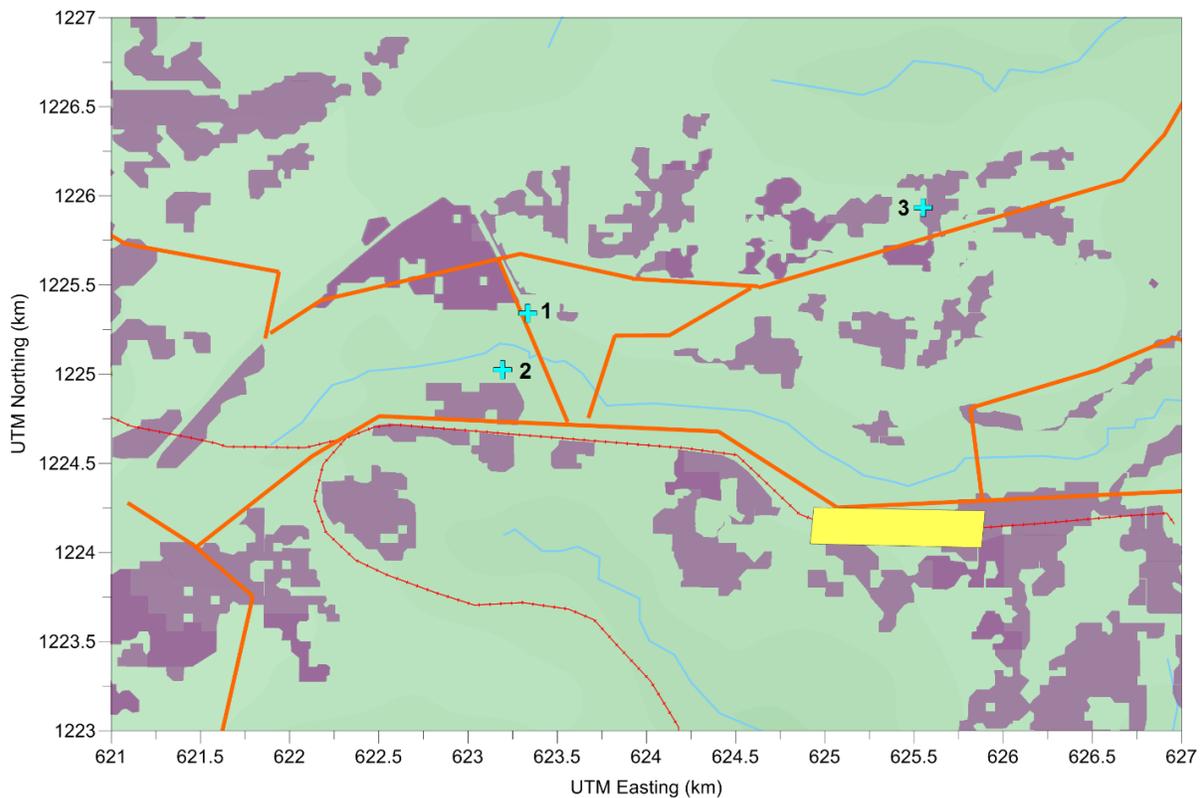


Table 4 Characteristics of potential resettlement locations

Relocation Area	UTM Coordinates (WGS84, zone 28P)		Distance to Nearest Haul Road (m)	Distance to Nearest Working Area (m)
	Easting	Northing		
1	623334	1225341	200 (assuming it gets changed a bit)	100 (minimum legal)
2	623195	1225024	210	100 minimum legal)
3	625552	1225933	165 to main road but haul road would be over 1 km	Village would be moved here after local bauxite areas mined - thereafter over 1 km.

As discussed in Section 6.2.2.4 of the Air Quality Technical Report, annual and short-term impacts were assessed differently due to the spatial extent of mining operations. Since the spatial extent of the mining plan was so large, it was not possible to complete a separate model run for each individual mining area in order to assess nearby short-term effects. Instead, a generic modeling approach similar to the blasting assessment was used to represent typical daily mining activities occurring within an extraction area of 200 m by 200 m. In addition, the effects of an unpaved haul road were also evaluated using a generic road stretching 2 km on either side of the mining area, which was modeled concurrently with extraction activities.

Like the blasting assessment, unit concentration curves were developed for each COPC. Using the mathematical relationships developed from the concentration curves, values of short-term COPC concentrations were calculated for each resettlement location based on the separation distance between the village and the nearest extraction area or road (whichever distance was smaller). Details of the modeling approach are outlined in Section 6.2.2.4 and Attachment D of the Air Quality Technical Report.

The predicted short-term concentrations of COPCs are provided in Table 5 below. Note that the 1-hour concentration of NO₂ is based on the revised blasting assessment outlined in Section 2.2.2 above. The bold values are those that exceed the WHO Interim Target 1 at least 1 time in the 5-year modeling period.

Table 5 Predicted COPC Concentrations at the Potential Resettlement Locations

Receptor	UTM Easting (m)	UTM Northing (m)	Distance to Nearest Haul Road (m)	Distance to Nearest Extraction Area (m)	Maximum Model Predicted Concentration ($\mu\text{g}/\text{m}^3$)				
					99 th 24h PM_{10}	99 th 24h $\text{PM}_{2.5}$	1h NO_2	10 min SO_2	24h SO_2
Resettlement location #1	623334	1225341	200	100	260	24.8	7,594	12.3	1.3
Resettlement location #2	623195	1225024	210	100	260	24.8	7,594	12.3	1.3
Resettlement location #3	625552	1225933	1000	1000	0.19	0.02	0.38	0.34	0.006
WHO Interim Target 1					150	75	-	-	-
WHO Interim Target 2					100	50	-	-	-
WHO Interim Target 3					75	37.5	-	-	-
WHO Guideline					50	25	200	500	20

As can be seen in Table 5, the 24-hour WHO Interim Target 1 criterion for PM_{10} and the 1-hour WHO Guideline for NO_2 are exceeded at locations #1 and #2 due to their close proximity to a mine haul road and extraction area, respectively. As outlined in Table 7.11 of the Air Quality Technical Report, a set-back distance of 170 m from a haul road is required for a production rate of 18.5 MTPA. As mentioned above in Section 2.2.2, a set-back distance of 370 m from a blast is required to meet the 1-hour NO_2 WHO Guideline. As a result, consideration should be given to locating settlements #1 and #2 at least as far away as the set-back distances noted here. If this distance is not achievable, additional control will be needed on nearby roadways, and no more than 300 kg of explosive can be detonated within one hour. Based on a powder factor of $0.6 \text{ kg}/\text{m}^3$, this equates to a blast size of about 500 m^3 if a village is located within 100 m of a blast.

There are no exceedances of any criteria at resettlement location #3.

2.4 Responses to noise and vibrations questions

Comments related to the noise and vibration impact assessment were outlined in the interim due diligence report prepared by Ramboll Environ (Ramboll), dated May 2015. One comment was provided related to noise that is summarized below, along with a response to the comment.

Question/Comment: Section 7.2.3 of the due diligence report states that “Further opinion on the suitability of these categorisations will be provided in the due diligence report, particularly as the ESIA reports existing exceedances. Of note, Ramboll Environ would question the ‘low magnitude’ categorisation for a 3–5 dBA increase.”

Response: For Environmental Assessments in North America, it is common practice to apply a magnitude rating of “low” to sound levels between 3 and 5 dBA. A change in sound level of 3 dB or less is imperceptible to the human ear, and therefore would be considered to have no impact, while a change of 5 dBA is considered noticeable but typically not a magnitude that would be overtly objectionable. In ISO 1996, a change in sound level of 5 dBA is identified as being associated with low community response (sporadic complaints).

2.5 Additional noise modelling

2.5.1 Summary of Previous Modelling

The Noise and Vibration Impact Assessment was submitted to the Government of Guinea in January 2015 as part of the ESIA. As outlined in Section 1.1 and Section 2.3 of the assessment report, the assessment considered four annual production levels, including an assessment of the increase in production to 18.5 million tonnes per annum (MTPA) by 2019.

CBG’s extraction operations in the Sangarédi mine region are increased, capacity at the CBG Kamsar port facility will increase and each step up in annual production will be accompanied by infrastructure improvements and additions at the Kamsar

processing facility. As discussed in Section 4.2 of the assessment, CBG's activities in the Sangarédi mining region are geographically distributed and consists of many small deposits of varying grade that are spread throughout an area of approximately 400 km², with over 100 separate villages distributed throughout at varying distances from the proposed extraction locations.

As described in Section 2.6 of the assessment, noise and vibration impacts associated with mining activities in Sangarédi were considered for all the production levels for two types of operations:

- Blasting, where raw material at the mine sites is loosened for extraction through the use of heavy ANFO-based explosives; and
- Mechanical extraction, where the loosened material is removed mechanically by front-end loaders and bulldozers before being loaded on haul trucks that transport the material to the train loading area.

Given the spatial extent of the areas proposed for mining activities, the distribution of villages throughout this area, the uncertainty with regard to the amount of equipment that deployed at each deposit at a given time and the amount of explosive (i.e., charge mass per delay) used in the blasting operations, it was not possible to complete a detailed predictive model for each village and mining scenario. Instead, the following modelling approaches were selected:

- The modelled blasting scenario considered the largest allowable charge mass per delay that would result in compliance with the criteria; and
- The modelled mechanical extraction activities considered typical clusters of equipment (i.e., two (2) front-end loaders; one (1) bulldozer; two (2) haul trucks at idle/being loaded; and haul trucks in transit to and from the mine site).

In both cases, the modelling considered the setback distance from each village (sensitive receptor) to the nearest extraction area, regardless of when or at what production level (i.e., 13.5 MTPA, 18.5 MTPA, 22.5 MTPA or 27.5 MTPA) the extraction area was planned to be mined. This approach allowed CBG to select setback distances for the mining areas that could be adjusted based on the desired quantity of explosive or amount of equipment.

The full results of the Noise and Vibration Impact Assessment can be found in Section 7 of that report, along with the associated tables and figures. Selected

results of the assessment of noise and vibration due to blasting are reproduced below.

Figure 4 Maximum Allowable Charge Mass per Delay by Distance (Ground Vibration)

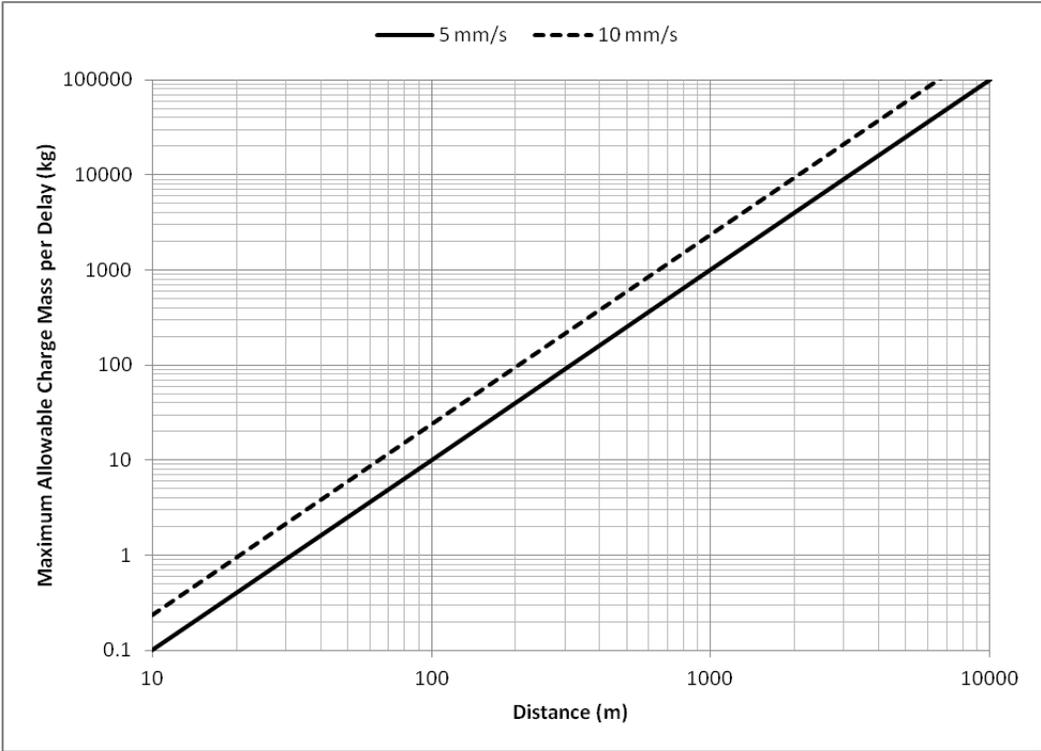
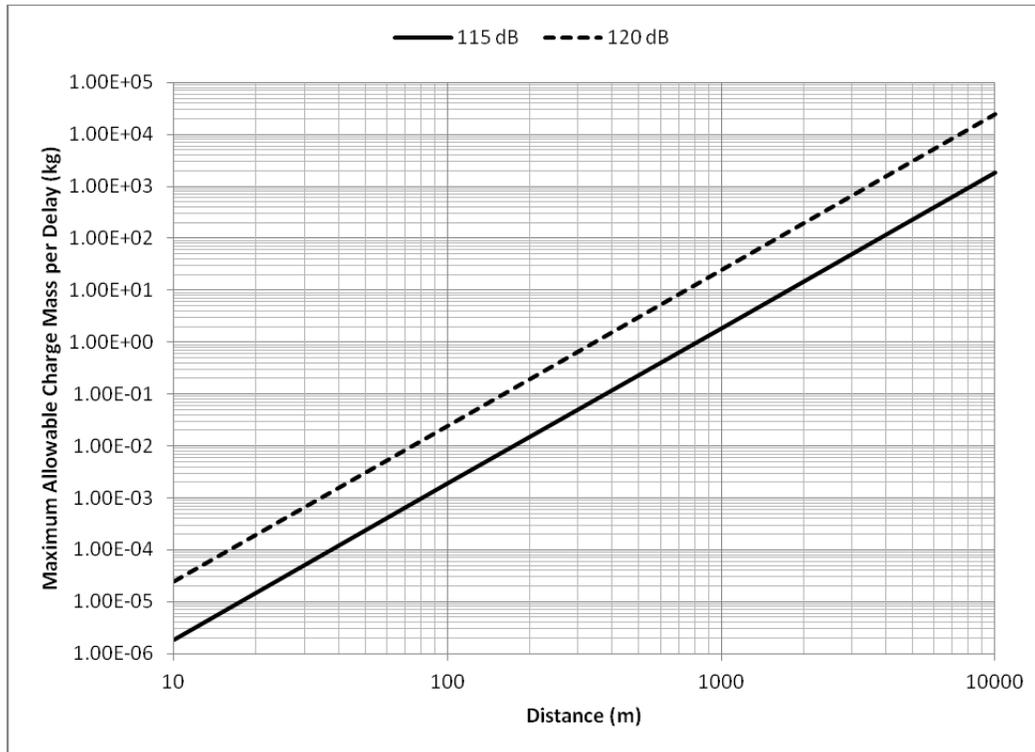


Figure 5 Maximum Allowable Charge Mass per Delay by Distance (Airblast)



As discussed above, the characteristics of a typical blast are as follows:

- One (1) blast per day;
- 10 tonnes of heavy ammonium nitrate/fuel oil (ANFO) explosive per blast, which is based on an average blast size of 16,646 m³ of material and a powder factor of 0.6 kg explosive per m³.

It is assumed that the 10 tonnes of total explosive material per blast will be distributed into separate charges over a given spatial area, and configured to detonate across a series of delays. The above figures are intended for use in designing the blast with regard to the actual setback that is encountered in the field. The actual setback distance between the proposed blast and the nearest village (x-axis) can be used to determine the maximum charge blast per delay (y-axis) for the given noise or vibration criteria. The total mass of explosive material (10 tonnes) would then be divided by the maximum charge mass per delay (derived from the figures) to determine how many separate charges will be required. For example, if a blast is to occur at 3 km from a village, the maximum allowable charge mass per

delay would be 50 kg (driven by the airblast requirements). In order to meet this limit, the 10 tonnes of explosive material should be distributed among 200 equal charges, each separated temporally by a delay (10,000 kg / 50 kg = 200 charges).

2.5.2 Additional Modelling Results

Additional modelling was completed to assess sound levels at three (3) resettlement locations, near Hamdallay and Petoun Bondou Wandé (see Map 8 and Table 4). Setback distances of at least 100 m between these locations and the nearest mining activity are required by law; however a larger distance to any active mining area of 1000 m would be in effect for location 3 near Petoun Bondou Wandé. The additional noise modelling was completed to determine whether these minimum setbacks are sufficient from a noise perspective. It was found that the setback distances would need to be increased to comply with IFC criteria, even when assuming only one cluster of equipment is operating at the nearest mine site. The following table summarizes the setback distances required to meet IFC limits as well as the setbacks associated with incremental increases in sound level of 3 dB, 5 dB and 10 dB for one cluster of mining equipment. As noted in the Noise and Vibration Impact Assessment, increases in sound level of +3 dB are not perceptible and therefore have a “low” impact rating, while increases of +5 dB and +10 dB have impact ratings of “moderate” and “high”, respectively.

Table 6 Noise assessment resettlement locations

Location	Minimum Setback (m)	IFC Compliance (m)		+3 dB Increment		+5 dB Increment		+10 dB Increment	
		Day	Night	Day	Night	Day	Night	Day	Night
1	100	468	313	374	314	278	234	162	136
2	100	468	313	374	314	278	234	162	136
3	1000	833	1,335	835	835	622	622	362	362

2.6 Responses to surface water questions

2.6.1 Baseline Data and Future Monitoring Plans

It is acknowledged that the limited sampling that was completed in 2014 on surface water and sediment in the Kamsar Port and Sangarédi Mining areas did not adequately address uncertainties regarding baseline data. For this reason, on-going monitoring of surface waters and sediment in both study areas has been recommended to augment the existing data set and to more accurately characterize existing conditions in each study area. The monitoring plan is detailed in the "*Surface Water and Sediment Monitoring Plan*" that was developed by ARCADIS in September 2015 and is intended to be adaptive, in order to allow for CBG monitoring activities to expand to reflect increased production and new information gathered through monitoring. In brief, the plan recommends frequent monitoring of both surface water and sediment at Kamsar and Sangarédi, on a monthly basis for at least the first year starting in September 2015, and continuing routinely as the long-term monitoring plan. In addition to sites that were previously sampled at Kamsar and Sangarédi during the 2014 field program, new stations have been added to the program to capture conditions in eco-sensitive areas occurring within the mining area and to assess the potential impact of the official landfill site located southeast of Kamsar and the dump site located along the eastern edge of the Sangarédi township. Flow monitoring of streams traversing the mining area has also been added to the program to obtain estimates of stream discharge rates that will help refine the water balance for the mine site.

2.6.2 Mine Water Balance

Concerns were raised by the reviewers that uncertainties regarding pit dewatering could affect the mine water balance. However, dewatering will not be conducted as part of either the mine or port operations, except during construction of the new car dumper building at the port. The dewatering activities associated with construction at the port were previously assessed. Pit dewatering that could affect the mine water balance is not anticipated at the mine site. Furthermore, as was mentioned in Section 2.6.1, monitoring of stream discharge in the mining area that

has been added to the surface water monitoring program will help refine the water balance for the mine site.

In response to additional information requests from reviewers, CBG has initiated a water supply/balance management framework which appears here as Appendix 9.5. The WMF contains a number of commitments to complete data collection, identify potential impacts and undertake related mitigation measures. The framework will lead to a management plan, once sufficient field data have been collected for this to be meaningful.

2.6.3 Assessment of Surface Water Quality Impacts

It is agreed that uncertainties regarding impacts from stormwater runoff on surface water quality were not assessed. Unfortunately, the necessary information required to quantify potential contaminant loads associated with runoff that would impact surface water quality is not available. Instead, a qualitative discussion and additional detail on mitigation measures to minimize stormwater runoff could be provided.

Another concern was raised that the assessment of impacts on surface water quality focused on aerial deposition and excluded the potential impacts of runoff from the mine pits. However, as was noted in Section 2.6.2, the mine pits are not being dewatered and all mine water essentially stays within the pits and slowly percolates downwards.

2.6.4 Aluminum Toxicity

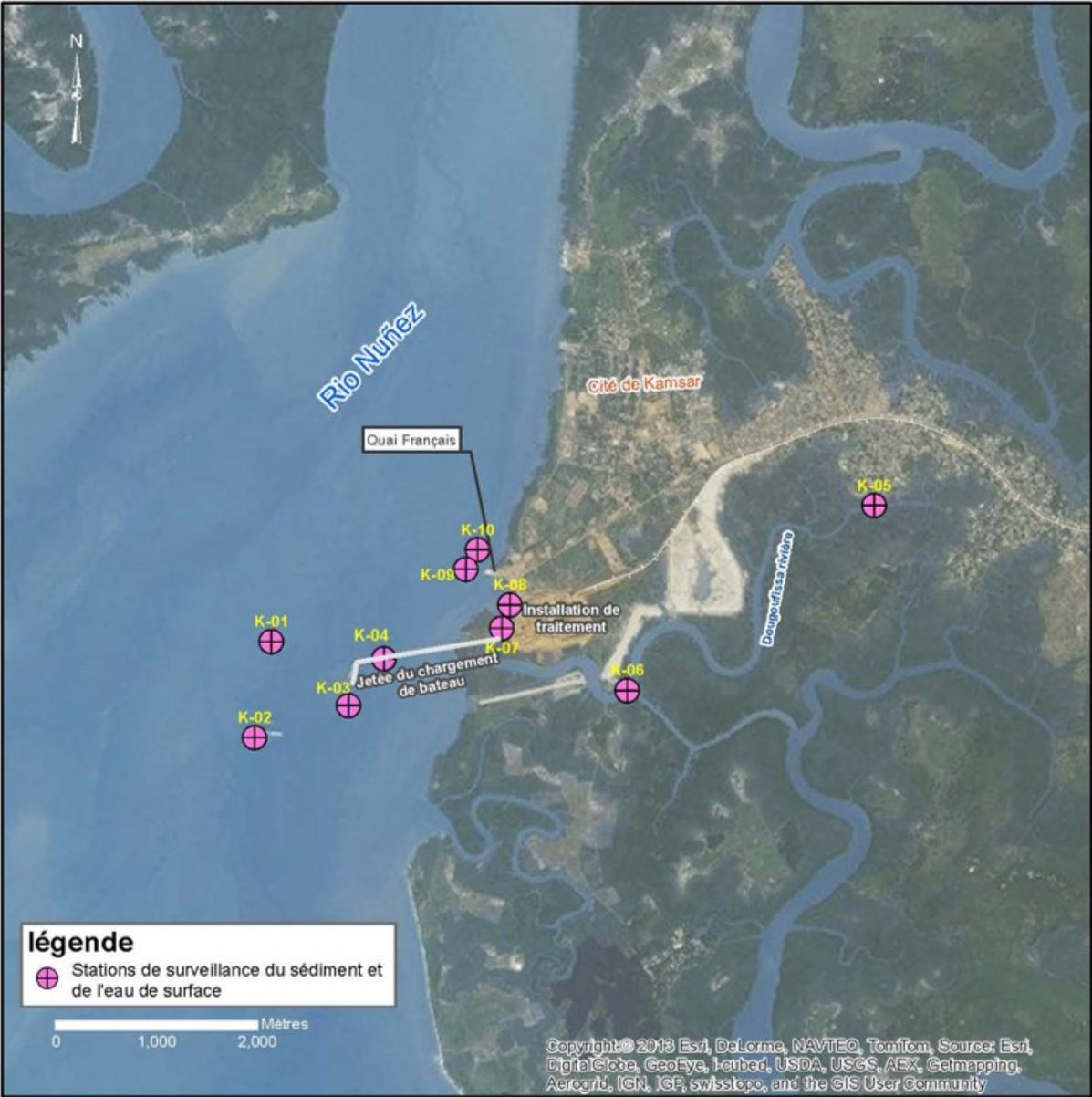
Appendix A of the “*Surface Water and Groundwater Impact Assessment*” (SENES 2014) provided an overview of aluminum speciation and toxicity. The overview identified pH and dissolved organic carbon (DOC) as the main modifying factors for aluminum toxicity. With respect to DOC, Trenfield *et al.* (2012) found that increasing DOC led to a corresponding decrease in the toxicity of aluminum to three tropical freshwater organisms in acidic environments (pH of 5) since DOC forms complexes with aluminum in acidic conditions (pH of 4 to 7), thereby reducing its bioavailability. The results of the study by Trenfield *et al.* (2012) are relevant to the waters of the Sangarédi study area since the waters are tropical, acidic and the DOC

concentrations found in the Sangarédi waters are within the range of those included in the study. The results of their aluminum toxicity tests on the three species (*Hydra viridissima*, *Chlorella* sp., and *Moinodaphnia macleayi*) for four different DOC concentrations, showed that aluminum concentrations ranging from 35 to 950 µg/L and from 87 to 2110 µg/L at respective DOC concentrations of 1 and 10 mg/L produced growth effects or lethality in 50% of the study population (i.e., LC₅₀ or IC₅₀).

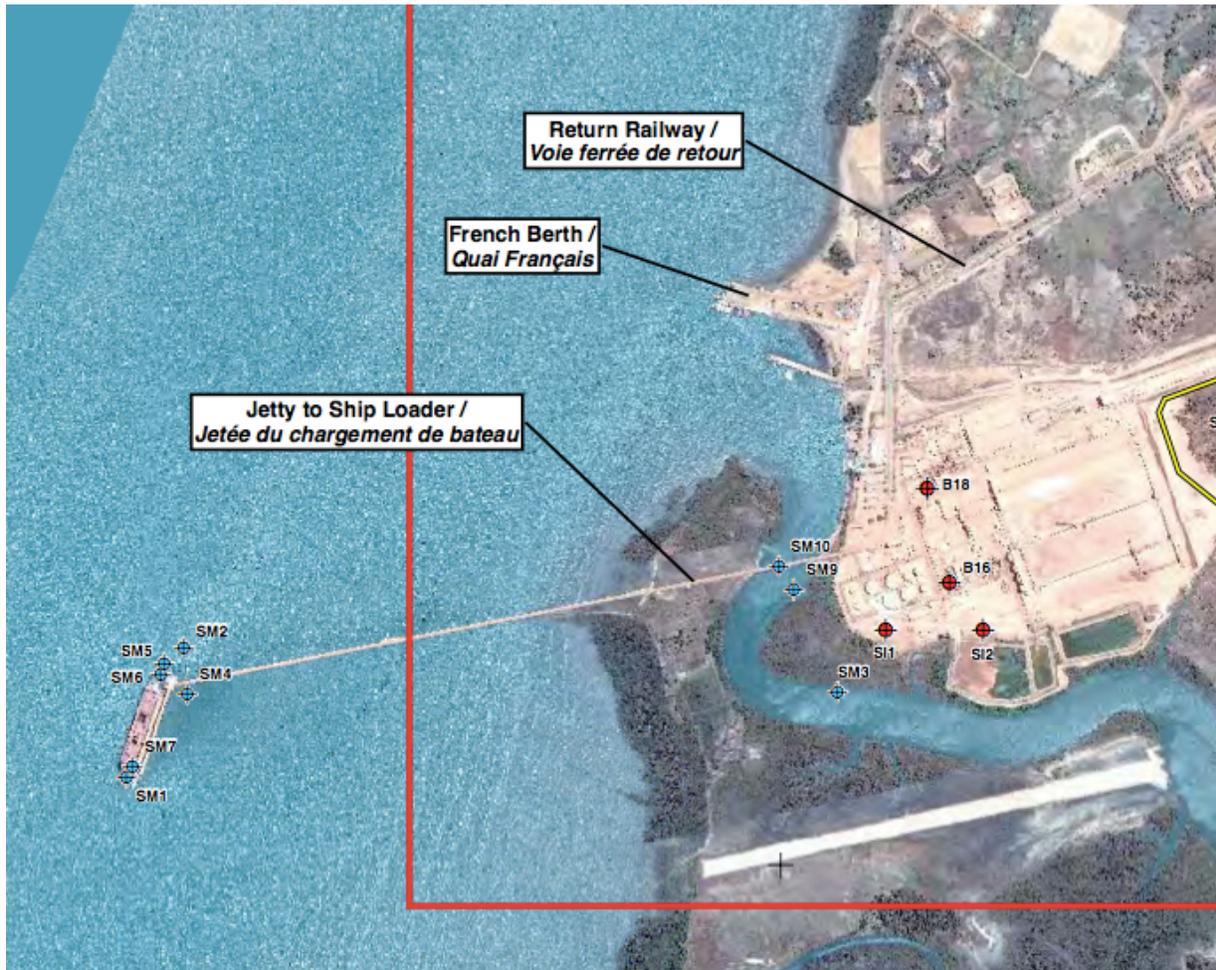
2.7 Responses to dredging questions

A question was asked about the quality of the material to be dredged. A new sampling program for the area to be dredged is currently underway and therefore it is too early to give a firm answer on this question. However there are prior sampling results from the sediment sampling program in 2014 (sampling points K-01 and K-02) (Map 9) and from the 2011 AECOM study (Map 10).

Map 9 2014 Sediment sampling stations



Map 10 2011 (AECOM) Sediment sampling stations



Sediment samples taken from Kamsar in 2014 showed low levels, often below reportable detection limits, for several metals including antimony, bismuth, cadmium, mercury, selenium, silver, and tin. The concentrations of arsenic and chromium exceeded Interim Sediment Quality Guidelines for Aquatic Life (ISQG) of the Canadian Council of Ministers of the Environment (CCME) for both freshwater and marine waters on all sediment samples in the Kamsar area. However the levels were all lower than the Probable Effects Levels (PEL) of the CCME. Aluminum levels were slightly higher in samples K-01 and K-02 than others in the Kamsar area.

The 2011 samples (SM1 to SM7) showed levels above guidelines only for SM7 for zinc. However the samples were not analyzed for arsenic or chrome.

The dredging study will result in much more detailed information on both the area to be dredged and the chosen deposition area (see the monitoring section 2.1.8). Impacts of deposition will be evaluated. The deposition area at sea beyond the mouth of the estuary is the one authorized by the Government of Guinea and has been used for prior deposition of dredged material from the turning basin and access channel.

The dredging study will also involve the collection of benthic invertebrate samples at the same locations as for the sediment sampling (see subsection 3.9)

2.8 Waste management plan

Reviewers of the ESIA have requested additional information on CBG's waste management processes. The current CBG waste management procedure appears as Appendix 9.6.

3 BIOLOGY

3.1 Introduction

The biology section refers to additional biology work undertaken following the August meeting in Paris. Most of these subsections simply refer to original reports or data presented in attached appendices. A re-evaluation of the biology impact assessment in light of these additional data is included in the Biodiversity Action Framework presented as Appendices 9.12 and 9.13 of this SIP.

3.2 Biology data maps

Additional biology maps were requested and these are presented in Appendix 9.6. These include more detailed maps showing the location of numbered sampling or observation points, maps and tables showing the amount of habitat within set distances from mining area and new mining roads through valleys, and the amount of habitat within dust deposition zones. Analysis of these is provided in the BAP Framework.

3.3 Additional data from original version of the BAF

Certain sections dealing with the conservation framework (laws, plans, conventions, etc.), mitigation measures of the ESIA and additional impact analysis were originally in the BAF but were moved to Appendices 9.8, 9.9 and 9.10 in this report.

3.4 Critical habitat assessment

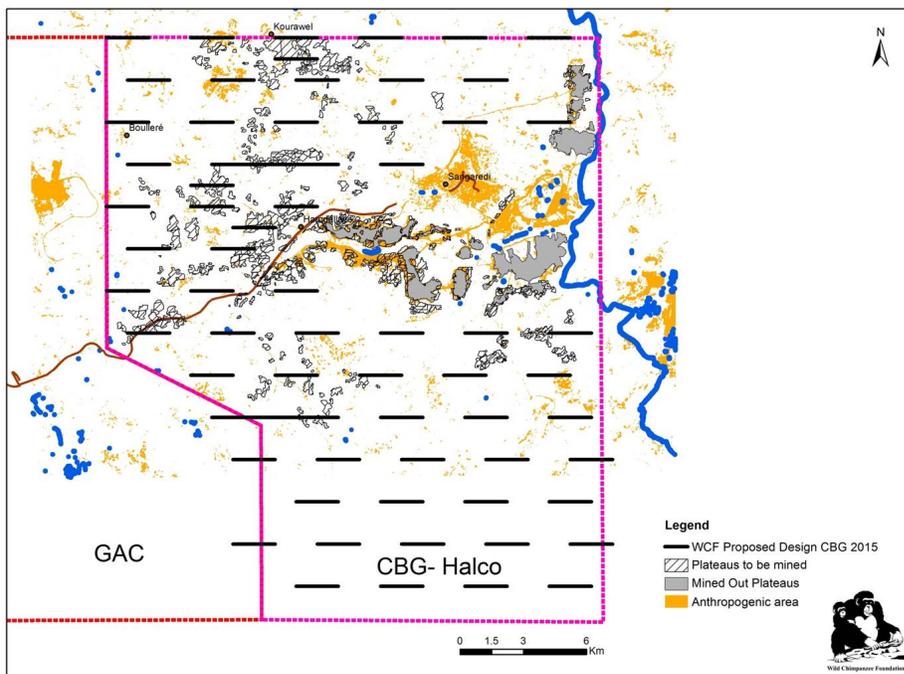
A Critical Habitat Assessment (CHA) was produced by The Biodiversity Consultancy (TBC) and is included in Appendix 9.11 of this report.

3.5 Primate assessment

A primate survey is currently underway by the Wild Chimpanzee Foundation (WCF). WCF proposes an intensive survey of 142 km of transects (74 transects of 2 km spaced apart by 2 km) during the period mid-September to the end of October. The estimation of abundance will be based on chimpanzee nest observations. Nests of chimpanzee have a mean lifetime ranging from 194 days (Fleury-Brugière, 1994) to 216 days in the Foutah Djallon (WCF, 2012) meaning that nest presence will be surveyed during all seasons.

When complete, the WCF report will be the subject of a separate release.

Map 11 Proposed WCF survey design for a rapid assessment of the CBG South Cogan concession



3.6 Ecosystem Services Review

3.6.1 Introduction

An ecosystem services review was requested at the Paris meetings to supplement the detailed studies presented in the ESIA (marine fishing, bushmeat hunting, fire wood and charcoal harvesting, etc.) and was produced in association with Sylvatrop Consulting.

3.6.2 Methods

This method is largely inspired by the WRI approach to ecosystem services (WRI, 2013. *Weaving ecosystem services into impact assessment. A Step-By-Step Method*, version 1.0). It has been adapted and simplified to ensure its feasibility. This report aims at reviewing the work done until now and at planning the next steps in order to comply with IFC standards.

This screening and scoping exercise consisted in two steps.

3.6.2.1 Screening

The screening phase has built on the existing data, principally the ESIA. Most documents of the ESIA were reviewed in order to find pertinent data about ecosystem services.

The basis of this step is an exhaustive check-list of ecosystem services. This is a list of 53 final and intermediary ecosystem services, of some ecological benefits and values of biodiversity. This list has been used in many projects and has proven its utility to avoid any omission in any context.

Starting from this list, were excluded all ecosystem services:

- not present or benefited locally by local population;
- with only global beneficiaries; and

- that are assessed to be affected by a non-significant or low impact due to the Project.

According to IFC PS6 (GN134), the ecosystem services with global beneficiaries are considered as services over which the client has no direct management control or significant influence. “These project-related impacts on ecosystem services where the client does not have direct management control or significant influence will be assessed per Performance Standard 1”. The GHG emission and sequestration will then be treated according to PS1 in the according topic section and not in this assessment. Similarly, the ‘existence (intrinsic) value’ of biodiversity has no identifiable local beneficiaries, and so is assessed in the biodiversity section.

The level of impact to the ecosystem services was assessed through the ESIA evaluation.

The result of the analysis of the screening phase is a list of Ecosystem services that benefit the local population or the Project.

3.6.2.2 *Scoping*

In this step, the data about the screened-in ecosystem services were gathered. Some descriptive statements were taken from the available documents. These data were compiled to comprehend the qualitative value of each one, either for local communities, or, for the Project. If possible, quantitative data were also extracted.

For each ecosystem service, there was also a characterization of:

- the beneficiaries;
- the ecosystems/species involved; and
- and the location of them, according to the three zones determined in the ESIA.

Ecosystem services benefitting local population were categorized as Type 1 while the ones useful to the Project, as Type 2 ecosystem services.

Some related ecosystem services were amalgamated to help their future analysis. The reason of these groupings is mainly practical and educational. It also shows the interrelations between similar ecosystem services.

Some other ecosystem services were subdivided when it seemed necessary to facilitate their future analysis. Usually, an ecosystem services was subdivided because some information permitted to distinguish some sub-types of ecosystem services specially related to an ecosystem, e.g. marine vs. freshwater, or to a taxonomic group, e.g. animals vs. plants.

The result of this phase is a list of ecosystem services together with some descriptive information and synthetic remarks about the way forward for each of these ecosystem services.

3.6.3 Results

All the results are presented in the main table at the end of the section (Table 12). Extracts of this table are presented in the following sections to facilitate the reading and the understanding. Table 7 presents the initial exhaustive checklist. The 53 ecosystem services are subdivided into five categories. Each type is explained briefly.

Table 7 Initial checklist of ecosystem services, ecological benefits and values of biodiversity

Category of ecosystem services	Type of ecosystem service	General definition of the service
Regulating services	Carbon sequestration and stocking	Reduction of global climate change
	Local climate regulation	Reduction of wind and other adverse weather conditions by vegetation
	Protection against extreme meteorological events and tsunamis	Reduction of devastative effects of waves and wind due to hurricanes and tsunamis
	Odour reduction	Dilution, degradation and capture of atmospheric molecules associated to bad odours
	Air Purification	Dilution, degradation and capture of atmospheric toxic molecules and suspended particles by vegetation
	Water Purification	Dilution, degradation and capture of diluted or suspended toxins or nutrients in water
	Mitigation of flood and droughts	Reduction of variation of the flow of water courses
	Soil fertility	Increase of the quantity and the availability of soil nutrients
	Degradation of organic wastes	Degradation of organic wastes produced by humans e.g. composting
	Soil decontamination	Degradation of toxic molecules or sequestration heavy metals in soils by plants
	Erosion control	Avoidance of degradation of soils or shores by wind, rain or waves
	Landslide control	Capacity of forests to hold substrates in hilly terrains
	Protection against falling rocks	Capture of rocks falling from cliffs
	Protection of urban infrastructures	Reduction of degradation of pavements and roofs by blocking the solar

Category of ecosystem services	Type of ecosystem service	General definition of the service
		incidence
	Road security	Reduction of vehicle accidents because of speed reduction due to vegetation
	Pollination	Fertilisation of flowers by animals
	Seeds dispersal	Transport of fruits and seeds by animals
	Reduction of agricultural and forest pests	Natural parasites and predators of pests
	Reduction of human sicknesses	Natural control of vector-borne diseases
	Reduction of noise	Reduction and concealing of unpleasant sounds
Access related services	Travel routes	Some ecosystems help humans to move into a territory e.g. rivers
	Barrier effect	Capacity of ecosystems to block the movement of humans in a territory e.g. quicksand
Provisioning services (ecological goods)	Wild food	Food extracted from natural ecosystems
	Agricultural food	Cultivated crops
	Freshwater	Water source for human uses
	Fuel	Biomass burned as energy
	Fibres and materials	Biomass used for construction or other uses
	Natural ornaments	Natural elements used for aesthetic reasons
	Pets	Animals for domestic uses
	Useful domesticated animals	Animals working for human
	Medicinal plants and animals	Plants or animals used to cure sicknesses
	Biochemical products	Extracts of plants or animals for medicinal or industrial uses
	Genetic resources	Genetic and molecular structures potentially useful
Ontogeny services	Immune system development	Reduction of allergies caused by a regular contact with natural organisms
	Psychosocial development	Optimal development of children due to a regular contact with nature

Category of ecosystem services	Type of ecosystem service	General definition of the service
Cultural services	Calming and stress reduction	Outdoors activities reduce stress hormone
	Tourism and recreation	Interest of elements of biodiversity for leisure
	Landscape aesthetics	Beauty of natural scenery
	Scientific interest	Value of biodiversity for research
	Education	Use of biodiversity for education
	Artistic inspiration	Value of biodiversity as a source of inspiration in arts
	Biomimicry	Use of natural mechanisms to resolve technical problems
	Knowledge system	Ecosystems as a structure for the maintenance of traditional practices and values
	Geographic intelligence	Ecosystems help to find one's bearing
	Temporal intelligence	Ecosystems help to know when to do some activities e.g. seeding
	Sense of place	Some ecosystems make someone feel he is in a special place
	Social relationships	Ecosystems influence the relationships weaved in communities
	Sense of belonging	Someone feels attached or responsible for some kind of home ecosystems
	Cultural heritage	Some varieties of crop or some ecosystems are part of ancestral traditions
	Spirituality and religion	Some ecosystems or species have sacred meanings e.g. sacred groves
	Warm glow value	Positive feedback someone feels by altruist activities favourable to biodiversity
	Existence value	Satisfaction people have by knowing that some species or ecosystems exist
	Bequest value	Satisfaction people have by transmitting to their heirs some species or ecosystems

3.6.4 Screening

Because these ecosystem services have not been reported in the ESIA or are supposedly not benefitted locally, they have been screened out:

- Odour reduction
- Landslide control
- Protection against falling rocks
- Protection of urban infrastructures
- Road security
- Barrier effect
- Pets
- Biochemical products
- Calming and stress reduction
- Tourism and recreation
- Scientific interest
- Biomimicry
- Warm glow value.

Because no local beneficiaries or only global beneficiaries could be identified, these ecosystem services have been screened-out:

- Carbon sequestration and stocking
- Existence value
- Genetic resources

Because the impact of the Project has been assessed as non-significant or low, these ecosystem services have been screened-out:

- Local climate regulation
- Protection against extreme meteorological events and tsunamis
- Degradation of organic wastes
- Mitigation of flood and droughts
- Soil fertility
- Pollination
- Seeds dispersal
- Reduction of agricultural and forest pests
- Reduction of human sicknesses

- Useful domesticated animals
- Immune system development
- Psychosocial development

These 28 screened-out ecosystem services have been excluded from the following steps.

3.6.4.1 *Scoping*

The 25 ecosystem services left have been categorised as Type 1 ES (T1), those that are benefitted by the local population, or Type 2 (T2), those that are useful for the Project. One ecosystem service falls into both categories: Freshwater provisioning. This ecosystem service is being benefitted by villagers of the Sangaredi area, and also by CBG, through the aqueduct from the Cogon River. This ecosystem service has then been subdivided:

- T1: Surface freshwater provisioning
- T2: Industrial use of surface water

Other ecosystem services have been subdivided to facilitate their future analysis, e.g. “Wild food” has been divided into 5 ecosystem services of Type 1:

- Marine artisanal fishing
- Freshwater artisanal fishing:
- Bushmeat hunting
- Harvest of the African locust bean
- Harvesting of other wild fruits and tubers

Some other screened-in ES have been grouped in order to combine similar ones (Table 8).

Table 8 Grouping of some of the Social ecosystem services

Previous category of ES	New name
Education	Traditional knowledge
Artistic inspiration	
Knowledge system	
Temporal intelligence	
Cultural heritage	Cultural practices
Bequest value	
Geographic intelligence	Cultural sites
Sense of place	
Sense of belonging	
Spirituality and religion	

Once the ecosystem services were reorganized, they received, sometimes, a new name more adapted to the context of the Project. At the end, there are 20 Type 1 ES and 7 Type 2 “Locally benefitted ES” (Tables 10 and 11).

Type 1 ES are mainly provisioning services (14/20 ecosystem services). This reflects the close relationship between the population and the ecosystem from which they live. 18 of them (90 %) are found in the concession zone, where a more traditional way of living is encountered. The two from the Kamsar zone are related to marine fishing.

The 7 Type 2 ES are mainly regulating services (6/7 ecosystem services). Five of these ecosystem services are related to the dilution, the degradation or the absorption of different types of industrial wastes: dust, atmospheric pollutants, water pollutants, soil contaminants and noises. The natural vegetation, especially the trees, is a useful component of the biodiversity that can reduce significantly the contact between these wastes and the rural population. Even if the end beneficiaries of the decontamination effect of the vegetation are the local people, these services are considered as Type 2 ES because CBG profits of them directly. Indeed, if these regulating ecosystem services were not present, the permitted threshold of concentration of pollutants would be more often exceeded, the local population would be more affected and CBG might need to modify its practice.

Table 9 Type 1 Locally benefitted ecosystem services

Category of ecosystem services	New name	Description of the ecosystem service	Ecosystems	Beneficiaries	Location	Remarks
Access related services	Circulation of fishing boats in the estuary	Enlargement of the quay and increase in marine traffic will complicate boat movements	Nunez estuary	Marine fishermen	2- Kamsar zone	
Provisioning services (ecological goods)	Marine artisanal fishing	Artisanal fishing Port Néné in Kamsar is Guinea's second artisanal fishing port	Coastal habitats, estuary and river	800 Fishermen with 51 small boats in 18 camps	2- Nunez estuary	Socio-economic activity well described in the ESIA.
	Freshwater artisanal fishing:	Fishing mainly for home consumption	Freshwater rivers	One-third of the rural households engaged in fishing	1- Sangaredi zone	Because of the potential impact of mining activities on the water quality of rivers, a better baseline description of the freshwater fishing would be usefully.
	Bushmeat hunting	Hunting in the concession zone does not represent a significant source of income or personal consumption for households.	Woodlands	Local villagers and Sangaredi citizens	1- Sangaredi zone	Socio-economic activity well described in the ESIA.
	Harvesting of the African locust bean	Harvest of pods of the African locust bean is the most important food foraging activity	Woodlands	Local villagers	1- Sangaredi zone	This activity is mentioned but not quantified.
	Harvesting of other wild fruits and tubers	No information except about the palm tree	Woodlands	Local villagers	1- Sangaredi zone	A certain proportion of the population is certainly involved in foraging activities like wild fruits and tubers collection. This has not been documented in the ESIA, except for the palm tree.
	Slash and burn agriculture	Mainly for rice and peanuts	Woodlands and fallow lands	65% of the households of the concession consider it their main activity and 29% consider it their second activity.	1- Sangaredi zone	Socio-economic activity well described in the ESIA.

Category of ecosystem services	New name	Description of the ecosystem service	Ecosystems	Beneficiaries	Location	Remarks
	Plantations	Cashew, mango, banana...	Orchards and other types of perennial plantations	85% of the rural population have a plantation	1- Sangaredi zone	Socio-economic activity well described in the ESIA.
	Herding	Migration of transitional cattle herds and locally owned herds	Many types of pastures: agricultural areas, bowals...	More than 83% of the rural population owns animals. Most have a few heads of livestock or often chickens and small ruminants.	1- Sangaredi zone	Socio-economic activity well described in the ESIA.
	Surface freshwater provisioning	People that live in the area use surface water and groundwater for potable purposes as well as for agriculture. Herders use water sources for the cattle while they cross the area. In Sangaredi, a small proportion of the inhabitants go to rivers and ponds to do their laundry and wash their dishes. They represent 7,5 % of the inhabitants of Thiankounaye because of the proximity of the Tiapikhouré River. Access to water in the rural part of the Study Area shows that more than half of the villagers obtain water from rivers and ponds.	Rivers, ponds	Villagers and herders	1- Sangaredi zone especially in Daramagnaki commune.	Socio-economic activity well described in the ESIA.
	Wood-energy	Both firewood and charcoal are used in Sangaredi and the other villages of the concession.	Woodlands	Used by 95 % of Sangaredi households; harvesting is carried out by villagers but also by professional crews	1- Sangaredi zone	Socio-economic activity well described in the ESIA.

Category of ecosystem services	New name	Description of the ecosystem service	Ecosystems	Beneficiaries	Location	Remarks
	Timber	Little timber is collected from the concession. Only in the furthest areas are some forests left.	Closest forests are quite far from Sangaredi	Timber is obtained in such forests by logging crews or villagers	1- Sangaredi zone	Additional information would be useful.
	Construction wooded material	Construction poles, roofs and walls material	Woodlands	Villagers	1- Sangaredi zone	A certain proportion of the population is certainly involved in the collection of poles, roof and wall material. This has not been documented in the ESIA.
	Leathers and other craft material	Skins of certain species that are commonly hunted may be sold to leather workers.	Woodlands	Hunters	1- Sangaredi zone	No information is available about the different crafts and their sources of material.
	Medicinal plants and animals	No information about plants. Medicinal animals: jackal (<i>Canis spp.</i>) supposedly has therapeutic virtues for the treatment of rheumatism, the serval (<i>Leptailurus serval</i>) is sought after for its skin and the colobus monkey for its heart, of medicinal value.	Woodlands	Tradipraticioners	1- Sangaredi zone	A certain proportion of the population is probably involved in foraging activities like medicinal herbs collection. This has not been documented in the ESIA.
Cultural services	Natural scenery	The agro-pastoral landscape unit is of a more rural nature and is less able to absorb the visual modifications than the other units	Woodlands and bowals	Local villagers and visitors	1- Sangaredi zone	Well described in the ESIA.
	Social relationships	The social relations between the villagers are related to the use of the resources. E.g. contractual rites between the hunters and the charcoal producers and the owners of the lands.	Natural and agricultural ecosystems	Charcoal producers, hunters and owners, farmers	1- Sangaredi zone	Well described in the ESIA.

Category of ecosystem services	New name	Description of the ecosystem service	Ecosystems	Beneficiaries	Location	Remarks
	Traditional knowledge (includes the education value of nature, the artistic inspiration and the temporal intelligence)	Hunters have learned their craft from a relative: the basics such as learning animal tracks, how to conceal oneself and how to shoot; after a certain period of practice, the novice is eventually taught the hunting secrets required before venturing out for a successful hunt in the bush, such as the ritual verses, talismans and preparatory washes from certain plants and from the ink washes of Koranic text.	Natural ecosystems	Hunters, tradipraticioners, fishermen, foragers...	1- Sangaredi zone	Partly described in the ESIA, it is difficult to assess the impact the Project will have on traditional knowledge and cultural practices. The gradual loss of natural ecosystems may modify completely the way of living of the rural population of the concession.
	Cultural practices (includes the bequest value)	E.g. Hunters prepare their hunt by first protecting themselves from evil spirits and to increase their hunting success. Hunting fetish made from the horn of the bushbuck (<i>Tragelaphus scriptus</i>).	Natural ecosystems	Hunters, tradipraticioners, fishermen, foragers...	1- Sangaredi zone	Partly described in the ESIA, it is difficult to assess the impact the Project will have on traditional knowledge and cultural practices. The gradual loss of natural ecosystems may modify completely the way of living of the rural population of the concession.
	Cultural sites (includes the geographic intelligence, the sense of place, the sense of belonging)	Sacred sites: often a gallery forest, a grove, a rock or a tree with an unusual shape, an inexhaustible or hidden spring, a cave, a termite mound, etc. It is the materialization of cultural heritage as unique natural environmental characteristics incorporating cultural values.	Various	Villagers	1- Sangaredi zone	Well described in the ESIA.

Table 10 Type 2 Locally benefitted ecosystem services

Category of ecosystem services	Adapted name	Description of the ecosystem service	Ecosystems	Beneficiaries	Location	Remarks
Regulating services	Dust capture	Suspended particles will be absorbed and captured by the vegetation	Urban forests and surrounding woodlands	CBG and villagers and citizens	1- Sangaredi zone 2- Kamsar zone 3- Railway	This ES is not taken into account in the ESIA. Its role as a potential mitigation measure is not assessed.
	Atmospheric waste assimilation	NOx-SO2 absorption and degradation by the vegetation	Urban forests and surrounding woodlands	CBG and villagers and citizens	1- Sangaredi zone 2- Kamsar zone 3- Railway	This ES is not taken into account in the ESIA. Its role as a potential mitigation measure is not assessed.
	Aquatic waste assimilation	Waste water rejected in Nunez estuary is diluted and degraded	Nunez estuary	CBG	2- Kamsar zone	This ES is not taken into account in the ESIA.
	Soil waste assimilation	Degradation of accidental spills in soils. Oils spills regularly happen.	Soils of the different plants	CBG	1- Sangaredi zone 2- Kamsar zone 3- Railway	This ES is poorly taken into account in the ESIA.
	Soil erosion control	Soil erosion is a problem for the soil stockpiles, the surroundings of the mining areas and the access roads. It is impossible to quantify the erosion problem at this stage but given the surface areas in question it is potentially major.	Anthropic areas, woodlands and bowals	CBG	1- Sangaredi zone	Soil erosion is considered in the ESIA and mitigation measures included.
	Noise reduction by wooded vegetation	Noise is not very much attenuated by vegetation. But with some wind, there are trees, like palm trees, that produce natural sounds that conceal industrial noises.	Urban forests and surrounding woodlands	CBG and villagers and citizens	1- Sangaredi zone 2- Kamsar zone 3- Railway	Use of vegetation screening to reduce noise is discussed.
Provisioning services	Industrial use of surface water	Taken from the dam on the Cogon River, some of the water supply is directed to industrial activities in Sangaredi and Kamsar, and also to local population in both cities.	Cogon River	CBG	1- Sangaredi zone 2- Kamsar zone	ES well described in the ESIA.

Table 11 Main table of ecosystem services

Category of ecosystem services	Type of ecosystem service	General definition of the service	Screening justification: excluded if not potentially significantly impacted by project (medium or high impact) or if global or regional beneficiaries	Subdivision or grouping (T1: Type 1 ES; T2: Type 2 ES)	Description of the ES	Ecosystems	Beneficiaries	Location	Remarks
Regulating services	Carbon sequestration and stocking	Reduction of global climate change	Global beneficiaries						
	Local climate regulation	Reduction of wind and other adverse weather conditions by vegetation	No mining activity planned in the arboreal buffer zones of villages that protect them against adverse weather						
	Protection against extreme meteorological events and tsunamis	Reduction of devastating effects of waves and wind due to hurricanes and tsunamis	No removal of mangrove planned						

Category of ecosystem services	Type of ecosystem service	General definition of the service	Screening justification: excluded if not potentially significantly impacted by project (medium or high impact) or if global or regional beneficiaries	Subdivision or grouping (T1: Type 1 ES; T2: Type 2 ES)	Description of the ES	Ecosystems	Beneficiaries	Location	Remarks
	Odour reduction	Dilution, degradation and captation of atmospheric molecules associated to bad odours	No bad odours emitted during the industrial process						
	Air Purification	Dilution, degradation and captation of atmospheric toxic molecules and suspended particles by vegetation		T2: Dust capture	Suspended particles will be absorbed and captured by the vegetation	Urban forests and surrounding woodlands	CBG and villagers and citizens	1- Sangaredi zone 2- Kamsar zone 3- Railway	This ES is not taken into account in the ESIA. Its role as a potential mitigation measure is not assessed.
				T2: Atmospheric waste assimilation	NOx-SO2 absorption and degradation by the vegetation	Urban forests and surrounding woodlands	CBG and villagers and citizens	1- Sangaredi zone 2- Kamsar zone 3- Railway	This ES is not taken into account in the ESIA. Its role as a potential mitigation measure is not assessed.

Category of ecosystem services	Type of ecosystem service	General definition of the service	Screening justification: excluded if not potentially significantly impacted by project (medium or high impact) or if global or regional beneficiaries	Subdivision or grouping (T1: Type 1 ES; T2: Type 2 ES)	Description of the ES	Ecosystems	Beneficiaries	Location	Remarks
	Water Purification	Dilution, degradation and captation of diluted or suspended toxins or nutrients in water		T2: Aquatic waste assimilation	Waste water rejected in Nunez estuary is diluted and degraded	Nunez estuary	CBG	2- Kamsar zone	This ES is not taken into account in the ESIA.
	Mitigation of flood and droughts	Reduction of variation of the flow of water courses	The distribution of several small footprints of mining activities over a large area may not have a significant impact on hydrological regime of specific rivers						

Category of ecosystem services	Type of ecosystem service	General definition of the service	Screening justification: excluded if not potentially significantly impacted by project (medium or high impact) or if global or regional beneficiaries	Subdivision or grouping (T1: Type 1 ES; T2: Type 2 ES)	Description of the ES	Ecosystems	Beneficiaries	Location	Remarks
	Soil fertility	Increase in the quantity and the availability of soil nutrients	The distribution of several small footprints of mining activities over a large area may not have a significant impact on flooding regime of specific wetlands used for cultivation, these flooding being a source of fertility.						
	Degradation of organic wastes	Degradation of organic wastes produced by Human e.g. composting	No significant impact conceivable						
	Soil decontamination	Degradation of toxic molecules or sequestration heavy metals in soils by plants		T2: Soil waste assimilation	Degradation of accidental spills in soils.	Soils of the different plants		1- Sangaredi zone 2- Kamsar zone 3- Railway	This ES is poorly taken into account in the ESIA.

Category of ecosystem services	Type of ecosystem service	General definition of the service	Screening justification: excluded if not potentially significantly impacted by project (medium or high impact) or if global or regional beneficiaries	Subdivision or grouping (T1: Type 1 ES; T2: Type 2 ES)	Description of the ES	Ecosystems	Beneficiaries	Location	Remarks
	Erosion control	Avoidance of degradation of soils or shores by wind, rain or waves		T2: Soil erosion control	Soil erosion is a problem for the soil stockpiles, the surroundings of the mining areas and the access roads. It is impossible to quantify the erosion problem at this stage but given the surface areas in question it is potentially major.	Anthropic areas, woodlands and bowals	CBG	1- Sangaredi zone	This ES is poorly taken into account in the ESIA. The role of soil stabilisation by vegetation could be enhanced in the mitigation measures.
	Landslide control	Capacity of forests to hold substrates in hilly terrains	No steep slopes						
	Protection against falling rocks	Capture of rocks falling from cliffs	No cliff in the study area						

Category of ecosystem services	Type of ecosystem service	General definition of the service	Screening justification: excluded if not potentially significantly impacted by project (medium or high impact) or if global or regional beneficiaries	Subdivision or grouping (T1: Type 1 ES; T2: Type 2 ES)	Description of the ES	Ecosystems	Beneficiaries	Location	Remarks
	Protection of urban infrastructures	Reduction of degradation of pavements and roofs by blocking the solar incidence	No impact to urban forest						
	Road security	Reduction of vehicle accidents because of speed reduction due to vegetation	Do not apply in this ecosystem						
	Pollination	Fertilisation of flowers by animals	The distribution of several small footprints of mining activities over a large area may not have a significant impact on the pollination of fruit orchards and cashew plantations						

Category of ecosystem services	Type of ecosystem service	General definition of the service	Screening justification: excluded if not potentially significantly impacted by project (medium or high impact) or if global or regional beneficiaries	Subdivision or grouping (T1: Type 1 ES; T2: Type 2 ES)	Description of the ES	Ecosystems	Beneficiaries	Location	Remarks
	Seeds dispersal	Transport of fruits and seeds by animals	The distribution of several small footprints of mining activities over a large area may not have a significant impact on the transport of seeds						
	Reduction of agricultural and forest pests	Natural parasites and predators of pests	The distribution of several small footprints of mining activities over a large area may not have a significant impact on the populations of predators of pests						
	Reduction of human sicknesses	Natural control of vector-borne diseases	The distribution of several small footprints of mining activities over a large area may not have a significant impact on the populations of animal vectors of diseases						

Category of ecosystem services	Type of ecosystem service	General definition of the service	Screening justification: excluded if not potentially significantly impacted by project (medium or high impact) or if global or regional beneficiaries	Subdivision or grouping (T1: Type 1 ES; T2: Type 2 ES)	Description of the ES	Ecosystems	Beneficiaries	Location	Remarks
	Reduction of noise	Reduction and concealing of unpleasant sounds		T2: Noise reduction by wooded vegetation	Noise is not very much attenuated by vegetation. But with some wind, there are trees, like palm trees, that produce natural sounds that conceal industrial noises.	Urban forests and surrounding woodlands	CBG and villagers and citizens	1- Sangaredi zone 2- Kamsar zone 3- Railway	Role as a potential mitigation measure is considered.
Access related services	Travel routes	Some ecosystems help humans to move into a territory e.g. rivers		T1: Circulation of fishing boats in the estuary	Enlargement of the quay and increase in marine traffic will complicate boat movements	Nunez estuary	Marine fishermen	2- Kamsar zone	

Category of ecosystem services	Type of ecosystem service	General definition of the service	Screening justification: excluded if not potentially significantly impacted by project (medium or high impact) or if global or regional beneficiaries	Subdivision or grouping (T1: Type 1 ES; T2: Type 2 ES)	Description of the ES	Ecosystems	Beneficiaries	Location	Remarks
	Barrier effect	Capacity of ecosystems to block the movement of humans in a territory e.g. quicksand	No known use of ecosystem to defend a village or another valued infrastructure						
Provisioning services (ecological goods)	Wild food	Food extracted from natural ecosystems		T1: Marine artisanal fishing	Artisanal fishing Port Néné in Kamsar is Guinea's second artisanal fishing port	Coastal habitats, estuary and river	800 Fishermen with 51 small boats in 18 camps	2- Nunez estuary	Socio-economic activity well described in the ESIA.
				T1: Freshwater artisanal fishing:		Freshwater rivers	One-third of the rural households engaged in fishing, mainly for home consumption	1- Sangaredi zone	Because the impact of mining activities can potentially be significant locally on the water quality of rivers, a better baseline description of the freshwater fishing would be useful.

Category of ecosystem services	Type of ecosystem service	General definition of the service	Screening justification: excluded if not potentially significantly impacted by project (medium or high impact) or if global or regional beneficiaries	Subdivision or grouping (T1: Type 1 ES; T2: Type 2 ES)	Description of the ES	Ecosystems	Beneficiaries	Location	Remarks
				T1: Bushmeat hunting	Hunting in the concession zone does not represent a significant source of income or personal consumption for households.	Woodlands	Local villagers and Sangaredi citizens	1- Sangaredi zone	Socio-economic activity well described in the ESIA.
				T1: Harvesting of the African locust bean	Harvest of pods of the African locust bean is the most important food foraging activity	Woodlands	Local villagers	1- Sangaredi zone	This activity is mentioned but not quantified.

Category of ecosystem services	Type of ecosystem service	General definition of the service	Screening justification: excluded if not potentially significantly impacted by project (medium or high impact) or if global or regional beneficiaries	Subdivision or grouping (T1: Type 1 ES; T2: Type 2 ES)	Description of the ES	Ecosystems	Beneficiaries	Location	Remarks
				T1: Harvesting of other wild fruits and tubers	No information except about the palm tree	Woodlands	Local villagers	1- Sangaredi zone	A certain proportion of the population is certainly involved in foraging activities like wild fruits and tubers collection. This has not been documented in the ESIA, except for the palm tree.

Category of ecosystem services	Type of ecosystem service	General definition of the service	Screening justification: excluded if not potentially significantly impacted by project (medium or high impact) or if global or regional beneficiaries	Subdivision or grouping (T1: Type 1 ES; T2: Type 2 ES)	Description of the ES	Ecosystems	Beneficiaries	Location	Remarks
	Agricultural food	Cultivated crops		T1: Slash and burn agriculture	Mainly for rice and peanuts	Woodlands and fallow lands	Agriculture is the main activity in the rural part of the concession zone: 65% of the households consider it their main activity and 29% consider it their second activity.	1- Sangaredi zone	Socio-economic activity well described in the ESIA.
				T1: Plantations	Cashew, mango, banana...	Orchards and other types of perennial plantations	85% of the rural population has a plantation	1- Sangaredi zone	Socio-economic activity well described in the ESIA.

Category of ecosystem services	Type of ecosystem service	General definition of the service	Screening justification: excluded if not potentially significantly impacted by project (medium or high impact) or if global or regional beneficiaries	Subdivision or grouping (T1: Type 1 ES; T2: Type 2 ES)	Description of the ES	Ecosystems	Beneficiaries	Location	Remarks
				T1: Herding	Migration of transitional cattle herds and locally owned herds	Many types of pastures: agricultural area, bowals...	83% of the rural population owns animals. A few heads of livestock or often chickens and small ruminants	1- Sangaredi zone	Socio-economic activity well described in the ESIA.

Category of ecosystem services	Type of ecosystem service	General definition of the service	Screening justification: excluded if not potentially significantly impacted by project (medium or high impact) or if global or regional beneficiaries	Subdivision or grouping (T1: Type 1 ES; T2: Type 2 ES)	Description of the ES	Ecosystems	Beneficiaries	Location	Remarks
	Freshwater	Water source for human uses		T1: Surface freshwater provisioning 93	People that live in the area use surface water and groundwater for potable purposes as well as for agriculture. Herders use water sources for the cattle while they cross the area. In Sangaredi, some inhabitants go to rivers and ponds for laundry and dishes. They represent 7.5% of the inhabitants of Thiankounaye because of the proximity of the Tiapikhouré River. Access to water in the rural part of the Study Area shows that more than half of the villagers obtain water from rivers and ponds.	Rivers, ponds	Villagers and herders	1- Sangaredi zone especially in Daramagnaki commune.	Socio-economic activity well described in the ESIA.

Category of ecosystem services	Type of ecosystem service	General definition of the service	Screening justification: excluded if not potentially significantly impacted by project (medium or high impact) or if global or regional beneficiaries	Subdivision or grouping (T1: Type 1 ES; T2: Type 2 ES)	Description of the ES	Ecosystems	Beneficiaries	Location	Remarks
				T2: Industrial use of surface water	Taken from the dam on the Cogon River, some of the water supply is directed to industrial activities in Sangaredi and Kamsar, and also to local population in both cities.	Cogon River	CBG	1- Sangaredi zone 2- Kamsar zone	

Category of ecosystem services	Type of ecosystem service	General definition of the service	Screening justification: excluded if not potentially significantly impacted by project (medium or high impact) or if global or regional beneficiaries	Subdivision or grouping (T1: Type 1 ES; T2: Type 2 ES)	Description of the ES	Ecosystems	Beneficiaries	Location	Remarks
	Fuel	Biomass burned as energy		T1: Wood-energy	Both firewood and charcoal are used in Sangaredi and the other villages of the concession.	Woodlands	Used by 95 % of Sangaredi households; harvesting is carried out by villagers but also by professional crews	1- Sangaredi zone	Socio-economic activity well described in the ESIA.
	Fibres and materials	Biomass used for construction or other uses		T1: Timber	Little timber is collected from the concession. Only in the furthest areas are some forests left.	Closest forests are quite far from Sangaredi	Timber is obtained in such forests by logging crews or villagers	1- Sangaredi zone	Like this activity may have an important impact on biodiversity of the last remains of forest in the area, this would need more information.

Category of ecosystem services	Type of ecosystem service	General definition of the service	Screening justification: excluded if not potentially significantly impacted by project (medium or high impact) or if global or regional beneficiaries	Subdivision or grouping (T1: Type 1 ES; T2: Type 2 ES)	Description of the ES	Ecosystems	Beneficiaries	Location	Remarks
				T1: Construction wooded material	Construction poles, roofs and walls material	Woodlands	Villagers	1- Sangaredi zone	A certain proportion of the population is certainly involved in the collection of poles, roof and wall material. This has not been documented in the ESIA.
	Natural ornaments	Natural elements used for esthetic reasons		T1: Leathers and other craft materials	Skins of certain species that are commonly hunted may be sold to leather workers.	Woodlands	Hunters	1- Sangaredi zone	No information is available about the different crafts and their sources of material.
	Pets	Animals for domestic uses	No source of pets						
	Useful domesticated animals	Animals working for human	Animals like donkeys can easily be displaced						

Category of ecosystem services	Type of ecosystem service	General definition of the service	Screening justification: excluded if not potentially significantly impacted by project (medium or high impact) or if global or regional beneficiaries	Subdivision or grouping (T1: Type 1 ES; T2: Type 2 ES)	Description of the ES	Ecosystems	Beneficiaries	Location	Remarks
	Medicinal plants and animals	Plants or animals used to cure sicknesses		T1: Medicinal plants and animals	No information about plants. Medicinal animals: jackal (<i>Canis spp.</i>) supposedly has therapeutic virtues for the treatment of rheumatism, the serval (<i>Leptailurus serval</i>) is sought after for its skin and the colobus monkey for its heart, of medicinal value.	Woodlands	Traditprat iconers	1- Sangaredi zone	A certain proportion of the population is probably involved in foraging activities like medicinal herbs collection. This has not been documented in the ESIA.
	Biochemical products	Extracts of plants or animals for medicinal or industrial uses	No organized extraction for transformation						

Category of ecosystem services	Type of ecosystem service	General definition of the service	Screening justification: excluded if not potentially significantly impacted by project (medium or high impact) or if global or regional beneficiaries	Subdivision or grouping (T1: Type 1 ES; T2: Type 2 ES)	Description of the ES	Ecosystems	Beneficiaries	Location	Remarks
	Genetic resources	Genetic and molecular structures potentially useful	Global or national beneficiaries						
Ontogeny services	Immune system development	Reduction of allergies caused by a regular contact with natural organisms	The distribution of several small footprints of mining activities over a large area may not have a significant impact on the contact of children with natural organisms						
	Psychosocial development	Optimal development of children due to a regular contact with nature	The distribution of several small footprints of mining activities over a large area may not have a significant impact on the contact of children with nature						

Category of ecosystem services	Type of ecosystem service	General definition of the service	Screening justification: excluded if not potentially significantly impacted by project (medium or high impact) or if global or regional beneficiaries	Subdivision or grouping (T1: Type 1 ES; T2: Type 2 ES)	Description of the ES	Ecosystems	Beneficiaries	Location	Remarks
Cultural services	Calming and stress reduction	Reduction of stress hormone caused by outdoors activities	No such activities in the area						
	Tourism and recreation	Interest of elements of biodiversity for leisure	No such activities in the area						
	Landscape esthetics	Beauty of natural scenery		T1: Natural scenery	The agro-pastoral landscape unit is of a more rural nature and is less able to absorb the visual modifications than the other units	Woodlands and bowals	Local villagers and visitors	1- Sangaredi zone	ES well described in the ESIA.
	Scientific interest	Value of biodiversity for research	No mention of any scientific institution or project in the area						

Category of ecosystem services	Type of ecosystem service	General definition of the service	Screening justification: excluded if not potentially significantly impacted by project (medium or high impact) or if global or regional beneficiaries	Subdivision or grouping (T1: Type 1 ES; T2: Type 2 ES)	Description of the ES	Ecosystems	Beneficiaries	Location	Remarks
	Education	Use of biodiversity for education		Included into "Traditional knowledge"					
	Artistic inspiration	Value of biodiversity as a source of inspiration in arts		Included into "Traditional knowledge"					
	Biomimicry	Use of natural mechanisms to resolve technical problems	No mention of any initiative of biomimicry in the area						

Category of ecosystem services	Type of ecosystem service	General definition of the service	Screening justification: excluded if not potentially significantly impacted by project (medium or high impact) or if global or regional beneficiaries	Subdivision or grouping (T1: Type 1 ES; T2: Type 2 ES)	Description of the ES	Ecosystems	Beneficiaries	Location	Remarks
	Knowledge system	Ecosystems as a structure for the maintainance of traditional practices and values		T1: Traditional knowledge (includes the education value of nature, the artistic inspiration and the temporal intelligence)	Hunters have learned their craft from a relative: the basics such as learning animal tracks, how to conceal oneself and how to shoot; after a certain period of practice, the novice is eventually taught the hunting secrets required before venturing out for a successful hunt in the bush, such as the ritual verses, talismans and preparatory washes from certain plants and from the ink washes of Koranic text.	Natural ecosystems	Hunters, tradipratic ioners, fishermen , foragers ...	1- Sangaredi zone	This ES being partly described in the ESIA, it is difficult to assess the impact the Project will have on traditional knowledge and cultural practices. The gradual loss of natural ecosystems may modify the way of living of the rural population of the concession.

Category of ecosystem services	Type of ecosystem service	General definition of the service	Screening justification: excluded if not potentially significantly impacted by project (medium or high impact) or if global or regional beneficiaries	Subdivision or grouping (T1: Type 1 ES; T2: Type 2 ES)	Description of the ES	Ecosystems	Beneficiaries	Location	Remarks
	Geographic intelligence	Ecosystems help to find one's bearing		Included into "Cultural sites"					
	Temporal intelligence	Ecosystems help to know when to do some activities e.g. seeding		Included into "Traditional knowledge"					
	Sense of place	Some ecosystems make someone feel he is in a special place		Included into "Cultural sites"					

Category of ecosystem services	Type of ecosystem service	General definition of the service	Screening justification: excluded if not potentially significantly impacted by project (medium or high impact) or if global or regional beneficiaries	Subdivision or grouping (T1: Type 1 ES; T2: Type 2 ES)	Description of the ES	Ecosystems	Beneficiaries	Location	Remarks
	Social relationships	Ecosystems influence the relationships weaved in communities		T1: Social relationships	The social relations between the villagers are related to the use of the resources. E.g. contractual rites between the hunters and the charcoal producers and the owners of the lands.	Natural and agricultural ecosystems	Charcoal producers, hunters and owners, farmers	1- Sangaredi zone	ES well described in the ESIA.
	Sense of belonging	Someone feels attached or responsible to some kind of home ecosystems		Included into "Cultural sites"					

Category of ecosystem services	Type of ecosystem service	General definition of the service	Screening justification: excluded if not potentially significantly impacted by project (medium or high impact) or if global or regional beneficiaries	Subdivision or grouping (T1: Type 1 ES; T2: Type 2 ES)	Description of the ES	Ecosystems	Beneficiaries	Location	Remarks
	Cultural heritage	Some varieties of crop or some ecosystems are part of ancestral traditions		T1: Cultural practices (includes the bequest value)	E.g. Hunters prepare their hunt by first protecting themselves from evil spirits and to increase their hunting success. hunting fetish made from the horn of the bushbuck, (Tragelaphus scriptus),	Natural ecosystems	Hunters, tradipratic ioners, fishermen , foragers ...	1- Sangaredi zone	This ES being partly described in the ESIA, it is difficult to assess the impact the Project will have on traditional knowledge and cultural practices. The gradual loss of natural ecosystems may modify the way of living of the rural population of the concession.

Category of ecosystem services	Type of ecosystem service	General definition of the service	Screening justification: excluded if not potentially significantly impacted by project (medium or high impact) or if global or regional beneficiaries	Subdivision or grouping (T1: Type 1 ES; T2: Type 2 ES)	Description of the ES	Ecosystems	Beneficiaries	Location	Remarks
	Spirituality and religion	Some ecosystems or species have sacred meanings e.g. sacred groves		T1: Cultural sites (includes the geographic intelligence, the sense of place, the sense of belonging)	Sacred sites: often a gallery forest, a grove, a rock or a tree with an unusual shape, an inexhaustible or hidden spring, a cave, a termite mound, etc. It is the materialization of cultural heritage as unique natural environmental characteristics incorporating cultural values.	Various	Villagers	1- Sangaredi zone	ES well described in the ESIA.
	Warm glow value	Positive feedback someone feels by altruist activities favorable to biodiversity	No philanthropic activities related to biodiversity known in the study area						

Category of ecosystem services	Type of ecosystem service	General definition of the service	Screening justification: excluded if not potentially significantly impacted by project (medium or high impact) or if global or regional beneficiaries	Subdivision or grouping (T1: Type 1 ES; T2: Type 2 ES)	Description of the ES	Ecosystems	Beneficiaries	Location	Remarks
	Existence value	Satisfaction people have by knowing that some species or ecosystems exist	Global beneficiaries						
	Bequest value	Satisfaction people have by transmitting to their heirs some species or ecosystems		Included into "Cultural practices"					

3.7 Benthic invertebrate survey of dredging area

A benthic invertebrate survey of the dredging area and deposition area is being carried out in conjunction with the dredging sediment sampling program (see Section 2.1.8).

At at least 10 sampling locations at each of the two sites, three separate grab samples will be taken using the Petite Ponar grab used for the sediment sampling. Use of the Petite Ponar grab for benthic invertebrate samples is justified (see Bingham et al, 1982 for example). The samples taken with the grab will be sieved using a 1mm mesh sieve and preserved in alcohol. Each of the over 60 samples will be analyzed by a recognized laboratory familiar with identification of marine/brackish benthic species of the region.

A report on the benthic invertebrates present will be presented after completion of the laboratory analyses.

3.8 Biodiversity Action Framework (BAF)

The BAF is included as Appendices 9.12 and 9.13 to this report. It provides the basis for actions leading to the full Biodiversity Action Plan (BAP) planned for November.

4 SOCIAL

4.1 Introduction

The social section refers to additional work undertaken following the August meeting in Paris. Most of these subsections contain short explanations in response to questions raised and refer to additional data presented in attached appendices.

One exception to this is the Resettlement and Livelihoods Restoration Policy Framework document, which was originally submitted separately but is now presented as Appendix 9.14 to the SIP. The Resettlement and Livelihoods Restoration Policy Framework contains response to comments and questions raised by reviewers.

4.2 Responses to questions regarding past grievances

Reviewers expressed concern regarding past grievances from the surrounding communities and the CBG's past activities to resolve these and current processes to address new ones. Specifically, the requests have been formulated as follows:

- A description of how past (5yr) unresolved compensation-related/ livelihood issues are to be addressed, and associated implementation issues;
- Review grievance mechanism to exclude workers from the GM relating to local communities;
- Review of unresolved grievances for consistency with current policy.

The following relevant CBG documents are provided in Appendix 9.15 by way of response to the above:

- Memorandum of Complementary Information to IFC and OPIC from Mohamed Talhaoui, HSEC Director, dated September 18, 2015, including:
 - Incident register
 - Grievances action plan
 - Data on compensation awarded 2010-2015
 - Livelihood form and completed examples

In addition the reader is directed to section 12 of the Resettlement and Livelihoods Restoration Policy Framework, submitted as a standalone document, for the key socioeconomic indicators to be used as part of monitoring and evaluation activities under CBG's PARC implementation.

Finally, CBG has initiated a socio-economic survey of those that have been compensated to check on current livelihood status.

4.3 Stakeholder Engagement

Reviewers expressed interest in understanding what was used as the Stakeholder Engagement Plan during the ESIA consultations, as well as how this relates to current stakeholder engagement processes at CBG as the Project moves forward. In addition, there is a request for evidence that further stakeholder identification and analysis is being undertaken. Specifically, the requests have been formulated as follows:

- Edit ESIA SEP to finalise (not draft/preliminary) and connect with post-ESIA SEP;
- Initiate process to include detailed stakeholder mapping and analysis in the SEP & means of communication.

The following relevant CBG documents are provided in Appendix 9.16 by way of response to the above:

- December 2013 Stakeholder Engagement Plan (English translation September 2015);
- CBG_HSEC_PRO_5040 Procedure for Stakeholder Engagement Plan (and associated form);
- CBG_HSEC_PRO_5030 Procedure for Stakeholder, Analysis and Mapping;
 - Stakeholder Identification and Analysis register;
 - Stakeholder mapping tool (available as Excel workbook; not included in Appendix).

5 CLOSURE

Reviewers have requested information on the financial mechanism used by the CBG is planning for its closure obligations.

CBG follows Guide to accounting for asset retirement obligations an analysis of FASB Statement n° 143 (KPMG, 2003).

In addition, some financial information has been provided in the CBG's Conceptual Closure Plan for the South Cogon mining area, as well email communication on actual amounts from Mohamed Talhaoui to reviewers. This document has been provided to reviewers in its original French version. It contains relevant information and plans for:

- Decontamination
- Stability and geochemistry
- Decommissioning - Disposal and Dismantling
- Backfilling and re-profiling
- Erosion control, draining, shaping, contribution of substrate or topsoil
- Re-vegetation and maintenance of vegetated areas
- Monitoring activities
- Biodiversity
- Social program

CBG is committed to producing a Mine Reclamation and Closure Plan which aligns with the requirements of the IFC EHS Guidelines for Mining. A draft plan will be produced as a Priority 2 action item for December 2015 and then updated periodically.

6 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)

The ESMP developed by CBG to manage the impacts identified in the ESIA for the Expansion Project has been modified in response to comments received during the E&S Due diligence.

An English version of the latest ESMP is included as Appendix 9.17.

7 CUMULATIVE IMPACT ASSESSMENT

CBG is considering cumulative impacts within its area of influence in accordance with PS1 and will cooperate with any national institution or any other company that would launch work in the CBG area of influence in order to implement common mitigation measures.

8 LIST OF REFERENCES

AECOM. 2011. *Projet d'augmentation de la production de la Compagnie des Bauxites de Guinée (CBG). Étude d'impact environnemental et social (EIES) présentée au Ministère de l'Environnement de la Guinée.*

Australian Government. 2012. *National Pollutant Inventory Emissions Estimation Technique Manual for Explosives Detonation and Firing Ranges, Version 3.0.* Department of Sustainability, Environment, Water, Population and Communities. January

Bingham, C. R., D. B. Mathis, L. G. Sanders and E McLemore. 1982. *Grab Samplers for Benthic Macroinvertebrates in the Lower Mississippi River.* Misc. Paper E-82-3. US Army Engineers Waterways Experiment Station Environmental Laboratory, Vicksburg, Miss.

ÉEM, 2014. *Environmental and Social Impact Assessment for the CBG Expansion Project.*

Fleury-Brugière M.-C., Brugière D., 2010. *High population density of Pan troglodytes verus in the Haut Niger National Park, Republic of Guinea: implications for local and regional conservation.* International Journal of Primatology 31: 383-392.

OSPAR. 2004. *Revised OSPAR Guidelines for the Management of Dredged Material (2004-08).*

OSPAR, 1992. *Convention for the protection of the marine environment of the North-east Atlantic.*

US EPA. *AP-42 Compilation of Air Pollution Emission Factors.* Chapter 13.1 - Explosives Detonation

Wild Chimpanzee Foundation, 2012. *Etat de la Faune et des Menaces dans les Aires Protégées Terrestres et Principales Zones de Forte Biodiversité de République de Guinée.* Activity report, 79 p.

WRI, 2013. *Weaving ecosystem services into impact assessment. A Step-By-Step Method, version 1.0.*