Air Quality Monitoring and Management Plan
Yaoure Gold Project, Côte d'Ivoire



Submitted to

Perseus Yaoure SARL

Submitted By

Amec Foster Wheeler Earth & Environmental UK Ltd.(Original)
2D Consulting Afrique, Cote d'Ivoire (Updated)

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LIST OF ABBREVIATIONS AND ACRONYMS

AQS	Air Quality Standards
AQMP	Air Quality Management Plan
ESIA	Environmental and Social Impact Assessment
EU	European Union
IFC	International Finance Corporation
IFC PS	International Finance Corporation Performance Standards
Mtpa	Million tons per annum
PM_{10}	Particulate matter with an aerodynamic diameter of less than 10 µm
$PM_{2.5}$	Particulate matter with an aerodynamic diameter of less than 2.5 µm.
ROM	Run of Mine
TSF	Tailings Storage Facility
WHO	World Health Organization
WRD	Waste Rock Dump

1 INTRODUCTION

1.1 Background

This document has been produced in support of the Perseus Yaoure SARL (Perseus) proposals to develop the Yaoure Gold Project, which is located in the Bouaflé Prefecture of the Marahoué Region in Côte d'Ivoire. The Project is approximately 40 km north-west of the political capital Yamoussoukro, 260 km north-west of the administrative capital Abidjan and 25 km from the regional capital Bouaflé. This document constitutes an Air Quality Management and Monitoring Plan (AQMP) which makes up an Appendix of the Environmental and Social Impact Assessment (ESIA) for the site. The AQMP has been developed following a full assessment of air quality effects presented within the Air Quality section of the ESIA Report submitted for the development of the Project.

The open pit will be mined at an average rate of 25 Mtpa (ore and waste rock), of which ore is mined at an average rate of 4.5 Mtpa. The maximum mining rate will be 30 Mtpa. The mining rate of waste rock will drop off towards the end of the mine life (estimated 6 years). Over the operational life of the mine, a total of 162 Mt rock will be mined, of which 137 Mt will be waste rock and 25 Mt will be ore.

This document therefore outlines the methods by which Perseus will systematically assess, reduce and, where possible, prevent emissions to air, including fugitive emissions to air from dust and particulate matter (PM_{10}), from the Project activities. It will serve to aid the decision-making process on the choice of controls, general site design and operational practice in line with current industry best practice.

The AQMP is a working document, with the specific aim of ensuring that:

- Emissions to air are considered as part of routine inspections and maintenance activities;
- The risks of unplanned incidents or accidents that could result in adverse air quality impacts/annoyance are minimised;
- Emissions are primarily controlled at source by good operational practices, the correct use and maintenance of plant and operator training; and
- All appropriate measures are taken to prevent or, where that is not reasonably practicable, to minimise emissions to air from the Project that may be considered to generate adverse air quality impacts/annoyance at receptor locations outside of the site boundary.

1.2 Scope

The scope of this document includes:

- All on-site works undertaken during the construction, operational and closure phases of the Project; and
- Consideration of the sensitivity of and potential impacts to receptors in proximity to the above activities.

1.3 Purpose

Both controlled and uncontrolled activities have the potential to adversely impact those receptors in proximity to the site that are sensitive to air quality impacts. This document is a key tool to reduce, manage and mitigate such potential impacts and has been produced to detail the manner in which work should be undertaken to ensure this.

The content of the AQMP is to be agreed in writing with the appropriate Cote d'Ivoire Authorities, as appropriate. External contractors will also be required to comply with the requirements of the AQMP.

1.4 Content

This AQMP contains the following sections:

- Relevant legislation, compliance and regulatory guidance;
- Identification of those sensitive receptors that may be affected by air quality impacts;
- A description of control measures which are both part of the design of the site and those which are specific mitigation measures to control potential air quality impacts;
- A description of the auditing process and paperwork which will enable management of both the implementation of mitigation and monitoring and the assessment and review of monitoring data; and
- A description of the roles and responsibilities for implementation of the AQMP in relation to air quality.

This AQMP is a "live" document; monitoring procedures, responsibilities and compliance actions should be updated as appropriate. It is the responsibility of all Perseus personnel involved in relevant activities and its contractors to be fully aware of its contents and to provide relevant training to staff.

2 RELEVANT LEGISLATION AND GUIDANCE

The principal pollutants that are likely to be emitted will be from the combustion of hydrocarbon fuels and from road vehicles, which are most likely to contribute to exceedances of the relevant international air quality standards and guideline values (see below) include:

- Nitrogen oxides (NO_X, which comprises nitric oxide (NO) and nitrogen dioxide (NO_2));
- Carbon monoxide (CO);
- Particulate matter (PM_{10}: particles with an aerodynamic diameter of less than 10 micrometres (µm) and $PM_{2.5}$: particles with an aerodynamic diameter of less than 2.5 µm); and
- Sulphur dioxide (SO_2).

Additionally, airborne dust and particulates are likely to be produced during site construction and operation.

2.1 Relevant guidance and criteria

Emission rates and concentrations are set in CIAPOL Decree No. 01164 of 4 November 2008 and are summarised in Table 2-1.

Table 2-1 Air quality standards

Substances	Applicable at hourly release rate of	Maximum allowable concentration (mg/m^3)
Total dust	< 1kg/h >1kg/h	100 50
Carbon monoxide	>1 kg/h	50
Sulphur oxide (expressed as sulphur dioxide)	>25 kg/h	500
Nitrogen oxide (expressed as nitrogen dioxide)	>1 kg/h	50
Discharges of various gaseous substances such as HCN	>50mg/h	5 mg/m^3

The Project will endeavour to comply with more stringent international standards, such as criteria from relevant WHO international Air Quality Guideline (AQG) values and European Union (EU) Air Quality Standards (AQSs). Table 2-2 summarises the standards and guideline values for those pollutants that are of relevance to this study.

Table 2-2 WHO Air Quality Guidelines and EU Air Quality Standards

Pollutant	Averaging Period	Limit Value (µg m^{-3})	
		WHO AQG	EU AQS
NO_2	Annual mean	40	40
	1-hour mean	200	200[A]
CO	Max 8 hour mean	10,000	10,000
PM_{10}	Annual mean	20	40
	24-hour mean	50	50[B]
$PM_{2.5}$	Annual mean	10	25
	24-hour mean	25	-
Benzene	Annual mean	-	5
SO_2	Annual mean	50	-
	24-hour mean	-	125[C]
	1-hour mean	-	350[D]
	10-minute mean	500	-

[A] Not to be exceeded more than 18 times per year.
[B] Not to be exceeded more than 35 times per year.
[C] Not to be exceeded more than 3 times per year.
[D] Not to be exceeded more than 24 times per year.

It is therefore the priority of this AQMP that, where possible, emissions to air associated with the Project are limited in an effort to comply with the above standards and guideline values.

2.2 Air Quality Management Guidance

There are various guidance documents that have been published internationally for the control and management of emissions to air, including minimising and mitigating potential dust generating activities.

This section provides a summary of those documents which are considered most relevant to managing the air quality emissions from the Project, but should not be considered an exhaustive list.

IFC EHS Guidelines

Section 1.1 of the IFC EHS Guidelines (2007) provides guidance on recommended prevention and control techniques for limiting emissions to air, including fugitive releases of dust and particulates. Provision is also provided within the guidance with regards to the approach to air quality monitoring as part of management process.

Building Research Establishment: Control of dust from construction and demolition activities

This Building Research Establishment (BRE) document[1] provides guidance to assist with the control of nuisance dust and fine particle (PM_{10}) emissions from construction and demolition activities.

Generic control measures for dust and fine particles are given for specific processes, such as the movement of vehicles and construction plant, materials handling and storage, cutting, grinding, grouting, grit blasting, concrete batching and pouring. The guidance also gives advice on pre-project planning, implementation and site management, together with checklists for use by the construction industry.

Greater London Authority and London Councils: London Best Practice Guide - The Control of Dust and Emissions from Construction and Demolition

The Greater London Authority (GLA) and London Councils' best practice guide[2] was developed in the UK, in partnership with the Mayor of London in recognition of the potential impacts that developments can have on air quality.

The guide builds upon existing BRE guidance, and aims to assist developers, architects, environmental consultants, local authority officers and any parties involved in the construction process by outlining best practice, providing a consistent approach to dust and emissions control from construction and demolition activities. Where applicable, these recommendations have been included in this AQMP. Although originally prescribed for construction projects in London, UK, it is considered that the dust mitigation measures outlined within the guidance for are likely to be suitable for projects elsewhere, including mining operations in Cote d'Ivoire.

Institute of Air Quality Management (IAQM): Guidance on the assessment of dust from demolition and construction

The Institute of Air Quality Management (IAQM) guidance[3] was developed primarily for use in the UK but it is recognised that the guidance will be used internationally.

The guidance seeks to classify demolition and construction sites according to their risk of impacts, and then to identify mitigation measure appropriate to the assigned risk. It is anticipated that with implementation of effective site specific mitigation measures the environmental effects will not be significant.

1 Building Research Establishment (BRE). Kukadia, V., Upton, S. L. and Hall, D. J. Control of dust from Construction and Demolition Activities (2003).
2 Greater London Authority and London Councils. The control of dust and emissions from construction and demolition - Best Practice Guidance (2006).
3 Institute of Air Quality Management: Guidance on the assessment of dust from demolition and construction (2014).

CIRIA: Environmental Good Practice On-Site Guide (third edition)

This updated CIRIA guide[4] provides practical advice about managing construction on site to minimise environmental effects. It is intended to provide clients, their professional advisers, contractors and the whole construction supply chain with an increased awareness of their responsibilities for appropriate environmental management, ensuring compliance with legal and other requirements.

Part of the CIRIA guide focuses on dust control and mitigation from construction activities, providing clear and concise good practice advice with case studies to support and reinforce this advice, legal examples highlighting impacts of failing (time and cost) to comply with legislation, and examples of good practice checklists.

3 CONTROL MEASURES

3.1 Introduction

The main potential sources of atmospheric emissions associated with the site operations include:

- Dust and particulates generated by on-site activities; and
- Emissions from vehicle movements.

The purpose of this section of the AQMP is to describe how air pollutant levels will be controlled, and thus maintain acceptable air quality during daily operations at the site.

Plans for the management of dust and air quality during operations are outlined below. The roles and responsibilities for the effective implementation of air quality control and mitigation measures to be undertaken as part of this AQMP are detailed in Section 5.

3.2 Design Control Measures

3.2.1 Control of dust and particulates emissions

As appropriate, the measures that will be implemented to control airborne dust and particulate generation during site operations include:

- Vehicles carrying loose materials to be sheeted when leaving site if dust emissions become a problem;
- Potentially dust generating material on the exterior of vehicles leaving the site to be minimised where possible;
- Use of water to suppress emissions from haul routes;

4 CIRIA: Environmental Good Practice On Site Guide (third edition) (2010).

- Implementation of design controls for equipment and vehicles and use of appropriately designed vehicles for materials handling;
- Effective cladding of the berms and soil stockpiles/heaps with vegetation or large rock fragments, and the minimising of the height of storage facilities to 6 m wherever possible;
- Completed long-term stockpiles to be covered or seeded as soon as is practicable in order to stabilise surfaces (finished platforms would be covered, external slopes would be seeded and therefore eventually vegetated);
- Ensuring that all construction plant and equipment are maintained in good working order and not left running when not in use; and
- Regulating on-site movements to keep dust generating activities to a minimum.

The extent to which the above control measures will be implemented on site during the Project lifetime will be flexible and responsive, with additional recommendations and measures introduced when required during particular activities which have significant dust generating potential, sensitive periods, or upon receipt of valid complaints relating to dust annoyance. Working practices will be systematically audited and revised where necessary in order to ensure dust impacts are mitigated to an acceptable level at the identified sensitive receptor locations.

3.2.2 Control of vehicle exhaust emissions

As appropriate, the following measures will be implemented to control emissions from vehicle exhausts:

- Review HGV movements to specific routes to travel to/ from and around the site; and
- Minimise idling and revving of vehicle engines - if mobile plant or HGV is likely to be idling for more than five minutes the engine is to be switched off.

4 AIR QUALITY MONITORING

On the basis of the conclusions of the air quality impacts assessment undertaken (see Section 8.7 of the ESIA), i.e. that all air quality impacts associated with the Project are slight and therefore of low significance after mitigation, it is considered that there is no need for an overly onerous air quality monitoring strategy to be implemented throughout the duration of the Project.

The following monitoring strategy is therefore proposed, commensurate with the potential air quality impacts that may be experienced as a result of the Project.

4.1 Monitoring locations

Air quality monitoring will be performed at the following five locations:

Site 1 Allahou-Bazi, approximately 600 m to the north west of the open pit area and 300 m from the centre of Allalou-Bazi – Angovia;

Site 2 Angovia, approximately 1100 m to the west of the Yaoure development site;

Site 3 Kouakougnanou, approximately 2100 m to the south of the Yaoure development site;

Site 4 Akakro, approximately 3100 m to the south west of the Yaoure development site; and

Site 5 Ex Banlaw, approximately 1700 m to the north of the Yaoure development site.

4.2 Dust and particulates

Dust deposition rates should be monitored using Frisbee Gauges at the same locations used in the baseline study (see Section 4.1). This will indicate whether the activities associated with the Yaoure Gold Project are significantly increasing the rate of dust deposition experienced by residents of the area. If the two month average dust deposition rate is greater than 25% above the baseline monitored rate, this will indicate that further dust control measures should be considered.

In addition, the Site Manager or appointed person is to be responsible for visual observations of on-site generation of airborne dust and particulates. This should be recorded when abnormal activities with a particularly high potential for dust generation are being undertaken, or if any annoyance complaints are received. This should include observations at the site boundary and at the identified sensitive receptors in the vicinity of the site locale (i.e. residential locations within Allahou-Bazi, Angovia, Akakro, Kouakougnanou and Kossou). This should take into account wind direction and any remedial action to be taken to eliminate the source.

The Site Manager is responsible for maintaining records of visual inspections, meteorological data and any assessment or evaluation made on the basis of such data (e.g. a summary of the site operations, together with any abnormal site activities throughout the period will be presented, with any links between these activities and observations discussed. If necessary, brief recommendations for any corrective actions/improvements will be made). Appendix A-1 provides the inspection checklist pro-forma for completion by the Site Manager, or other designated person.

4.3 Complaints handling procedure

In the unlikely event that a complaint is received regarding dust emissions or other emissions to air, the following procedures shall be followed:

- The Site Manager or responsible deputy will be notified immediately;
- The source of the activity causing the complaint or exceedance will be identified and, if necessary, any appropriate mitigation measures will be instigated without delay; and
- If site activities have been identified and mitigation implemented but on-site activities are continuing to generate considerable amounts of dust emissions or other emissions to air, suspension of the activity will be implemented and not recommenced until remedial action has been taken to eliminate the source.

In all instances, a brief summary report will be prepared following an investigation into a complaint received, summarising the above and detailing the cause and the action taken. Where required, a response will be provided to the complainant and/or the appropriate Cote d'Ivoire Authorities in conjunction with the nominated individual responsible for managing community liaison. Appendix A-2 provides the complaints investigation record pro-forma for completion by the Site Manager.

5 ROLES AND RESPONSIBILITIES

During the hours of operation the site will be supervised by at least one member of staff (the Site Manager) who is suitably trained and conversant with the requirements of the AQMP with respect to:

- Operational controls and environmental monitoring;
- Site maintenance (site inspection checklist);
- Record keeping;
- Emergency action plans; and
- Notification to the appropriate Cote d'Ivoire Authorities.

The key roles and responsibilities associated with the operation of the Site Manager include:

- Overall responsibility for implementation of the AQMP;
- Responsibility for ensuring compliance with environmental legislation;
- Oversight of site audits;
- Monitor and review implementation and adherence to the AQMP and review and implement any corrective actions;
- Responsibility for delivering environmental aspects of site inductions;

- Carry out any environmental awareness training and work with site foremen to ensure implementation of good practice;
- Responsible for monitoring considerate contractors scheme compliance;
- Responsibility for public liaison, and complaints handling; and
- Preparation and managing dissemination of information on site operations and health and safety information to site neighbours.

The implementation of best practice guidance for the control of dust and emissions to air will be required to be monitored as will compliance with the requirements set out in the AQMP. This will include ensuring all site personnel are made aware of the scope and contents of the AQMP. The responsibility for ensuring that all site operatives are undertaking management measures, and reviewing and revising site processes and procedures as necessary will be that of the SHEC Manager. The SHEC Manager will also be responsible for monitoring and management of this process through auditing, incident reporting and implementation of corrective actions.

The SHEC Manager will also be responsible for undertaking spot checks on-site to ensure compliance with requirements set out in the AQMP.

Liaison with local residents and the regulator(s) will be co-ordinated through the SHEC Manager. Both parties will be notified of activities that have the potential to generate significant air pollution/ dust and particulate emissions, and also of any unpermitted activities programmed to take place outside of normal site operating hours.

The SHEC Manager will be responsible for ensuring all contractors comply with the measures outlined in the AQMP.

6 APPENDICES

Appendix A-1 Air Quality Visual Inspection Checklist

Completed by:		**Date:**	
on behalf of:			
1	**Complaints**		
1.1	Have any air quality complaints been received in the last 24 hours? (if no, proceed to Section 2)	Y	N
1.2	Provide details:		
1.3	Has an investigation report been started for each complaint?	Y	N
1.4	Has the complaints register been updated?	Y	N
1.5	Have investigation reports been issued to the complainant or the relevant Cote d'Ivoire Authority?	Y	N
1.6	Have additional controls been put in place as a result of the complaints investigation?	Y	N
1.7	If yes, provide details:		

2 **2.1**	**Standard Mitigation Measures** **Site inspections should take account of Good Practice Guidance air quality control measures, as outlined in the AQMP and supporting documentation.**		
2.2	Is the site being operated in accordance with these recommendations?	Y	N
3	**Air Quality Monitoring**		
3.1	Has the visual inspection identified any issues?	Y	N
3.2	If so, specify the issues and any corrective actions taken:		

Appendix A-2 Air Quality Complaint Investigation Record

Completed by:			**Date:**	
		Complaint number:		
		Date received:		
1	**Complaint Details**			
1.1	Address of complainant			
1.2	Date/time of issue			
1.3	Identified source(s) (by complainant):			
2	**Site Activities**			
2.1	Describe ongoing activities at time of complaint (including: location, duration, and likely continuing duration)			
2.2	Initial Complaint Record issued to SHEC Manager (or deputy)?		Y	N
2.3	Telephone discussions held with relevant Cote d'Ivoire Authority?		Y	N

3	**Analysis of Visual Observations**		
3.1	Have site issues been identified during the time of complaint?	Y	N
3.2	Has an air quality investigation report been prepared by the SHEC Manager? (attach)	Y	N
3.3	If relevant, describe actions recommended to mitigate the effects:		
3.4	If actions were recommended to mitigate the effects, were these implemented?	Y	N
4	**Closure**		
4.1	Has the relevant Cote d'Ivoire Authority been briefed on complaint investigation?	Y	N
4.2	Has the Site Manager provided a formal response to the complainant? (attach)	Y	N