

# **Mining Environmental Management**

## **CODES OF PRACTICE**

# **Environmental Effects Monitoring Program**

Guyana Geology and Mines Commission  
Brickdam, Georgetown, Guyana

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**Rev – 0**

<b>MINING (AMENDMENT) REGULATIONS 2005</b>	<b>ENVIRONMENTAL MANAEMENT CODES OF PRACTICE (DRAFT) Environmental Effects Monitoring Program - (Rev. 0)</b>	<b>GUYANA GEOLOGY AND MINES COMMISSION</b>
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## TABLE OF CONTENTS

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<b>1.0</b>	<b>INTRODUCTION .....</b>	<b>3</b>
1.1	REGULATORY AUTHORITY/MANDATE .....	3
1.2	JUSTIFICATION FOR THE ENVIRONMENTAL EFFECTS MONITORING PROGRAM CODE OF PRACTICE ....	3
1.3	ADMINISTRATION OF CODES AND RESPONSIBILITIES OF OWNERS AND WORKERS.....	4
<b>2.0</b>	<b>GLOSSARY OF TERMS.....</b>	<b>6</b>
<b>3.0</b>	<b>MISSION AND OBJECTIVES.....</b>	<b>1</b>
3.1	MISSION STATEMENT.....	1
3.2	OBJECTIVES.....	1
<b>4.0</b>	<b>SCOPE.....</b>	<b>2</b>
<b>5.0</b>	<b>PRINCIPLES AND STANDARDS OF PRACTICE.....</b>	<b>3</b>
5.1	ENVIRONMENTAL ASSESSMENT .....	3
5.2	MONITORING .....	5
5.3	EVALUATION AND REPORTING .....	6
<b>6.0</b>	<b>CODE IMPLEMENTATION .....</b>	<b>7</b>
6.1	ENVIRONMENTAL ASSESSMENT .....	7
6.2	MONITORING .....	7
6.3	EVALUATION AND REPORTING .....	8
<b>7.0</b>	<b>MONITORING AND SURVEILLANCE .....</b>	<b>10</b>
<b>8.0</b>	<b>EMERGENCY MEASURES .....</b>	<b>10</b>
<b>9.0</b>	<b>REFERENCES .....</b>	<b>11</b>

### LIST OF FIGURES

<b>Figure 1.0</b>	<b>Monitoring Strategy, EEM Program.....</b>	<b>4</b>
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<p><b>MINING (AMENDMENT) REGULATIONS 2005</b></p>	<p><b>ENVIRONMENTAL MANAEMENT CODES OF PRACTICE (DRAFT) Environmental Effects Monitoring Program - (Rev. 0)</b></p>	<p><b>GUYANA GEOLOGY AND MINES COMMISSION</b></p>
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## **1.0 Introduction**

This Code of Practice for **Environmental Effects Monitoring (EEM) Programs** for medium-scale and large-scale mines is intended to provide environmental management guidance and to promote the related best management practices. It is not a design manual<sup>1</sup>.

### **1.1 Regulatory Authority/Mandate**

The Mining (Amendment) Regulations 2005<sup>2</sup> were promulgated in 2004. Regulation 248 of the Mining (Amendment) Regulations 2005 stipulated that the Guyana Geology and Mines Commission (GGMC) prepare Codes of Practice for Mining Environmental Management prior to their incorporation into the Regulations.

The Codes of Practice were intended to provide critical environmental guidance to the Mining Industry, particularly small and medium-scale gold mines. The importance of the codes was even more enhanced by the development of the Low Carbon Development Strategy.

The following ten (10) provisions of the Codes of Practice for Environmental Management were identified:

- Use of Mercury
- Tailings Management
- Contingency and Emergency Response Plans
- Mine Effluents
- Mine Reclamation and Closure Plans
- Mine Waste Management and Disposal
- Environmental Effects Monitoring Program
- Quarrying
- Sand and Loam Mining
- Use of Small Dams for the Control of Water and Tailings

### **1.2 Justification for the Environmental Effects Monitoring Program Code of Practice**

Mining, by its very nature, is disruptive, and impacts the environment. The impacts can be physical, chemical, biological or socio-economic. The level and nature of the impacts and the consequence of the

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<sup>1</sup> This document is **NOT** a design manual. Users of this document shall assume full responsibility for the design of facilities and for any action taken as a result of the information contained in this document.

<sup>2</sup> The Mining Regulations, made under the Mining Act (1989), was amended by the Mining (Amendment) Regulations 2005: Collectively they address all the important aspects of mining environmental management.

<b>MINING (AMENDMENT) REGULATIONS 2005</b>	<b>ENVIRONMENTAL MANAEMENT CODES OF PRACTICE (DRAFT) Environmental Effects Monitoring Program - (Rev. 0)</b>	<b>GUYANA GEOLOGY AND MINES COMMISSION</b>
--	--	--

impacts depends on the deposit, the mining method employed and the characteristics of the existing or receiving environment.

The visual impacts of large and medium-scale gold and diamond mining are very disturbing to the general public. In Guyana there is a growing public demand for adherence to the Mining Regulations, mitigation of the impacts of unreclaimed properties, and practice of sustainable mining in the gold and diamond industry.

The Mining (Amendment) Regulations 2005 aims to promote responsible environmental management practices within the mining industry and to minimize the resulting environmental impacts. The acceptable level of environmental impacts associated with the gold and diamond industry must reflect the interest of the Regulatory Agencies, those of the general public and other stakeholders, and those of the Mining Industry.

In order to make an informed decision on what level of impacts are acceptable it is important to determine the environmental effect (areal, terrestrial, aquatic) of the disruption or impacts. The Environmental Effects Monitoring (EEM) Program would provide the data and information to make that determination.

The EEM Program Code of Practice was developed to provide guidance to the Regulators, the mine owners or proponents, and other stakeholders on its preparation and implementation.

The Mining (Amendment) Regulations 2005, Part XXVIII, Section 252 stipulates:

- (1) Three years after the commencement of these Regulations, save and except for small-scale mines, environmental impacts monitoring shall be conducted for every mine, including new mines.
- (2) Two years after commencement of these Regulation, each environmental effects monitoring programme shall be required to be submitted to the Commission for approval as part of the Environmental Management Plan referred to in regulation 248

This Code reflects sound management practices followed in other countries. Its principles and approaches are also taken from various sources. It is the result of a comprehensive literature review and consultations with the various stakeholders in Guyana.

### **1.3 Administration of Codes and Responsibilities of Owners and Workers**

A useful strategy for sustainable environmental management in the small and medium-scale gold and diamond mining is co-regulation by the various stakeholders including the GGMC, and the Miners, and Mining Industry.

GGMC's mandate or role as defined by the Mining Act 1989 and the Mining (Amendment) Regulations 2005 is to develop, administer and enforce the mining regulations. Specific responsibilities include:

- Development and upgrading of the codes of practice
- Consultations with the stakeholders in the mining industry including mining organizations and miners on the development, and utility of the Codes Of Practice.

<p><b>MINING (AMENDMENT) REGULATIONS 2005</b></p>	<p><b>ENVIRONMENTAL MANAEMENT CODES OF PRACTICE (DRAFT) Environmental Effects Monitoring Program - (Rev. 0)</b></p>	<p><b>GUYANA GEOLOGY AND MINES COMMISSION</b></p>
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- Public education, orientation and training
- Enforcement of, and monitoring compliance with, the Mining (Amendment) Regulations 2005

The prime responsibility for the implementation of, and compliance with, the Mining (Amendment) Regulations 2005, and the application of sound environmental management practices rests with the Mine Owners and operators. Specifically, with the respect to the EEM Program, the Mine Owners and operators must:

- Manage their operations in compliance with the Mining (Amendment) Regulations 2005, the related Codes of Practices and Guidelines
- Prepare and implement an EEM Program consistent with this code of practice.
- Provide their employees with required training and orientation on the EEM Program, and the related the regulations, best management OHS practices, codes and guidelines

<b>MINING (AMENDMENT) REGULATIONS 2005</b>	<b>ENVIRONMENTAL MANAEMENT CODES OF PRACTICE (DRAFT) Environmental Effects Monitoring Program - (Rev. 0)</b>	<b>GUYANA GEOLOGY AND MINES COMMISSION</b>
--	--	--

## 2.0 Glossary of Terms

Acid Rock Drainage (ARD)	Drainage of acid water containing dissolved metals as a result of natural oxidation of sulphides found in waste rock, ore and tailings exposed to wind, air, and water.
Best practice	The best way of doing things. The objective of best practices is to prevent or (when that is not possible) minimize risks to human health, as well as adverse environmental, social and economic impacts.
Co-Regulation	The mechanism whereby a <i>Community legislative act</i> entrusts the attainment of the objectives defined by <i>the legislative authority</i> to parties which are recognized in the field (such as economic operators, the social partners, non-governmental organizations, or related industry associations).
Code of practice	<p>Means the Environmental Code of Practice for the operation of mines that is published by the Commission and which shall be read as part of the Mining (Amendment) Regulations 2005.</p> <p>(A collection of rules and ethical principles related to a specific field of activity. A code of practice describes procedures and sets out standards considered to be best practices in the said field of activity. The code may be voluntary or mandatory)</p>
Data Validation	The checking of <b>data</b> for correctness, or the determination of compliance with applicable standards and protocols.
Ecosystem	A dynamic complex of plant, animals and microorganism communities and their non-living environment interacting as a functional unit.
Effluent	Means any fluid including airborne particles of matter and other substances in suspension or solution in the fluid and includes mine de-watering discharges, site runoff, discharges from a tailings basin or settling pond, discharges from a processing plant or dredging operation which is released to the surface or ground water and other substances such as colloids, in solution or suspension.
End points	The projected final state of a measurable process as defined by specific characteristics and parameters

<b>MINING (AMENDMENT) REGULATIONS 2005</b>	<b>ENVIRONMENTAL MANAEMENT CODES OF PRACTICE (DRAFT) Environmental Effects Monitoring Program - (Rev. 0)</b>	<b>GUYANA GEOLOGY AND MINES COMMISSION</b>
--	--	--

Environmental effects	Regular and systematic gathering and analysis of information to evaluate the patterns
Monitoring	or changes in the characteristics of an environment related to specific human activity. The information is gathered by select methods, focusing on a specific set of parameters.
Guidelines	A non-binding document, usually designed to provide users with information, explanations, guidance and help with respect to a specific topic. Guidelines are a tool frequently used to enforce new regulations. Users can be either the Regulator itself or the industry.
Medium-scale mine	A mine for which a mining permit has been issued and from which a volume in excess of 200m <sup>3</sup> , but less than 1000m <sup>3</sup> of material, inclusive of any overburden, is excavated or processed as an aggregate in any continuous period of twenty-four hours.
Mine	Includes any excavation, processing facility and/or related facilities for the recovery of metal, mineral or quarriable material and excludes any excavation, processing facility or related facilities that excavate or process less than 20m <sup>3</sup> in any continuous period of twenty-four hours
Mine closure	A whole of mine life process which typically culminates in property relinquishment. Closure includes decommissioning and rehabilitation. This term is often used interchangeably with Mine decommissioning.
<b>pH</b>	A measure of the acidity or alkalinity of water, <i>sediment</i> or soil. The measure is based on the concentration of hydrogen ions and gives the negative logarithm of the hydrogen (H <sup>+</sup> ) ion, corresponding to 10 <sup>-7</sup> . A pH value of 7 is neutral. All values higher are considered alkaline, and all values lower are considered acidic.
Quality Assurance	The systematic monitoring and evaluation of the various aspects of a project, service, or facility to ensure that standards of quality are being met
Quality Control	The process by which product quality is compared with applicable standards; and the action taken when nonconformance is detected
Regulations	A type of “delegated legislation” enacted by a state or local government agency given authority to do so by the appropriate legislature.  Regulations are generally very specific and are also referred to as rules or simply administrative law. Regulations are official rules and must be followed.

<p><b>MINING (AMENDMENT) REGULATIONS 2005</b></p>	<p><b>ENVIRONMENTAL MANAEMENT CODES OF PRACTICE (DRAFT) Environmental Effects Monitoring Program - (Rev. 0)</b></p>	<p><b>GUYANA GEOLOGY AND MINES COMMISSION</b></p>
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<p>Risk assessment</p>	<p>The process of addressing what could go wrong with a facility and its associated plans and procedures and what are the consequences of failure. Risk assessment provides a basis for the development of risk management, including communication, contingency, mitigation and emergency and response plans.</p>
<p>Small-scale mine</p>	<p>A mine for which a claim license has been issued and from which a volume in excess of 20m<sup>3</sup>, but less than 200m<sup>3</sup>, of material, inclusive of any overburden, is excavated or processed as an aggregate in any continuous Twenty-four hour period.</p>
<p>Species</p>	<p>A group of plants, animals or microorganisms that have a high degree of similarity and generally can interbreed only among themselves.</p>
<p>Sustainable Development (SD)</p>	<p>Development that meets present-day needs without compromising the ability of future generations to meet their needs.</p>
<p>Tailings</p>	<p>The gangue and other waste material resulting from the washing, concentration, or treatment of ground ore. Also those portions of washed ore that are regarded as too poor to be treated further</p>
<p>Tailings dam</p>	<p>Impoundment to which tailings are transported, the solids settling while the liquid may be withdrawn.</p>
<p>Trends</p>	<p>Patterns of change in specific parameters and characteristics</p>
<p>Toxicity:</p>	<p>The inherent potential or capacity of a material to act on a group of selected organisms, under defined conditions. An aquatic <i>toxicity test</i> usually measures the proportion of organisms affected by their exposure to specific concentrations of chemical, effluent, elutriate, Leachate, or receiving water.</p>
<p><b>Toxicity test:</b></p>	<p>The means by which the <i>toxicity</i> of a chemical or other test material is determined. A toxicity test is used to measure the degree of response produced by exposure to a specific level of stimulus (or concentration of chemical).</p>
<p><b>Turbidity</b></p>	<p>The state, condition or quality of opaqueness or reduced clarity of a fluid, due to the presence of suspended material.</p>



## **3.0 Mission and Objectives**

### **3.1 Mission Statement**

The following is the Code's mission statement:

To provide the framework for the generation and evaluation of data to support the assessment of the environmental effects associated with large and medium-scale mines in Guyana.

### **3.2 Objectives**

- 1) Ensuring that the monitoring program generates data that is accurate and reliable and representative of conditions in the mine-impacted environment.
- 2) Produce data and the basis to address and mitigate the observed indications of environmental impacts, as necessary
- 3) Ensure that the EEM Program is flexible and dynamic and able to respond to observed changes in the receiving environment

<p><b>MINING (AMENDMENT) REGULATIONS 2005</b></p>	<p><b>ENVIRONMENTAL MANAEMENT CODES OF PRACTICE (DRAFT) Environmental Effects Monitoring Program - (Rev. 0)</b></p>	<p><b>GUYANA GEOLOGY AND MINES COMMISSION</b></p>
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#### **4.0 Scope**

This Code of Practice is a mandatory code that applies to large and medium-scale mining operations. The Code addresses all phases of the mining cycle and is dependent on an accurate description of the baseline conditions and an environmental impact assessment.

This Code is subordinate to the Mining (Amendment) Regulations 2005 and intended to complement regulatory requirements, not to replace them. Compliance with the rules, regulations and laws is therefore necessary.

No guarantee is made in connection with the application of the Code to prevent hazards, accidents, incidents, or injury to workers and/or members of the public at any specific site where environmental effects monitoring is conducted.

<b>MINING (AMENDMENT) REGULATIONS 2005</b>	<b>ENVIRONMENTAL MANAEMENT CODES OF PRACTICE (DRAFT) Environmental Effects Monitoring Program - (Rev. 0)</b>	<b>GUYANA GEOLOGY AND MINES COMMISSION</b>
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## 5.0 Principles and Standards of Practice

An EEM program monitors the identified significant environmental effects associated with a mining operation over time to determine if they (the effects) follow the predicted or expected trends. The EEM Program is designed to detect, evaluate and respond to any changes or fluctuations from the projected trends and end points.

The significant effects are usually defined during an environmental assessment (EA) which also establishes baseline conditions (water quality, soil quality, aquatic and terrestrial eco-systems, etc). Environmental effects are the receiving environment's response to mining activities.

EEM Program generally has two (3) phases:

- 1) Environmental Assessment and Related Monitoring
- 2) Environmental Effects Monitoring
- 3) Evaluation and Reporting

The typical sequence of monitoring and other related tasks are depicted in Figure 1.0, Monitoring Strategy, EEM Program. The tasks are discussed in subsequent sections

(For further details on how the following may be implemented, the Readers should refer to **Section 6 Code Implementation**).

### 5.1 Environmental Assessment

**Principle:** The environmental assessment determines if there are any significant environmental affects associated with the proposed mine-related activities and identifies mitigation measures. The EA establishes baseline site conditions (water quality, soil quality, aquatic and terrestrial eco-systems, etc) and projects the trends and end points of the receiving environment's response to the mining over time.

Any major changes in operation or expansions may trigger additional assessment and related monitoring.

There are specific monitoring and reporting requirements for the EA.

#### **Standards of practice**

Some of the standard practices and considerations associated with the EA are:

- 5.1.1 A feasibility study or a preliminary mine plan
- 5.1.2 Site and regional baseline conditions
- 5.1.3 Applicable regulatory criteria and limits
- 5.1.4 Potential significant environmental effects and contaminants of concern associated with specific activities
- 5.1.5 Mitigation measures
- 5.1.6 Field studies and monitoring
- 5.1.7 Environmental effects trends and end points
- 5.1.8 Compounding factors that could alter the projected environmental effects

<b>MINING (AMENDMENT) REGULATIONS 2005</b>	<b>ENVIRONMENTAL MANAEMENT CODES OF PRACTICE (DRAFT) Environmental Effects Monitoring Program - (Rev. 0)</b>	<b>GUYANA GEOLOGY AND MINES COMMISSION</b>
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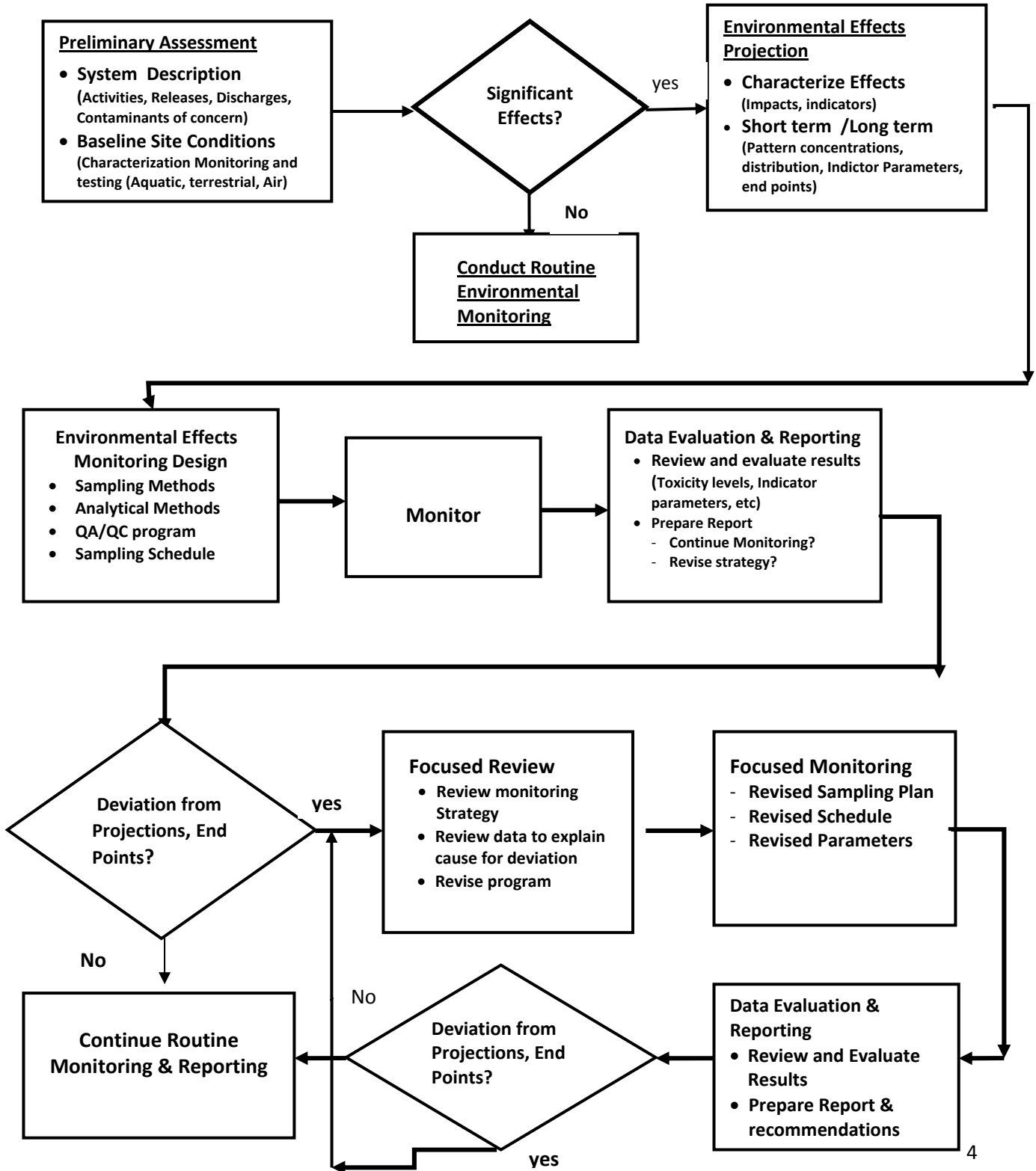


Figure 1 Monitoring Strategy, EEM

<p><b>MINING (AMENDMENT) REGULATIONS 2005</b></p>	<p><b>ENVIRONMENTAL MANAEMENT CODES OF PRACTICE (DRAFT) Environmental Effects Monitoring Program - (Rev. 0)</b></p>	<p><b>GUYANA GEOLOGY AND MINES COMMISSION</b></p>
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## 5.2 Monitoring

Principle: The monitoring program must be dynamic, site and project-specific, be able to support the evaluation of observed trends and patterns, and support the determination of causes of major fluctuations from the projections of the environmental assessment.

There are essentially four types of monitoring:

- Monitoring in support of the EA and the establishment of baseline Conditions
- Environmental effects monitoring
- Monitoring to explain deviations from projected environmental effects trends and end points
- Routine Monitoring

All sampling and monitoring programs must be guided by work/sampling plans.

### Standards of practice

5.2.1 **EA Investigation and monitoring** as defined in Sections 5.1.1 through 5.1.8: The sampling and monitoring would be project specific but should include the following:

- Soil, water quality, fish tissue/toxicity sampling to establish baseline conditions
- Follow up sampling/monitoring to confirm original results
- Sampling to characterize effluents and other releases

5.2.2 **EE Monitoring**: A site-specific environmental effects monitoring plan must be developed and implemented. The plan should:

- Clearly define the environmental effects being monitored and evaluated
- Include provisions and strategies to measure and evaluate all effects predicted or estimated in the environmental assessment
- identify all parameters to be measured along with related sampling/monitoring intervals
- Indentify all environmental performance indicators, including air and water quality, and aquatic and terrestrial species and ecosystems, as necessary.
- Reference historical water quality data and ecological studies of the area
- Include reporting criteria, frequency and goals

5.2.3 **Focused Monitoring**: This monitoring is triggered if EEM detects deviation from the predicted environmental effects trends and end points. The results of this phase of monitoring would be used to explain the observed deviations and design new sampling/monitoring protocols.

<b>MINING (AMENDMENT) REGULATIONS 2005</b>	<b>ENVIRONMENTAL MANAEMENT CODES OF PRACTICE (DRAFT) Environmental Effects Monitoring Program - (Rev. 0)</b>	<b>GUYANA GEOLOGY AND MINES COMMISSION</b>
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5.2.4 **Routine Monitoring:** Routine monitoring is long term monitoring and represents a reduced level from the EEM. The parameters and indicators monitored are based on discussion with and approval by the Regulators (GGMC/EPA).

### 5.3 Evaluation and Reporting

**Principle:** Data collected must be evaluated and analyzed with respect to the goals and purpose of the investigation. The reporting procedures and scheduled is dictated by regulatory criteria and the monitoring plans.

#### Standards of practice

##### Data Evaluation

- 5.2.5 A validation exercise is necessary to confirm the validity of the data collected
- 5.2.6 Data collected during the baseline environmental assessment will be used to establish baseline conditions.
- 5.2.7 The EA will identify the significant effects, and related mitigation measures
- 5.2.8 Data collected during the environmental effects monitoring will be compared to the environmental effects end-points and trends predicted in the baseline assessment.
- 5.2.9 Data gathered during the focused monitoring will be analyzed to determine the cause of the observed deviation fluctuations. Outcomes could include changes in the monitoring frequency and the list of parameters monitored.

##### Reporting

- 5.2.10 The reporting schedules are established in the monitoring plans
- 5.2.11 There are essentially three types of reports
  - **EA Reports:** This report describes baseline conditions based on the environmental assessment, identifies the significant effects and associated mitigation measures.
  - **Interpretive Reports:** Presenting data, comparing the results with baseline conditions to the observed concentrations, distribution and trends; interpreting results with respect the projected end points. This report will be prepared annually.
  - **Focused Monitoring Report:** This report will provide a causative explanation of the variations in the observed deviation from the projected environmental effects end points and trends. It will also propose changes in monitoring focus and strategy in order to address the observed deviations.

<p><b>MINING (AMENDMENT) REGULATIONS 2005</b></p>	<p><b>ENVIRONMENTAL MANAEMENT CODES OF PRACTICE (DRAFT) Environmental Effects Monitoring Program - (Rev. 0)</b></p>	<p><b>GUYANA GEOLOGY AND MINES COMMISSION</b></p>
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## **6.0 Code Implementation**

### **6.1 Environmental Assessment**

Environmental Assessments are pre-operational studies designed to determine the impact of specific mine and mine-related activities on the receiving environment.

The EA must be conducted by a professional approved by the EPA. The EA process includes the following:

#### **6.1.1 The initial determination, through consultations with the Regulators (EPA, GGMC), if an EA is required.**

#### **6.1.2 Preparation of the EA, including:**

- A feasibility study or a preliminary mine plan, including a system/process description
- A detailed description of the Site and regional baseline conditions
- Review of the applicable regulatory criteria and limits
- Determination if the proposed operation will meet the regulatory conditions and criteria
- Identification of the potential significant environmental effects and contaminants of concern associated with specific activities
- Identification, evaluation and testing of mitigation measures
- Conduct appropriate literature searches, field studies and monitoring so as to project ecological and other responses to the mining activities
- Identification of all compounding factors that could alter the projected environmental effects

#### **6.1.3** The results of the assessment include:

- A detailed description and characterization of the baseline conditions
- Identification of the significant environmental effects and the proposed mitigation measures
- Projection of the long term response by the receiving environment and environmental effects end points.

### **6.2 Monitoring**

The EEM track, measures, verifies and evaluates the projected environmental effects and identifies any deviations from the expected trends or end points. This monitoring also facilitates the evaluation of the effectiveness of the mitigation measures.

#### **6.2.1 Environmental Effects Monitoring**

##### **Contents of the Environmental Effects Monitoring Plan**

<b>MINING (AMENDMENT) REGULATIONS 2005</b>	<b>ENVIRONMENTAL MANAEMENT CODES OF PRACTICE (DRAFT) Environmental Effects Monitoring Program - (Rev. 0)</b>	<b>GUYANA GEOLOGY AND MINES COMMISSION</b>
--	--	--

The EEM is guided by a monitoring plan that should include most of the following:

- Projected significant environmental effects
- Description of baseline conditions (from EA)
- Parameters/Systems that may be monitored (depending on the identified environmental effects), include:
  - Air
  - Aquatic
  - Terrestrial
  - Surface and groundwater
- Identification of indicator parameters
- Sampling locations and strategy
- Sampling procedures and frequency
- Applicable regulatory standards and limits
- Analytical methods
- QA/QC procedures
- Contingency plans to address unpredicted fluctuations in observed trends and values
- Plans and format for the reporting results to regulatory agencies, general public and other stakeholders.

### **6.3 Evaluation and Reporting**

#### **6.3.1 Data Evaluation**

Data and results from all phases of monitoring must be processed, validated, analyzed interpreted and presented in readable format. This includes the following:

- Validation to confirm the data is accurate, defensible and representative of the receiving environment
- Interpretation field and laboratory QA/QC results
- Statistical analysis where required
- interpretation and integration of aquatic data
- Water quality and sediment quality analysis
- interpretation of effects trends and comparison with original projections

#### **6.3.2 Reporting**

- **EA Reports:** This report describes baseline conditions based on the environmental assessment, identifies the significant effects and associated mitigation measures. The report will be presented as part of the application for the environmental permit and presented for public and stakeholder review.
- **Interpretive Reports:** This report processes the data from the EEM, compares the results with baseline conditions, interprets observed concentrations,



<p><b>MINING (AMENDMENT) REGULATIONS 2005</b></p>	<p><b>ENVIRONMENTAL MANAEMENT CODES OF PRACTICE (DRAFT) Environmental Effects Monitoring Program - (Rev. 0)</b></p>	<p><b>GUYANA GEOLOGY AND MINES COMMISSION</b></p>
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distribution and trends; interprets results with respect the projected end points. This report will be prepared annually.

- **Focused Monitoring Report:** This report provides a causative explanation of any observed deviations from the projected environmental effects trends end points. It will also propose changes in monitoring focus and strategy in order to address the observed deviations. The report is prepared after the EEM.

<p><b>MINING (AMENDMENT) REGULATIONS 2005</b></p>	<p><b>ENVIRONMENTAL MANAEMENT CODES OF PRACTICE (DRAFT) Environmental Effects Monitoring Program - (Rev. 0)</b></p>	<p><b>GUYANA GEOLOGY AND MINES COMMISSION</b></p>
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## **7.0 Monitoring and Surveillance**

There are no additional monitoring associated with the implementation of this Code of Practice.

## **8.0 Emergency Measures**

There are no additional emergency measures or considerations related to the implementation of this code of practice

<p><b>MINING (AMENDMENT) REGULATIONS 2005</b></p>	<p><b>ENVIRONMENTAL MANAEMENT CODES OF PRACTICE (DRAFT) Environmental Effects Monitoring Program - (Rev. 0)</b></p>	<p><b>GUYANA GEOLOGY AND MINES COMMISSION</b></p>
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[www.on.ec.gc.ca/search/metadata.cfm?](http://www.on.ec.gc.ca/search/metadata.cfm?)

[www.ec.gc.ca/ese-eem/](http://www.ec.gc.ca/ese-eem/)