Mining Environmental Management

CODES OF PRACTICE

Quarrying

Guyana Geology and Mines Commission
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1.0 Introduction

This Code of Practice is for **Quarrying** operations which are subject to quarrying licenses granted by the GGMC. It is intended to provide environmental management guidance and to promote the application of related best management practices. It is not a design manual[1].

1.1 Regulatory Authority/Mandate

The Mining (Amendment) Regulations 2005[2] 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 incorporation into the final Regulations.

The Codes of Practice were intended to provide critical environmental management guidance to the Quarrying Industry. 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 indentified:

- 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 Tailing and Water Management

The Quarrying Code of Practice is administered by the GGMC; GGMC will periodically report on compliance with the Code of Practice to the Environmental Protection Agency (EPA). *(Notwithstanding this, the EPA has reserved the right to monitor and regulate the said quarrying properties and operations under the provisions of the Environmental Protection Act).*

[1] 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.

[2] 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.

1.2 Justification for the Quarrying Code of Practice

The Quarrying industry is very important to the sustained development of Guyana. The materials extracted and processed in Quarrying are essential to every aspect of infrastructural development and maintenance.

Quarriable materials exist in a variety of geological environments and are widely distributed in Guyana. The extractive methods employed in Quarrying makes the industry potentially disruptive to the environment and neighbouring communities and adjacent land uses.

This Code of Practice necessarily addresses the above concerns by providing environmental management guidance to the operators, regulators and other stakeholders, and ensures the application of best management practices within the industry.

This Code of Practice for Quarrying is based on sound management practices exercised elsewhere and on principles and approaches from various sources.

1.3 Administration of Codes and Responsibilities of Owners and Workers

The best strategy for sustainable environmental management in quarrying is co-regulation by the various stakeholders including the GGMC, the EPA, Quarry Operators, and the Mining Industry.

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

- Development and upgrading of the codes
- Consultations with the stakeholders in the mining industry including quarrying organizations and miners.
- Public education, orientation and training
- Enforcement of the quarrying regulations
- Compliance monitoring and enforcement of the Mining (Amendment) Regulations 2005

The prime responsibility for the implementation of, and compliance with, the Mining (Quarrying) (Amendment) Regulations 2005, and the application of sound environmental management practices rests with the Licensees, Quarry Owners and Operators. Specifically, with the respect to Quarrying, the Owners and Operators must:

- Manage their operations in compliance with the requirements of the Quarry License , and the Mining Act and Regulations
- Provide their employees with required training and orientation in the applicable regulations and statutes, including:
  - Quarrying regulations, and the related codes and guidelines
  - Environmental management
  - Contingency and Emergency Response Plans
  - The Mine Reclamation and Closure Code of Practice

- Occupational health and safety

2.0 Glossary of Terms

Abandoned site	An area formerly used for quarrying/mining and mineral processing, where closure is incomplete and for which a titleholder still exists.
Acceptable Standard	Commonly agreed standards that will normally ensure acceptable environmental performance is achieved. Where a specific issue requires attention at a quarry, the acceptable standard may be modified by the GGMC for inclusion in the permit.
Air Blast	Air vibration or air blast is the pressure or shock waves that radiate in air from an exploding charge. When a pressure wave passes a given point, the pressure of the air rises rapidly before returning to atmospheric pressure after a period of oscillations. The maximum pressure is the 'Air Blast Overpressure' measured in dB.
Ambient Noise:	The pervasive noise associated with a given environment, being usually a composite of sounds from sources both near and distant normally experienced in an area. Ambient noise is measured as dB (A) over a set period of time.
Artisanal mine	A small, medium or even large-scale, informal, legal or illegal mining operation that uses rudimentary processes to extract gold from either primary or secondary ore bodies.
Batter	The uniform side slope of walls, banks, cuttings, etc.
Bench	A ledge constructed in a batter or natural slope.
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.
Blasting	The firing (detonation) of explosive charges. The breaking of solid rock into smaller fragments by the use of explosives.
Buffer areas	A buffer area is a transitional area between areas of predominantly different activities or land uses.

Buffer Zone	Means land on either bank of rivers or watercourses from the low watermark of the bank to 20 meters (20 m) inland, and extending from the mouth of the river or navigable watercourse to its source; or any area within 30 meters (30 m) of a public road; or 100 meters (100 m) of approved residences, commercial/industrial developments; or 1 kilometer (1 km) of an approved nature reserve or park.
Bunds	Mounds or banks of earth made from the top-soil or sub-soil stripped off the excavation area, to create visual or sound barriers.
Burden	The distance from the borehole and the nearest free face, or the distance between boreholes measured perpendicular to the spacing: The total amount of material to be blasted by a given hole, usually measured in cubic yards.
Code of practice	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. (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).
Co-Regulation	The mechanism whereby a Community legislative act entrusts the attainment of the objectives defined by the legislative authority to parties which are recognized in the field (such as economic operators, the social partners, non-governmental organizations, or related industry associations).
Decibel (symbol dB)	A unit used to measure the power of a sound signal relative to some reference level. As a measure of sound intensity, a zero-decibel reference is stipulated to be the lowest level audible to the human ear.
Developer	The applicant for an environmental authorization for a project under the Environmental Protection Act.
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.
Environment	Surroundings in which a quarry operates, including air, water, land, natural resources, flora and fauna, humans, and their interaction.
Environmental Impact	Any change to the environment, whether adverse or beneficial, wholly or partially resulting from the quarry's environmental aspects.
Environmental Impact Assessment (EIA):	The process of identifying, predicting, and evaluating potential environmental impacts of development proposals. The results of the study are taken into account by the Regulatory Authority in determining whether the proposed development should be allowed, and under what conditions.
EPA	The Environmental Protection Agency
End of mine life process	A process undertaken when the quarrying operation is about to be decommissioned or safely closed down.
Fly-rock	Rock thrown an excessive distance from the blasting site.
Ground Vibration (vp)	This is expressed in terms of peak particle velocity (symbol vp) and is measured in mm/s. People can feel ground vibration levels of approximately 0.5 mm/s, a level well below vibration levels, which are likely to cause damage to buildings.
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.
HSE	Stands for **H**ealth, **S**afety and **E**nvironment.
Medium-scale mine	A mine for which a quarrying/mining permit has been issued and from which a volume in excess of 200m^3, but less than 1000m^3, of

	material, including any overburden, is excavated or processed as an aggregate in any continuous 24-hour period.
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 20 m^3 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.
Overburden	Loose soil, sand, gravel, etc., that lies above the bedrock or above a deposit of useful materials, ores, or coal. Also called burden, capping, cover, drift, mantle, and surface, it may or may not include topsoil
Progressive reclamation	Reclamation that is carried out throughout the mine life, in day-to-day operations.
Quarry:	All extractive pits from which building construction and road making materials are obtained. It is normally referred to as an Extractive Industry in Planning Schemes.
Quarry face	The vertical or near vertical working surface of a quarry, rock excavation or gravel pit; also the steep section between benches.
Reclamation (rehabilitation)	The return of the disturbed land to a stable, productive and self-sustaining condition, taking into account beneficial uses of the site and surrounding land.
Regulations	A type of “delegated legislation” enacted by the appropriately authorized state, federal or local government agency. Regulations are generally very specific and are also referred to as rules, or simply administrative law. Regulations are official rules and must be followed.
Relinquishment Point	Point where the quarrying company has met agreed completion criteria to the satisfaction of the responsible authority. At this point, the site is no longer a danger to public health and safety is not a source of ongoing pollution or instability and allows a

	productive use of the land similar to its original use, or approved alternative beneficial use. A quarrying company has no further obligations regarding a specific property once its relinquishment has been accepted by the regulatory authorities.
Residential Premises:	Any building or part of a building lawfully used as, or for the purposes of, a private residence including the curtilage of the building or, where the boundaries of the cartilage are not ascertainable, the land within a distance of 25 meters from the building.
Risk assessment	The process of addressing what could go wrong with a mine or 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 response plans
Small-scale mine	A mine/quarry for which a claim license has been issued and from which a volume in excess of 20 m^3, but less than 200 m^3, of material, including any overburden, is excavated or processed as an aggregate in any continuous 24-hour period.
Stakeholders	The sum of all representative institutions of the community as well as the relevant sectoral Regulatory bodies.
Stream	Any watercourse, no matter how small or large it is; Includes creeks and rivers.
Stripping	The removal of earth or non-ore rock materials in order to gain access to desired ore or mineral materials; the process of removing overburden or waste material in a surface mine/quarrying operation.
Topsoil	Dark-colored, organic, well-decomposed soil material consisting of the residues of plant and animal materials together with synthesized cell substances of soil organisms and various inorganic elements.
Temporary closure	Phase following temporary cessation of operations when infrastructure remains intact and the site continues to be managed. Also called Care and Maintenance.

Turbidity	The state, condition or quality of opaqueness, cloudiness or reduced clarity of a fluid, due to the presence of suspended matter.

3.0 Mission and Objectives

3.1 Mission Statement

The mission of the Quarrying Code of Practice is to promote sound and sustainable Quarrying practices in Guyana in order to minimize the impacts on communities and the environment.

3.2 Objectives

1) Protect communities and the environment from potential adverse environmental effects caused by Quarrying
2) Foster a holistic approach to stewardship of Quarrying considering all stages in the mine life-cycle including, operation, reclamation and closure.
3) Promote the use of the Code of Practice by Licensees, Operators and Regulators.
4) Raise the awareness of, and educate all parties as to the importance of environmental management practices within the Quarrying industry.
5) Promote sustainable and environmentally sound Quarrying practices.

4.0 Scope

This mandatory Code of Practice applies to all current and proposed (applications) quarrying operations subject to licenses granted by the GGMC.

Compliance with the rules, regulations and statutes is mandatory.

This Code of Practice addresses only environmental issues related to Quarrying and does not specifically address occupational health and safety (OH&S) issues related to this industry

This Code of Practice covers all stages in the Quarry life cycle, i.e., planning, operation and decommissioning.

No guarantee is made in connection with application of the Code to prevent hazards, accidents, incidents or injuries to workers and/or members of the public at any specific Quarrying operation.

5.0 Principles & Standard Practice

5.1 Introduction

Careful planning throughout the life cycle is the key to successful and sustainable (financially and environmentally) quarrying. Each phase of quarrying, planning through closure, has environmental challenges. These can be overcome through compliance with the governing regulations and statutes, and best management practices.

This Code of Practice focuses on three distinct phases of Quarrying, they are:

- Permitting
- Operations
- Reclamation and Closure

The principles and standards of practice for each of these phases are reviewed subsequently.

5.2 Preplanning and Permitting

The permitting stage represents the formal engagement with the Regulatory Agencies, the GGMC and the EPA, and presentation of the application for the license to operate a quarry. The process is iterative and would involve various forms and levels of interactions, submittals, discussions and reviews

The permitting process allows the regulators, GGMC and the EPA, to ascertain if the prospective operator is aware of, has the resources to, and is prepared to, operate in an environmentally sound and sustainable manner. Award of a Quarrying license (GGMC) is contingent on an environmental authorization from the EPA.

The process for permitting and licensing a quarry is presented in Appendix A, Quarry Permitting Process.

5.3 Operations

Principle: A Quarry should be operated in an environmentally sound and sustainable manner. Careful planning and adherence to the regulations is the best strategy to a successful operation. The critical aspects of a successful operation are:

- Mine /Quarry Planning
- Environmental Management

5.4 Quarry Planning

Principle: The mine or quarry plan is the primary operational document for development and progression of a quarry. Its objective is the economical, orderly and sustainable exploitation of the resource: The plan optimizes production in conjunction with effective environmental management and best practices for occupational health and safety. The plan should reflect the

projected best options for the quarrying sequence, the location of plants, stock piles, working areas and for progressive rehabilitation.

The implementation of the quarry plan, and the development of the quarry, can only proceed after GGMC's approval of the quarry plan.

The use of vegetation and topography for screening of quarrying activities and the reduction of noise, dust and visual impacts are important consideration, and must be considered in the Quarry Plan.

The quarry plan should include some of the following:

- Property layout and Boundary
  - Site topography
  - Access Roads
  - Adjacent land use and properties
  - Buildings, support facilities
- Reserves
  - Quarriable Reserves
  - Phased production rates
  - Projected mine life
- Site Hydrology
- Production
  - Quarrying Methods
  - Operation hours
  - Quarrying sequence and progression
  - Initial quarry layout
  - Final quarry layout
  - Equipment
  - Production rates
  - Hauling
  - Drainage control
- Environmental management

The following section discusses some of the pivotal activities that have major environmental impact.

5.4.1 Quarrying Methods and Sequence

Principle: The basic sequence of quarrying involves site clearing and removal of overburden, drilling, blasting, and crushing. The quarrying sequence, and equipment used is project-specific and reflect the nature of the deposit, the required production rates and the intended end use of the product.

Some of the significant environmental impacts related to quarrying are associated with excavation, drilling, blasting and crushing. The impacts include noise, dust and waste generation,

and ground vibrations. Observation of the standards of practice, adherence to regulatory stipulations, and implementation of the proposed mitigation measures will limit the projected environmental impacts.

Standards of practice

5.4.2 Site Clearing

This is the first activity in the production sequence. The clearing sequence and progression is guided by the quarry plan and the rehabilitation strategy. The following are some important considerations in site clearing:

- The clearing should be progressive, only the area required for that particular phase should be cleared (progressive clearing would minimize fugitive dust generation, runoff, erosion and other associated environmental impacts)
- Clearing should not violate the quarry boundary, buffer zones
- Excavation and stock piling of top soil should progress immediately after clearing to maintain its vitality

5.4.3 Excavation of Overburden

The extent of overburden is determined during exploration and developmental drilling. The removal of overburden is usually coordinated with the rehabilitation strategy. The excavated material is either stockpiled or used in filling designated areas, in the construction of berms and bunds for noise abatement, and to visually screen the developing quarry.

The stockpiled materials must be managed to prevent erosion and runoff; run off from stockpiles can contribute to sedimentation in drainage systems and watercourses and in the deterioration in surface water quality.

Locate topsoil, overburden and waste rock piles as far away as possible from surface waters, springs, seeps and wetlands (swamps and marshes).

5.4.4 Drilling

Principle: Drilling essentially serves two purposes at this phase of the development of the quarry; development drilling to prove of further refine the extent of the reserves, and production drilling (blast hole) in support of blasting and rock fragmentation.

The drilling pattern is part of the blasting pattern and must be carefully controlled. The drilling/blasting pattern reflects the properties of the host rock, the dimensions of the area to excavated, the size of the haulage equipment and the degree of rock fragmentation required.

Standards of Practice

The prescriptions for blast holes include:

- Borehole diameter and depth
- Hole Spacing
- Hole Burden
- Subdrill

Consistency and precision in drilling is essential to the achievement of the desired fragmentation and bench dimensions, and to the control ground vibrations.

It is important the driller or drilling contractor be well qualified and have the appropriate equipment. The drilling rigs/equipment must have noise and dust suppression options.

5.4.4.1 Drilling Procedures

The Driller must:

- Drill clean drill holes to the precise depth
- Accurately log the bore holes and complete a drill log
- Check each hole for water and other obstructions that might compromise the loading of the hole
- Document all observations in the drill log

Variations from the drill-hole prescription must be identified and corrected prior to blasting. Corrective measures may include re-drilling of the holes and/or adjusting the explosive loading. The corrective measures should be incorporated in the Blast Report.

5.4.5 Blasting

Principle: Controlled bench blasting is the most efficient method of "cutting" rock away from a host formation in preparation for processing to the desired size. The desired intermediate result is a competent and stable quarry face and bench. The fragmented rock is usually loaded in haulers or conveyors and transported to the processing plant for crushing and sizing.

The size, height and width of the benches, is predetermined from the quarry/mine plan and is based on the competency of the rock, economic considerations and the final closure design. There are some distinct environmental impacts associated with blasting. These include ground vibrations, dust emissions, "fly rock", and air blast pressure. The ground vibrations and the air blast pressure could negatively impact the public.

The blasting contractor must make every effort and use all applicable techniques to minimize or mitigate the adverse environmental impacts.

Standards of practice

The blaster- in-charge must have a certificate of competence for blasting issued under the Explosive and Blasting Act. The blaster- in-charge will have total responsibility for all aspects of blasting including safety, control of the blast site, blast pattern design, loading of explosives, detonation, post-blast coordination and maintenance of the blast record.

- The blast-hole size, spacing and burden, the loading of the charges, the detonation and delay patterns should be adjusted after every blast to optimize the results as necessary.
- Secondary fragmentation with explosives should not be practiced unless specific approval is given.
- Blasting should be limited to the specific working hours stated in the blasting permit; the working hours should be in daylight hours between 7:00 am – 6:00pm on weekdays. Weekend blasting should only be done with special approvals and notifications. A public

information program must be implemented to make nearby residents and businesses aware of the blasting program, schedules and safety measures.

- Blasting should be controlled to limit the effects at the nearest residence or land use to the following:
  - For 95 percent of blasts, air blast over pressure shall not exceed 115 dB (Lin Peak);
  - The maximum air blast overpressure shall not exceed 120 dB (Lin Peak); and
  - Ground vibration shall not exceed 5 mm/s peak particle velocity.

The blaster-in-charge shall complete a Blasting Record after each blast that identifies the

Following:

- Customer/mine name
- Date/Time of blast
- Location of the blast
- Timing diagram
- Drill pattern
- Hole diameter
- Stemming type and depth
- Sub-drill depth
- Total number of holes in blast
- Hole depths
- Distance and direction to nearest structure
- Scaled distance
- Maximum pounds per delay
- Typical hole pattern
- Description of blasting products
  - Manufacturer's name
  - Product name
  - Size and quantity used
- Seismometer
  - Location of seismometer (distance & direction from shot)
  - Ground vibration and air overpressure results
  - Date of last Manufacturer's calibration
  - Blaster's signature
- Percentage fragmentation
- Powder Factor

The Blast Record should contain all the information required to re-create the blast

5.4.6 Benching

Principle: Quarries are advanced from top to bottom in a series of layers, or benches. Quarriable rock deposits are normally thicker than can safely be worked as one quarry face. In general each

quarry face, the vertical section of the bench, is no higher than 15 metres; bench widths vary between eight and fifteen metres and are functions of a number of considerations including:

- Competence of the host rock
- Overall design slope
- Access requirements for equipment
- Rehabilitation plans and post closure requirements

The overall dimensions of the benches are based on topographic, geological and economic considerations and are established in the initial quarry planning. The upper benches which are most visible should be rehabilitated first. Towards the end of operations in a particular section of the quarry, the quarry face should be cut into smaller benches to aid rehabilitation.

5.4.6.1 Other Considerations

- Benches should be self-draining, able to convey water along the bench to a suitable discharge point, sump or settling pond.
- In active quarries loose rock must be scaled from quarry faces and rock traps constructed at the toe of benches to guard against rock fall.
- Safety and stability considerations may dictate wider benches

5.4.7 Crushing

Principle: Mechanical crushing is the final stage in the fragmentation of the rock material. Sizing (screening) of the fragmented rock generally reflects its proposed end use. Blasting products are conveyed to the crushing plants by trucking and/or conveyors.

Fugitive dust emissions and noise are the two main adverse environmental impacts associated with this process.

Standards of practice

Dust and noise control measures specific to crushing and screening include:

- Enclosing conveyors and conveyor transfer systems
- Placing crushing and screening plants in buildings
- Using dust suppressants
- Locating the crushing plants away from the property boundaries and in consideration of the prevailing wind directions.

5.5 Environmental Management

Quarries must be operated in a safe and environmentally acceptable manner in compliance with the approved quarry plan, licenses and regulations. Environmental management must be incorporated into every aspect the operation, from planning through closure. Each phase of the quarry life-cycle has environmental challenges that can be overcome.

Standards of practice

Every operation is required to prepare an Environmental Management Plan. The plan should include the following:

- Identification of the significant impacts and the proposed mitigation measures
- Property/Site Description
- Waste Management & Disposal
- Noise Control
- Dust Control
- Access and Haulage
- Cleanup Plans
- Buffer Zones
- Environmental monitoring

Operational Considerations

5.5.1 Access and Haulage

Access roads, haul roads, and access ramps collectively provide access to the quarry, facilitate movement of personnel, equipment, and excavated rock from the quarry face to other parts of the quarry. Access and haulage roads requirements must be identified during the initial planning. Drainage, visibility, neighbours, dust control and noise control, gradient, type of equipment used on the road and access ramps are factors to be considered in planning phases. Access points to and from public roads must be carefully considered. They are critical both to quarry operations and smooth flow of non-quarry traffic.

Access and haulage roads are both a source of noise and dust. The roads and ramps must be well maintained and coupled with effective drainage. Access roads must also be safe, have acceptable widths and gradients.

Standards of practice

5.5.1.1 Access Roads

- Limit the number of access roads to the quarrying area
- Access strips where the quarry pit joins major public roads should be made of concrete or asphalt to protect the road shoulder.
- Haulage distances should be minimized; ramp grades should not exceed 10%.
- Keep access roads well maintained

5.5.1.2 Access Ramps and Haul Roads

- Must be defined and located during the planning phase of the quarry
- Must be well maintained and drained
- Wide enough to allow two –way traffic
- Haulage distances should be minimized; ramp grades should not exceed 10%.
- Kept safe from the instability of benches and falling rock from quarry faces

- Necessary signs should be erected

Provisions must be made to maintain access and haulage roads even after the closure as they will be required for post closure activities.

5.5.2 Noise Reduction

Principle: Noise is a major pollutant in the quarrying environment. Almost all production and haulage activities contribute to noise within the quarrying environment and every effort should be made to reduce or mitigate it.

Standards of practice

Noise levels are of particular concern to neighbouring residents and other entities adjacent to quarries. Public concerns must be considered and addressed during the planning, layout and operation of quarries. Standard practice limits noise levels to within 10% of ambient noise.

Bund walls, and other solid barriers and topographical features can be effective for 'in line' reduction of sound levels.

Noise mitigation efforts include:

- Reduction in haulage routes and use of equipment within the mine
- Use mufflers to keep decibel levels below 85.
- Select low-noise equipment
- House conveyor belts and crushing and screening plants to limit noise
- Set and observe maintenance schedules for equipment
- Reduce speeds of empty haulage trucks
- Gradients on quarry roads should not exceed ten (10) percent
- Optimize the use of explosives to minimize overpressures
- Construct berms to act as buffers

Noise abatement plans must be prepared and presented for public review at the initial planning and permitting stage and whenever there are major new expansions.

5.5.3 Waste Management and Disposal

Licensees, owners and operators are responsible for the management and disposal of waste related to the operation. Waste is generated in almost every aspect of quarrying. The best strategy is to address the wastes at the planning stages of the quarry. Every quarry operation should have a waste management and disposal plan.

Standards of practice

A waste management hierarchy should be considered for all materials used at the quarry. Table 1.0, Waste Management Hierarchy, lists the options.

Table 1.0 Waste Management Hierarchy

Waste Management Practice	Description
Waste Avoidance	Practices that prevent the generation of waste altogether
Waste Reuse	Direct reuse of waste materials for the same grade of use
Waste Recycling or reclamation	Using valuable components of waste in other processes
Waste Treatment	To reduce hazard or nuisance, preferably at the site of generation
Waste Disposal.	

The waste management plan should address the following:

- Waste classification (type, source, amount)
  - Household waste
  - Sewage Waste
  - Industrial waste
  - Hazardous waste
- Waste Reduction Strategy
- Waste Avoidance Strategy
- Waste Reuse Strategy
- Disposal Strategy
  - Onsite disposal (burial) of domestic waste (should be at depths ≥1 metre).
  - Offsite disposal at landfills
  - Sewage wastes (septic tanks should be at least 50 metres from creeks or water sources)

Table 2.0, Waste Management Strategies, detailed waste management principles and standards of practice for the various types of wastes projected on a quarry site.

TABLE 2.0 WASTE MANAGEMENT STRATEGIES

Type of Waste	Principle	Standard of Practice
Household	Foster the application of waste minimization principles so as to reduce the amount of household wastes that are disposed of and ensure that sound waste disposal practices are implemented	• Promote waste avoidance, reduction, reuse and recycling practices. • Compost organic waste such as food, leaves, and roots. This compost could be used for revegetating the site. • Bury non-recyclable and non-compostable waste in an appropriate landfill complying with corresponding national or local landfill regulations. • Develop and implement an awareness program on waste minimization for mine workers
Fuels, Lubricants and oils	These represent a potentially serious threat to the environment and must be carefully managed.	• It is an offence to drain or dispose of any matter containing tars, oil, grease or any poisonous substances directly onto the surface of the land or into a river or creek. • A fuel containment bond with an impervious surface must be constructed for the handling of tars, all oils (including waste oils), lubricants and fuels. • Waste oils must be collected and stored on site until they are ready for reuse, or disposal at approved sites or centers offsite. • Training of employees in handling and storage, labeling, construction of containment bunds, and vehicle maintenance
Top Soil, Overburden and Waste Rock	Ensure that topsoil and waste rock piles are adequately located, designed, managed and reutilized for revegetation and rehabilitation works	• Build separate piles for topsoil, overburden material and waste rock. • Locate topsoil, overburden and waste rock piles as far away as possible from surface waters, springs, seeps and wetlands (swamps and marshes). • Locate and construct piles so that the potential of failure is minimized. • Take preventive measures to avoid water and wind erosion. • Keep topsoil biologically active to retain its value as a plant growth medium. • Where possible use top soil and waste rock immediately to rehabilitate disturbed sections of the quarry.
Hazardous Wastes	Protect workers, communities and the environment from chemicals and other hazardous substance used on site. The potential environmental threats from hazardous wastes dictates waste disposal strategies be developed and rigorously implemented	• Identify materials and prepare hazardous waste inventories • Material safety data sheets (MSDS) for chemical and hazardous materials must be kept on site • Describe methods for transport, storage and handling of hazardous waste. • Identify options for disposal and long term storage of hazardous waste. • Hazardous material must be packaged appropriately and disposed of at approved facilities or onsite locations. • When facilities are not available, operators are permitted to burn wastes, including batteries, using kerosene or similar fluids at specially set-aside or

		approved areas • Provide training on hazardous waste handling and storage for workers

5.5.4 Fuel Storage and Handling

Principle: Fuels, lubricants and oils are hazardous materials, represent a potentially serious threat to the environment and must be carefully managed. Management includes training of employees in handling and storage, labeling, construction of containment bunds, and vehicle maintenance.

Standards of practice

- It is an offence to drain or dispose of any matter containing tars, oil, grease or any poisonous substances directly onto the surface of the land or into a river or creek.
- A fuel containment bund with an impervious surface must be constructed for the handling of tars, all oils (including waste oils), lubricants and fuels.
- Collect and store waste oils on site until they are ready for reuse, or disposal at approved sites or centers offsite.
- Vehicle storage and maintenance facility must contain drainage sumps to capture/contain spills, and runoff
- Maintenance schedule for vehicles and must be implemented and followed.

5.5.5 Dust Control

Principle: Dust is potentially an environmental and health hazard. It must be controlled in order to minimize impacts to workers and adjacent communities. Dust is generated during almost all phases of Quarrying including, excavation, grading, drilling, blasting, from traffic on unpaved roads, from stockpiled materials and from uncovered haulage trucks. Effective dust control focuses on the sources of dust and dust-generating activities.

Standards of practice

Dust control measures include the following:

- Maintenance and watering of roads
- Enforcement of lower truck speeds on site
- Covering trucks hauling materials
- Watering and covering stockpiles
- Use chemical dust suppressants as necessary
- Use of dust suppressing drilling equipment
- Isolation and encasement of crusher and other dust-generating equipment

5.5.6 Buffer Zones

Principle: A buffer zone is a transitional area between areas of predominantly different activities or land uses. They have been used to isolate areas or protect resources such as water resources from degradation. The stipulated size of a buffer zone may vary even within the same industry, depending on the nature of a particular adjacent land use or resource.

Standards of Practice

The following are stipulated buffer zones for quarrying:

- **General**: A non-extractable, vegetated buffer zone 150 meters wide shall be maintained from the quarrying pits and adjoining areas with different land uses unless otherwise approved by the EPA. A copy of such approval shall be filed with the GGMC.

  A vegetated buffer zone 50 meters wide shall be maintained from the side of the access road to the edge of the pit
- **Major Highways**: A non-extractable, vegetated buffer zone, 100 meters wide, must be maintained along the side of the mine/pit parallel to Major Highways and power lines.
- **Other Locations**: A non-extractable, vegetated buffer zone, 100 meters wide, must be maintained along the side of the mine/pit parallel to any main public or private road and power lines.
- **River, Creek or Water Source**: No quarry pit shall operate within 200 meters of these resources unless adequate protection can be demonstrated in writing and approved in writing by the EPA. A copy of such approval shall be filed with the GGMC

5.6 Reclamation and Closure of Quarrying Operations

Principle: Quarries should be "mined for closure". The final pit layout and identified end-use should guide all activities during operation. Closure of quarries should result in a safe, stable and sustainable environment.

Progressive reclamation reflects the "mine for closure" strategy and should be practiced. It offers the best strategy for successful closure. Reclamation or rehabilitation plans should be included in the initial quarry plan, and then verified and updated periodically through the operating life of the quarry, in preparation for closure.

5.6.1 Progressive Reclamation and Closure

Progressive reclamation includes stabilization of benches and slopes, recontouring and revegetation of mined-out areas, screening of mined-out areas, as the mine progresses.

The Reclamation/Rehabilitation Plan should be submitted with the application for a quarrying permit. It is expected that the plan would evolve as the operation progresses.

The Reclamation/Rehabilitation Plan should include:

- A description of the site prior to the beginning of operations including: soils, landform, flora and fauna, drainage and conservation values, previous land use and environmentally damaged or sensitive areas
- Projections of site conditions at 5-year intervals or at critical phases of development
- Locations of stock piles ,berms and screening bunds
- Identification of disturbed sections of the quarry that will be highly visible from off-site locations and proposed mitigation measures
- Plans of intermediate drainage works and final drainage pattern
- Revegetation plans; sequence, use of native plants, proposed plant types.

Standards of practice

5.6.1.1 Top Soil

Management of topsoil is necessary for eff**ective dust and erosion control an**d revegetation. The following are important considerations

- Topsoil and vegetation should be carefully stripped and stockpiled in a clearly identified area for future use in reclamation and revegetation.
- Topsoil should not be stored within three meters of natural vegetation or mine face
- Topsoil should be kept alive by covering and allowing vegetative cover
- Implement erosion control procedures and mechanisms to protect topsoil from rainfall and wind
- Berms may be constructed to prevent erosion
- Locate topsoil Stockpiles outside of future quarrying area and faces.

5.6.1.2 Revegetation

As much as possible the site should be re-vegetated with native species or species determined t have specific attributes beneficial to the proposed end-use of the property.

- Identify source of grass and shrubs for use in revegetation at the quarry planning stage
- Revegetation must be implemented throughout the life of the quarry and not only at closure
- Revegetation shall include the replacement of topsoil

5.6.1.3 Contouring of Quarry Faces

Quarries progress through a series of benches. The size and location of these benches reflect the nature of the deposit and rock type, the extraction strategy and sequence and the access/haulage requirements. The overall slope of the final quarry pit reflects the widths of the benches and the height of the quarry faces.

Principle: Recontouring or restructuring of the quarry faces and slopes must reflect long term stability considerations, aesthetics and visual enhancement, and end use designation for the site.

5.6.2 Closure Plans

Principle: Closure plans must be developed in the early stages of the planning and development, and then verified and updated periodically through the operating life of the quarry in preparation for closure. The closure plan both guides, and is influenced by, the quarrying sequence and progression, and the final pit layout.

The primary purpose of the Closure Plan is to ensure the creation, maintenance and sustainability of the final end-use of the quarry property.

The Closure Plan should include, but not limited to:

- Operational history of the site
- Infrastructure development
- Final quarry layout
- Hydrology/water management
- Plans for removal and disposal of wastes and any hazardous or contaminated materials — fuel drums, soil contaminated by leaked fuel or oil
- Impact assessment results
- Revegetation plans
- Demolition and disposition plans for building and infrastructure
- Long term access requirements
- Long-term maintenance, if needed
- Potential land use upon closure

5.6.3 Communications

- The GGMC must be informed in writing twelve months in advance, of the time period over which mine/pit closure is expected, proposed change of land use after closure or temporarily cessation of operations.
- Upon satisfactory restoration of the area(s) the quarry/pit Operator or owner will be issued a formal discharge by the Commissioner of obligations to restore and the Environmental Bond shall be refunded.
- The Environmental Bond, or part thereof, will be used by the Commission to restore the environment where restoration of the said area was not done to the satisfaction of the Commissioner, provided that the Commission will not retain a third party to carry out such restoration before the Owner or Operator has been given three months from the date restoration becomes due to restore the area.

6.0 Monitoring and Surveillance

Monitoring and surveillance are associated with quarry safety and operations. Particular concerns are with the transportation, storage and use of explosives. Monitoring and security considerations with respect to explosives are addressed in Section 5.2, Operations.

7.0 Emergency Measures

Slope failure, misfiring of explosives and quarry accidents are the major potential emergency associated with Quarry operations. There are other potential emergencies associated with the quarrying environment.

The Contingency and Response Plan Code of Practice details the approach and strategies for addressing emergencies associated with the construction and operation of quarries.

8.0 References

British Geological Society, Natural Environmental Research Council, Explore *Quarry Restoration*
Environmental Protection Agency, *EIA Guidelines: Volume 1: Rules and Procedures for Conducting and Reviewing EIA5*. EPA Environmental Assessment Board, 2000

Dominica Physical Planning Division, Quarry Code of Practice, General Requirements for Establishing and Operating a Quarry in Dominica, January 2008

Environmental Protection Agency: *Environmental Impact Assessment Guidelines Volume 3: Mining*, 2000.

Pluess-Staufer Industries, Inc. Geology Department, Proctor, Vermont: *Jobe Phillips Quarry Property, Danby, Vermont, Quarry Plan with Progressive Reclamation. January, 2000*

Ripley, E.A., Redman, R.E. and Crowder, A. (1996), *Environmental Effects of Mining.* St. Lucie Press, 356 p., 1996.

Rock Products, What's *New in Drilling and Blasting,* Penton Media, 1999

Web sites

http://www.goodquarry.com/glossary (Glossary of quarry terms)
http://xmlwords.infomine.com/xmlwords.htm (on-line dictionary of mining terms)
http..pdf.usaid.gov-pdf docs-PNADL591.pdf.url
www.qpa.org - Quarry Products Association (QPA)

Appendix A

GGMC - Quarry Licensing/Permitting Process

GGMC: Quarry Permitting Process

Permit applications to develop and operate quarries must demonstrate the potential operator's understands the governing regulations and a commitment to good environmental management practice. The permitting process allows the regulators, GGMC and the EPA, to ascertain if the prospective operator is aware of, has the resources to, and is prepared to, operate in an environmentally sound and sustainable manner.

At the permitting stage the developer is assumed to have conducted and completed a feasibility study that would have included data gathering and evaluation, a site assessment, preliminary quarrying plans, layout and strategy, a preliminary environmental management plan and identification of data/information gaps.

The permitting stage represents the formal engagement with the Regulatory Agencies, the GGMC and the EPA, and presentation of the application for the license to operate a quarry. The process is iterative and would involve various forms and levels of interactions, submittals, discussions and reviews. The basic quarry permitting/licensing process is illustrated in Figure

Site Visit

A site visit is a mandatory and necessary step in the permitting process. The applicant should facilitate at least one such visit with the Regulators, GGMC and the EPA. The site visits offers the Regulators and the Developer the opportunity to review the property and discuss issues and concerns pertaining to the site. The Developer should maximize this opportunity by thoroughly preparing for the site visit. The visit should be documented and focus on, among other things:

- Environmentally sensitive areas
- Previous land use
- Rivers and creeks
- Drainage concerns
- Topography
- Adjacent land use
- Existing public and private roads
- Vegetation
- Housing areas
- Adjacent quarrying operations
- Boundary markers.

Application for a Quarrying License

The application for a license should follow the instructions and present enough supporting information, data and documentation to facilitate an effective review and evaluation by the GGMC. Failure to do so would likely to lead to a request for further information and thus delay consideration of the application. The application should include the some of the following:

- Project Description and Goals
- Maps and Illustrations
- Proposed Mine (Quarry) Plan
- Supporting infrastructure and systems
- Reclamation and Closure Plan
- An Environmental Impact Assessment (EIA) , specifically listing the significant impacts
- An Environmental Management Plan, that address, among other things, the mitigation measures to the significant impacts identified in the EIA

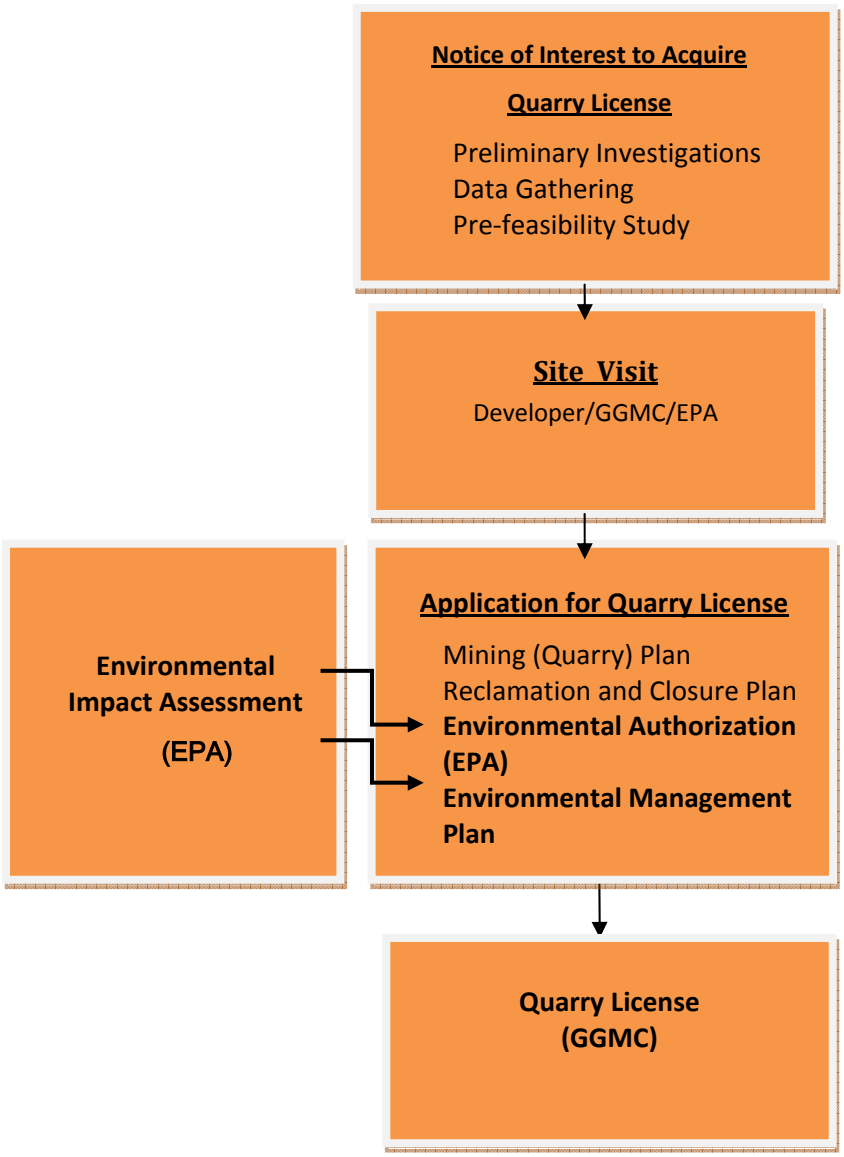

Figure 1 Quarrying Licensing Process

Mine (Quarry) Plans

A mine plan should accompany each application for a Quarrying permit. The mine plan is a "living document" which evolves as the operation progresses and on-the-ground experiences influences changes in approach and strategy. The mine plan must be updated annually and presented to the GGMC for approval on or before the third Monday in January of each calendar year.

A detailed discussion of mine planning is presented in Section 5.2.1 Mine Planning

Environmental Authorization

Award of a Quarrying license is contingent on an environmental authorization from the EPA.

An Environmental Impact Assessment may be required for awarding of an environmental permit; Developers must complete the requisite application and follow the stages outlined in the permitting process of the EPA (Appendix B)

Appendix B

Guyana Environmental Protection Agency - Environmental Impact Assessment Process

Environmental Impact Assessment Guidelines

Volume 3 - Mining

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Version 1

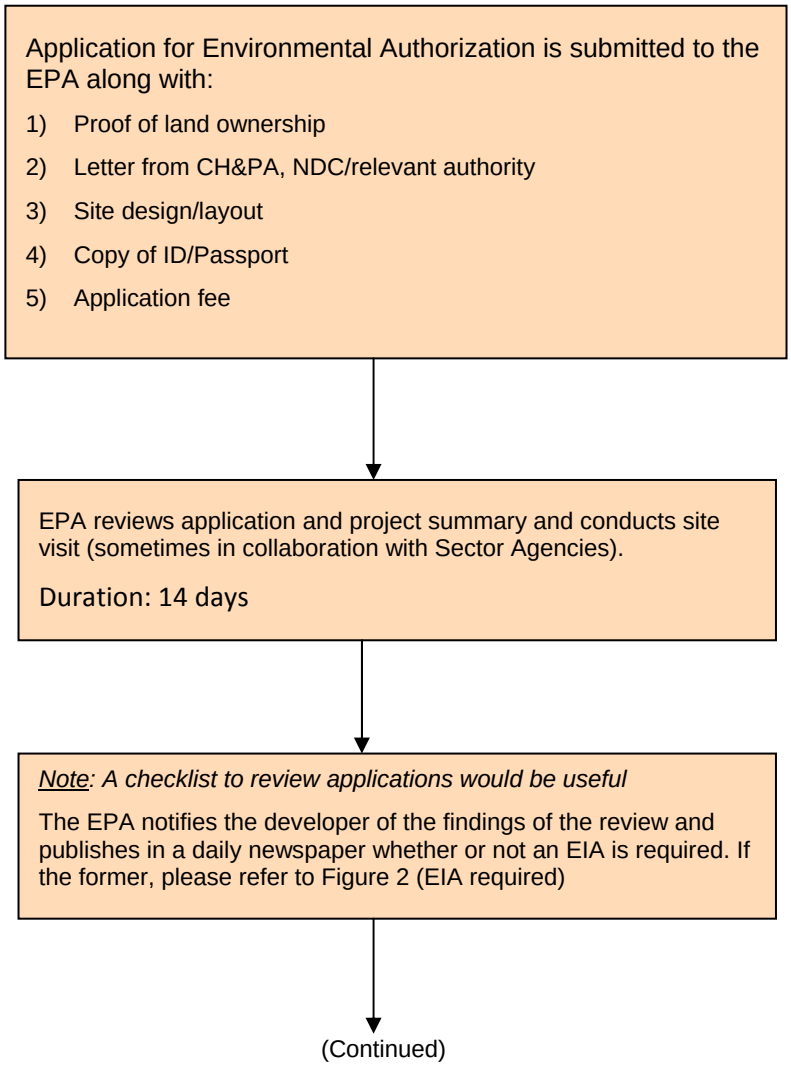
August 2000

Environmental Protection Agency/Environmental Assessment Board

Environmental Protection Agency

Figure 1

Preparatory Stages in Obtaining an Environmental Permit



(Continued)

Environmental Protection Agency

Figure 2

Stages in Obtaining an Environmental Permit - EIA Required

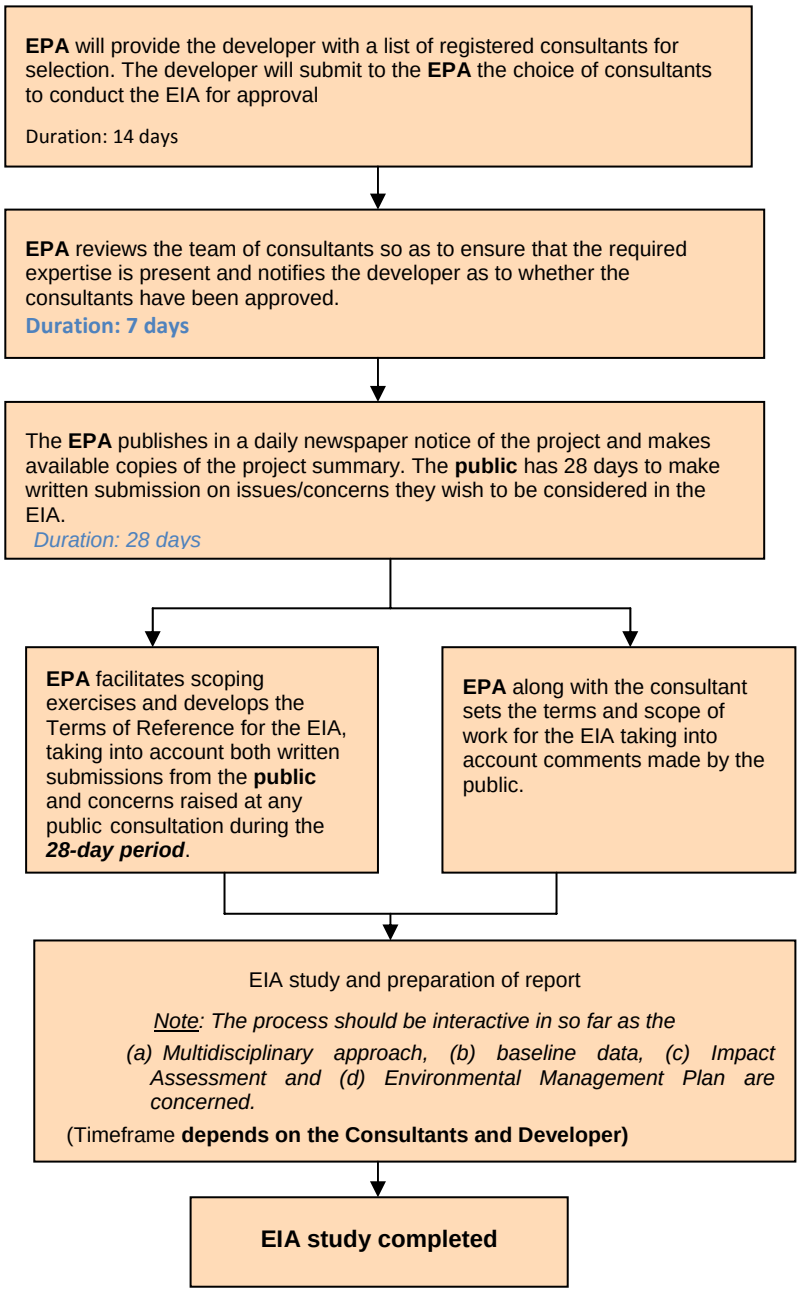
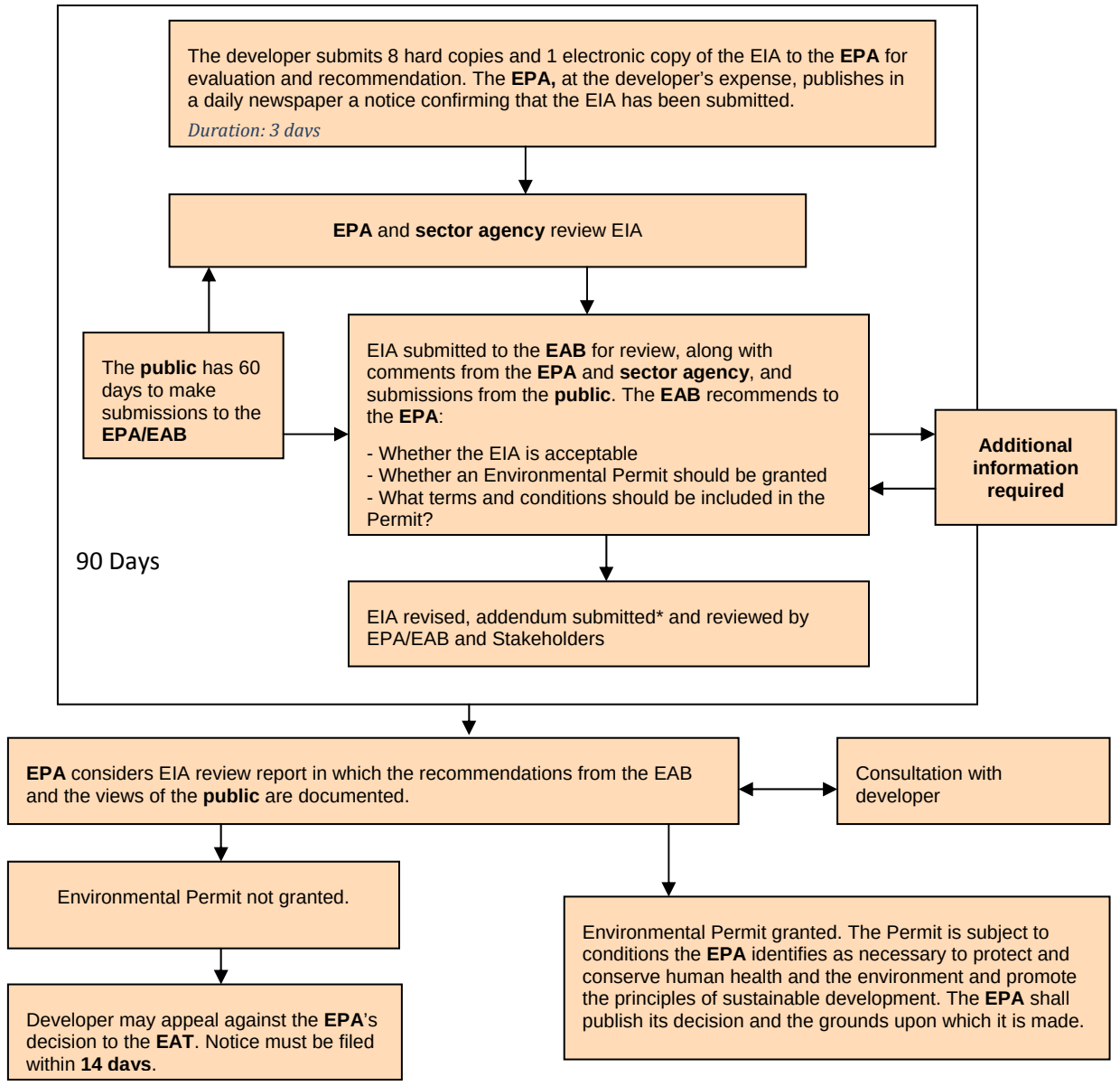


Figure 2

Stages in Obtaining an Environmental Permit - EIA required (cont'd)



Depending on the significance of the information requested, the EIA may need to be re-submitted either as a revised document or as an addendum to the EIA