Series A: Activity Guidelines



A1

BEST PRACTICE GUIDELINE

Small-Scale Mining (Standard Format)

Best Practice Guidelines for Water Resource Protection in the South African Mining Industry

DIRECTORATE: RESOURCE PROTECTION & WASTE

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DOCUMENT INDEX

This document is the first in a series of the following Activity Best Practice Guideline documents:

BPG A1. Small-Scale Mining

BPG A2. Water Management for Mine Residue Deposits

BPG A3. Water Managment in Hydrometallurgical Plants

BPG A4. Pollution Control Dams

BPG A5. Water Management for Surface Mines

BPG A6. Water Management for Undergrond Mines

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Since 1999 a number of steering committee meetings and stakeholder workshops were held at various stages of the development and drafting of this series of Best Practice Guidelines for Water Resource Protection in the South African Mining Industry.

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APPROVALS

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PREFACE

Water is typically the prime environmental medium (besides air) that is affected by mining activities. Mining adversely affects water quality and poses a significant risk to South Africa's water resources. Mining operations can further substantially alter the hydrological and topographical characteristics of the mining areas and subsequently affect the surface runoff, soil moisture, evapo-transpiration and groundwater behaviour. Failure to manage impacts on water resources (surface and groundwater) in an acceptable manner throughout the life-of-mine and post-closure, on both a local and regional scale, will result in the mining industry finding it increasingly difficult to obtain community and government support for existing and future projects. Consequently, sound management practices to prevent or minimise water pollution are fundamental for mining operations to be sustainable.

Pro-active management of environmental impacts is required from the outset of mining activities. Internationally, principles of sustainable environmental management have developed rapidly in the past few years. Locally the Department of Water Affairs and Forestry (DWAF) and the mining industry have made major strides together in developing principles and approaches for the effective management of water within the industry. This has largely been achieved through the establishment of joint structures where problems have been discussed and addressed through co-operation.

The Bill of Rights in the Constitution of the Republic of South Africa, 1996 (Act 108 of 1996) enshrines the concept of sustainability; specifying rights regarding the environment, water, access to information and just administrative action. These rights and other requirements are further legislated through the National Water Act (NWA), 1998 (Act 36 of 1998). The latter is the primary statute providing the legal basis for water management in South Africa and has to ensure ecological integrity, economic growth and social equity when managing and using water. Use of water for mining and related activities is also regulated through regulations that were updated after the promulgation of the NWA (Government Notice No. GN704 dated 4 June 1999).

The NWA introduced the concept of Integrated Water Resource Management (IWRM), comprising all aspects of the water resource, including water quality, water quantity and the aquatic ecosystem quality (quality of the aquatic biota and in-stream and riparian habitat). The IWRM approach provides for both resource directed and source directed measures. Resource directed measures aim to protect and manage the receiving environment. Examples of resource directed actions are the formulation of resource quality objectives and the development of associated strategies to ensure ongoing attainment of these objectives; catchment management strategies and the establishment of catchment management agencies (CMAs) to implement these strategies.

On the other hand, source directed measures aim to control the impacts at source through the identification and implementation of pollution prevention, water reuse and water treatment mechanisms.

The integration of resource and source directed measures forms the basis of the ***hierarchy of decision-taking*** aimed at protecting the resource from waste impacts. This hierarchy is based on a *precautionary approach* and the following order of priority for mine and waste water management decisions and/or actions is applicable:

The documentation describing Water Resource Protection and Waste Management in South Africa is being developed at a number of different levels, as described and illustrated in the schematic diagram on the next page.

RESOURCE PROTECTION AND WASTE MANAGEMENT HIERARCHY

Step 1: Pollution Prevention

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Step 2: Minimisation of Impacts
Water reuse & reclamation
Water treatment

↓

Step 3: Discharge or disposal of waste and/or waste water
Site specific risk based approach
Polluter pays principle

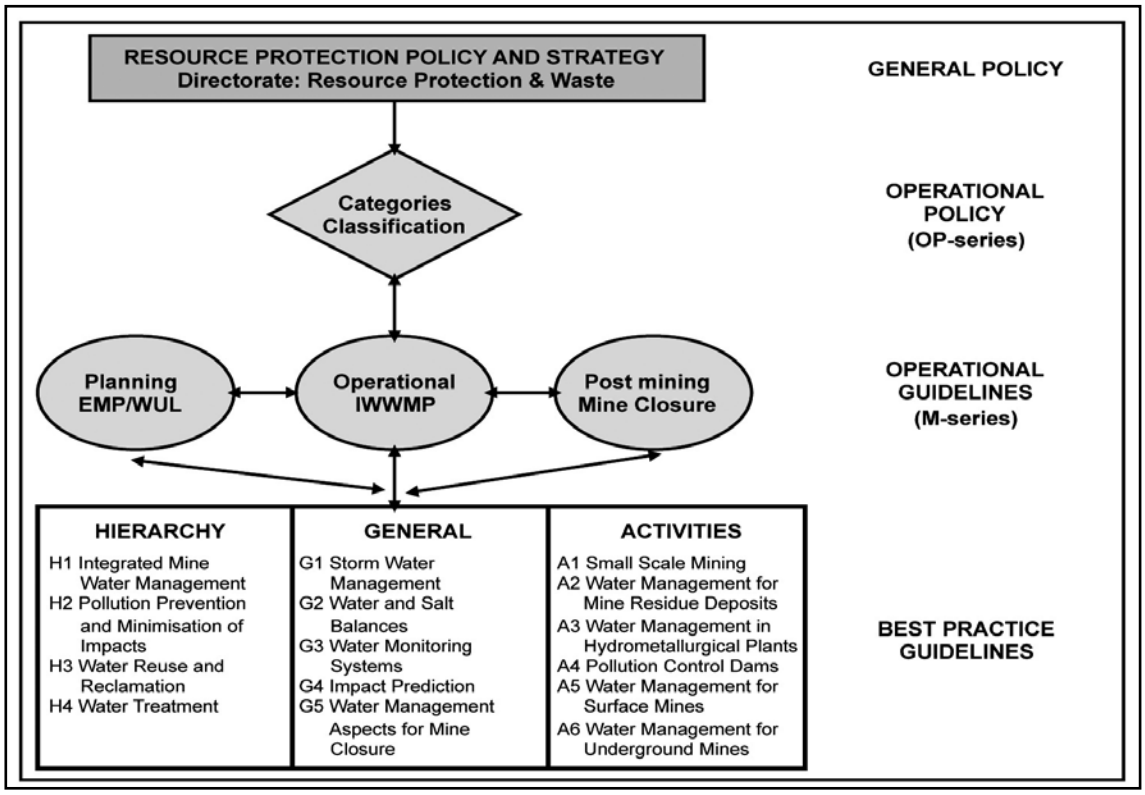
The overall Resource Protection and Waste Management Policy sets out the interpretation of policy and legal principles as well as functional and organisational arrangements for resource protection and waste management in South Africa.

Operational policies describe the rules applicable to different categories and aspects relating to waste discharge and disposal activities. Such activities from the mining sector is categorised and classified based on their potential risks to the water environment.

Operational Guidelines contain the requirements for specific documents e.g. licence application reports.

Best Practice Guidelines (BPG's) define and document best practices for water and waste management.

Schematic Diagram of the Mining Sector Resource Protection and Waste Management Strategy



The DWAF has developed a series of **Best Practice Guidelines** (BPGs) for mines in line with International Principles and Approaches towards sustainability.

The series of BPGs have been grouped as outlined below:

BEST PRACTICE GUIDELINES dealing with aspects of DWAF's water management **HIERARCY** are prefaced with the letter **H**. The topics that are covered in these guidelines include:

- H1. Integrated Mine Water Management
- H2. Pollution Prevention and Minimisation of Impacts
- H3. Water Reuse and Reclamation
- H4. Water Treatment

BEST PRACTICE GUIDELINES dealing with **GENERAL** water management strategies, techniques and tools, which could be applied cross-sectoral and always prefaced by the letter **G**. The topics that are covered in these guidelines include:

- G1. Storm Water Management
- G2. Water and Salt Balances
- G3. Water Monitoring Systems
- G4. Impact Prediction
- G5. Water Management Aspects for Mine Closure

BEST PRACTICE GUIDELINES dealing with specific mining **ACTIVITIES** or **ASPECTS** and always prefaced by the letter **A**. These guidelines address the prevention and management of impacts from:

- A1. Small-Scale Mining
- A2. Water Management for Mine Residue Deposits
- A3. Water Management in Hydrometallurgical Plants
- A4. Pollution Control Dams
- A5. Water Management for Surface Mines
- A6. Water Management for Underground Mines

The development of the guidelines is an inclusive consultative process that incorporates the input from a wide range of experts, including specialists within and outside the mining industry and government. The process of identifying which BPGs to prepare, who should participate in the preparation and consultative processes, and the approval of the BPGs was managed by a Project Steering Committee (PSC) with representation by key role-players.

The BPGs will perform the following functions within the hierarchy of decision making:

Utilisation by the mining sector as input for compiling water use licence applications (and other legally required documents such as EMPs, EIAs, closure plans, etc.) and for drafting licence conditions.

Serve as a uniform basis for negotiations through the licensing process prescribed by the NWA.

Used specifically by DWAF personnel as a basis for negotiation with the mining industry, and likewise by the mining industry as a guideline as to what the DWAF considers as best practice in resource protection and waste management.

Inform Interested and Affected Parties on good practice at mines.

The information contained in the BPGs will be transferred through a structured knowledge transfer process, which includes the following steps:

Workshops in key mining regions open to all interested parties, including representatives from the mining industry, government and the public.

Provision of material to mining industry training groups for inclusion into standard employee training programmes.

Provision of material to tertiary education institutions for inclusion into existing training programmes.

Provision of electronic BPGs on the DWAF Internet web page.

CONTENTS

1 INTRODUCTION

In the past, South Africa has relied heavily on large-scale mining activities by large mining houses to generate wealth and employment. However, it is increasingly believed that the future of mining will lie in the promotion of small-scale mining (SSM), which has, by and large, been operating informally. This comes from the fact that small-scale miners generally have had a low degree of ownership of mining property, a rudimentary knowledge of the exploitable reserves, limited technology and very little or no access to financing. The sector has also been characterized as highly unstable, with a large number of seasonal miners. High percentages operate with short-term contracts and the smallest operations also tend to be subsistence activities.

The country's new minerals legislation, however, endorses equitable mining rights and the promotion of previously disadvantaged persons who, in the past, did not have access to mining rights. Small-scale mining is therefore planned to be an important development and growth node for the country.

The environmental impacts of the small-scale mining sector have tended to be ignored. It is often assumed that because they are small these operations have little impact. However, given the growing numbers of such operations, increasing access to mechanized mining methods, and often, haphazard management, small-scale mining does have the potential to significantly affect the environment and our scarce national water resources. There is therefore an increasing need to address the problems of pollution and health and safety hazards associated with small-scale mining. It requires a concerted effort on the part of the mining industry and government to ensure that small-scale mining not only operates on a financially sustainable basis but also in an environmentally responsible manner. Moreover, successful resource protection management in the small-scale mining sector will require an approach that provides guidance and support and sets limits of acceptability.

The primary legal documents regulating environmental and water management on a small-scale mine are:

1 **The Environmental Management Plan (EMP).** Section 39 and Regulation 52 of the Minerals and Petroleum Resources Development Act (MPRDA) of 2002 (Act 28 of 2002) requires small-scale miners to fill in an EMP. The forms and the application process are administered and coordinated by the Department of Minerals and Energy (DME).

2 A **Water Use Licence/Authorisation** as set out in the *National Water Act (NWA), 1998 (Act 36 of 1998)* and administered by the DWAF.

3 The regulations published in **Government Notice No. 704 (1999)** on the use of water for mining and related activities aimed at the protection of water resources. Section 26(1) of the National Water Act, 1998 *(Act 36 of 1998),* provides for the development of such regulations.

4 A **Basic Assessment Report** (BAR). Regulations in terms of Chapter 5 of the National Environmental Management Act (NEMA), 1998 (Act 107 of 1998) define reconnaissance, prospecting, mining or retention operations as provided for in the MPRDA as a listed activity that requires a BAR to be completed. A Basic Assessment is a requirement for all listed activities in terms of government notice R386 of 2006, however the mandate for mining lies with the competent authority, namely the DME. Therefore the DME requirements for Small-Scale mining operations prevail and it is only the Environmental Management Plan and financial provision for remediation of environmental damage which is required. The current amendment to both the EIA regulations and MPRDA will entail that the DME requirements will be aligned with the EIA regulations and a Basic Assessment will then be required for Small-Scale operations. The Environmental Management Plan will then no longer be used, instead a basic assessment report will have to be submitted. The status quo prevails

until such time both pieces of legislation have come into force. As a result the basic assessment report does not apply to small scale mine operators at the date of publication of his guideline.

In the spirit of co-operative governance (*Constitution 1996),* key stakeholders and governmental departments will be consulted in the approval of any applications. This provides for a more effective, transparent, accountable and coherent management of our country's natural resources. It also provides for the enactment of the principles of sustainable development (NEMA, 1998) and integrated water resource management. This collaboration will include various spheres of government e.g. at national level the Departments of Water Affairs and Forestry, Minerals and Energy, Agriculture, and Land Affairs; and at provincial level the Departments of Environmental Affairs, Tourism, Nature Conservation etc.

As part of this co-operation, DWAF has taken a policy decision (subject to certain prior consultations) to recognize the contents of an EMP. Thus the recommendation for approval of an EMP by DWAF can be considered an approval of the proposals made by the specific mining company. This could also mean that exemption may be granted from the requirements of a specific regulation in terms of regulation 3 of GN 704.

This BPG serves to clarify what is required by DWAF and identifies operation strategies. It provides an overview of water related impacts of small-scale mining and outlines priority concerns and acceptable practices for this sector.

The quick reference guide gives a brief overview of what the guideline is about and where the information is located. In preparing the guideline, it was anticipated that users would be more likely to dip into sections rather than to read the guideline from beginning to end. To facilitate this, a detailed content list and a descriptive reference guide have been provided.

QUICK REFERENCE GUIDE

SECTION	WHAT IT IS ABOUT?	WHERE TO GO
INTRODUCTION	• Puts this guideline in context and describes important document links.	**Chapter 1**
OBJECTIVES/ PRINCIPLES	• Highlights what this guideline can do for you. • Presents the principles and methodology upon which this guideline was developed.	**Chapter 2**
DEFINITIONS AND SMALL-SCALE MINING	• Describes what small-scale mining is. • Discusses what mining methods, types and commodities are involved. • Presents which small-scale mining operations are relevant to this guideline.	**Chapter 3&4**
LEGAL REQUIREMENTS	• Describes what the legal requirements are for small-scale mining operations. • Discusses what legal issues you need to be familiar with. • Explains what information is required from small-scale miners in order to properly assess their licence applications.	**Chapter 5**
IMPACT IDENTIFICATION	• Discusses how small-scale mining does impact on the environment and in particular our water resources. • Describes what the pollution potential is from small-scale mines. • Shows how to assess the risk posed to our water resources by small-scale mining activities.	**Chapter 6**
INTEGRATED WATER MANAGEMENT PLAN	• Illustrates how one can prevent and minimize the impact of small-scale mining? • Highlights the key water impact management areas. • Describes what EMP Life Cycle Water Management is.	**Chapter 7**
MONITORING AND REPORTING	• Discusses what monitoring and reporting needs to be conducted during the life cycle of a small-scale mine.	**Chapter 8**
	• Useful Checklists and References • Proposed Best Management Practices	**Appendices**

2 OBJECTIVES AND PRINCIPLES

2.1 OBJECTIVES

This BPG is intended to be a practical "hands-on" document that gives practical advice on the very important topic of resource protection and water management in the small-scale mining sector. This BPG aims to pay attention to the fact that the acceptable practices proposed are sustainable and affordable to a sector that is often operating with limited resources. This particular guideline is prepared in two versions:

i) A **Standard** format aimed at Department officials viz. water pollution control officials and environmental management personnel.

ii) A **User** format aimed at the small-scale miners, produced in English, Sotho and Zulu.

This BPG describes typical small-scale mining scenarios and develops generic integrated assessment procedures. It uses a constructivist approach to detail regulatory requirements and procedures, the water management hierarchy, operational implementation and management. It therefore provides a useful tool to assist in the sustainable development of this sector.

The specific objectives are:

- To describe relevant mining documentation and legal requirements;
- To assist in identifying potential areas of concern or impact for each of the small-scale mining types;
- To encourage planning and prioritisation of water management actions for resource protection by small-scale mining operators;
- To clarify what is required by the regulators to satisfy them that pollution prevention/ minimization, water reuse and treatment requirements have been correctly applied at each stage of the life cycle of the mine;
- To describe best management practices that are appropriate for the small-scale mining sector and ensure continual improvement and protection of the environment and water resources.

Furthermore, this BPG provides a logical decision support system that enables the regulators to assess risk to water resources by the various small-scale mining operations. It also aims to ensure consistency in the approach of the DWAF from mine to mine, and region to region and thus encourages uniformity in water use licence conditions.

The production of the User BPG incorporates persons that are technically proficient in the subject matter of the guideline and are linguistically proficient in English, Sotho and Zulu.

2.2 PRINCIPLES

In order to successfully implement integrated mine water management in a manner that complies with all legislation, certain principles must be adhered to, as listed below:

- Compliance with the water management hierarchy;
- A life cycle approach;
- The cradle to grave principle;
- The precautionary principle;
- A risk based approach;
- Consensus and acceptance of the guidelines from the people who will use them i.e. small-scale miners and DWAF.

However, certain important descriptions or concepts must also be made that are relevant to this activity guideline (as outlined in quick reference guide), viz.:

- Definition of the small-scale mining sector *(Chapter 3 and 4).*
- Definition of water related impacts and pollution potential from the various mining methods employed *(Chapter 6).*
- The appropriate measures and practices that could be implemented to mitigate these impacts *(Chapter 7 and Appendix E).*
- Operational and maintenance requirements and responsibilities *(Chapter 7).*
- Issues of monitoring and auditing *(Chapter 8 and Appendix F).*

This BPG supports the evaluation of EMPs and applications for water use authorisations and fits in with other guidelines. This BPG is not enforced by regulation but rather used by DWAF personnel as a basis for negotiation with the mining industry. This BPG is also produced in a **"User"** format with some repetition of content in parts to facilitate small-scale mining development and understanding. The **"User"** format is available in English, Sotho and Zulu.

3 DEFINITION OF SMALL-SCALE MINING

3.1 GENERAL

There is no generally agreed definition of the term "small-scale mining", although it is often defined in terms of the mine's output, capital investment, number of people employed or managerial structure. According to the *White Paper on Mineral and Mining Policy (1998)*, in South Africa, small-scale mining ranges from very small operations that provide subsistence living (e.g. artisanal mining with pick and shovel; manual or portable panning equipment), to "junior" companies (e.g. mechanized operation involving several employees) for which revenue and profit are the prime motivators. A typical small-scale mine has also been characterized as a mine that operates at or near the surface, would work with non-complex ore, which requires non-complex mining and processing methods, and would operate on estimated, if not proven, reserves (Franz, 2000).

Small-scale mining is often equated with informal, unstable or illegal operations that are typified by complete lack of capital, haphazard mining methods, environmental damage and health and safety risks. This extends from the fact that the small-scale miner is frequently part of a marginal group that has a low degree of ownership of mining property and whose activity is very sensitive to fluctuations in prices and cost. Smaller operations often involve an informal or temporary worker, with little or no patrimony, who operates with rudimentary, low cost techniques. Larger operations often involve a higher level of mechanisation (e.g. front-end loaders, draglines), some permanent staff that are supervised, as well as employment of casual labour.

3.2 EMP QUALIFYING CRITERIA

The DME has developed an EMP document that is a simplified national standard that applicants for prospecting rights and mining permits need to comply with. Typically, operations in this sector of the mining industry:

- Use little or no chemicals to extract mineral from ore.
- Work on portions of land of 1.5 hectares in size or smaller.
- Disturb the topography of an area somewhat but have no significant impact on the geology.
- The **EMP** document, however, **may not be used** in the following instances:
- In the case of coal mining or the exploitation of any mineral containing sulphide; and
- The exploitation of any mineral, metal or rock in a sensitive area or environment.
- According to this definition, a sensitive area or environment can be described as an area or environment where a unique ecosystem, habitat for plant and animal life, wetlands or conservation activity exists, or where there is a high potential for eco-tourism.
- The DME also tends to show leniency to the environmental requirements of small-scale mines if there is no extensive mechanization. In terms of this guideline, small-scale is taken to exclude junior companies (between 50 and 200 employees) and may be divided into three categories based on the extent of mechanization as described below (Heath *et. Al.,* 2002):
- **No mechanization** – this refers to artisanal mining that involves pick, shovel and wheelbarrows and the prime motivation is subsistence.
- **Limited mechanization** – this type of mining is not subsistence orientated and may include one truck, one front-end loader and a mechanical pan/washer.
- **Mechanized** – this type of mining is also not subsistence orientated and involves the use of extensive mechanical equipment. This may include several trucks, front-end loaders and mechanical equipment for the processing of ore.

3.3 DWAF CRITERIA

Mines are classified into three categories by DWAF for registration and management purposes. They are classified according to the potential impacts that the mining activity may have on water resources viz.

Category A: All gold and coal mines, irrespective of size. Any mine with any kind of extractive metallurgical process, including heap leaching. This includes most other precious and base metal mines. Any mine where sulphide-producing or other acid-generating material occur in the mineral deposit.

Category B: Mines with potentially significant and/or permanent impact only on non-water quality aspects of the water environment, such as yield or availability of water, dynamics of the river, riparian uses, etc.

Category C: All other mines not covered by A and B. This includes big mines with no significant impact on the water environment and small- or low-impact mines and prospecting operations.

3.4 BPG DEFINITION

The definition used for this BPG is a combination of the classification systems discussed. It is related to the scale of operation and potential impact on water environment and is described below:

Working definition used in this guideline

- Small-scale mining operations ranging from artisanal miners up to small companies, **(excluding junior companies)**. This includes companies who are classified as **micro** (< 5 employees) to **very small** (<20 employees) to **small** (<50 employees), but who are involved in single commodity small-scale mining operations.
- Small-scale mining operations involving **surface mining** types only (easy access).
- Small-scale mining operations where the **level of mechanization** ranges from:
  - **no mechanization** which involves artisanal mining with pick and shovel digging and whose prime motivation is subsistence;
  - **limited mechanization** where mining is not subsistence orientated and involves mechanization on a limited scale (e.g. one truck, one front-end loader and a mechanical pan/washer);
  - to **mechanized** where mining is not subsistence oriented and involves the use of extensive mechanical equipment (several trucks, front-end loaders and mechanical equipment for the processing of ore).
- Small-scale mining operations that **have a relatively low impact on the water environment,** do not involve chemical processes (uncomplicated metallurgy) or do not entail mining or processing of sulphide-containing deposits.

This guideline therefore includes the following surface mining types*:

Alluvial Diamond; Alluvial Gold Panning (gravity separation); Sand Winning; Clay and Alluvial Semi-Precious Stones.

* The examples given above do not include all small-scale mining types that may fall within this working definition. Please refer to **Appendix A** for a more comprehensive list of potential small-scale mining types/ commodities.

4 SMALL-SCALE MINING

Mining operations generally progress through five stages:

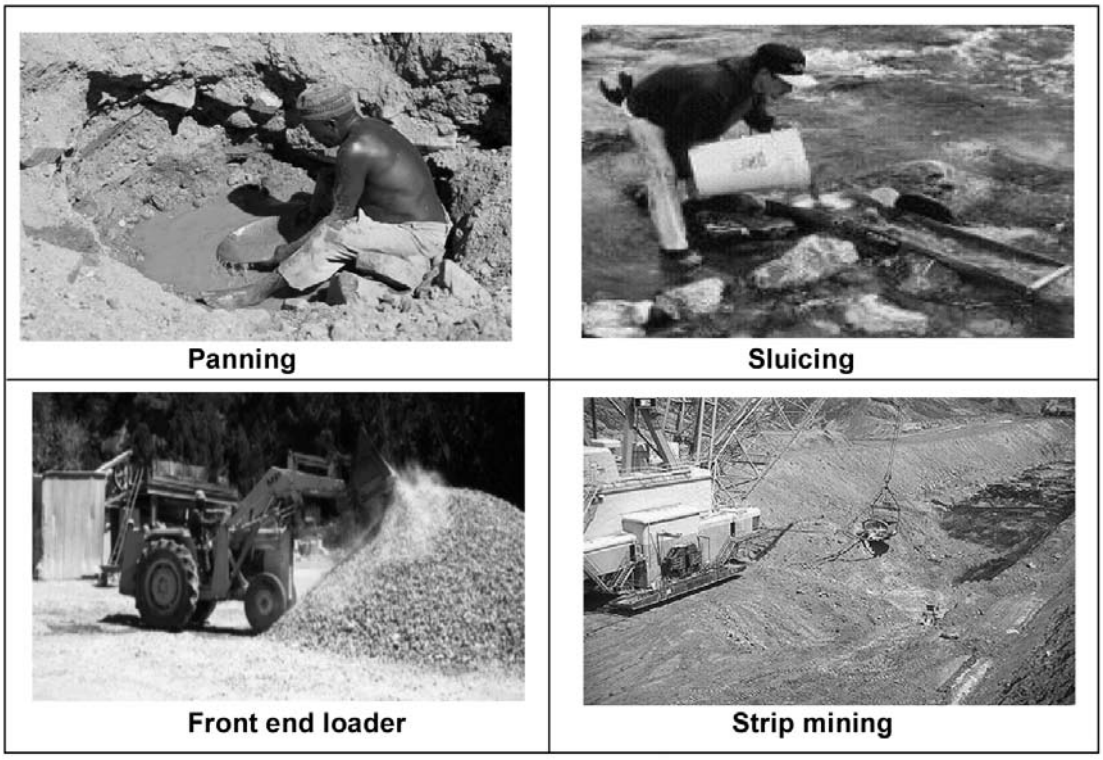
- Planning and authorization phase (including the consideration of alternatives and exploration activities);
- Construction phase;
- Operational phase;
- Decommissioning and closure phase;
- Post-closure phase (management of post closure residual and latent impacts).

Small-scale mining operations generally require surface or near surface deposition, very little waste or overburden, uncomplicated metallurgy and relatively easy access (McDivitt et al, 1990; Meyer, 1980). Mining methods vary widely and depend on the location, type and size of mineral resources.

4.1 SURFACE MINING METHODS

Surface mining methods are most economical in situations where mineral deposits occur close to the surface or form part of surface deposits and allow easy access (e.g. alluvial gold and diamonds). Typical surface mining methods include: panning; sluicing; open pit and strip mining, as well as dredging and hydraulic mining in riverbeds, terraces and beaches. These activities can affect aspects such as soils, surface water and near-surface ground water, river banks, habitat availability, fauna, flora, and alternative types of land-use etc.

Figure 4.1: Various mining methods used by small-scale miners



4.1.1 Panning and Sluicing

Panning involves the digging up of semi-consolidated river alluvium and washing it in dishes with a flow of water so that a concentrate of gold, diamond or other heavy mineral is left behind.

In sluicing, the placer (superficial deposit from which gold can be washed) gravel is shovelled into the head of an elongated sluice box, which is inclined and has various configurations of bars and traps across the bottom called riffles. Water is directed through the sluice box, and the heavy placer minerals are trapped in the riffles; the fine material is washed over them and out as a relatively barren tailing.

4.1.2 Strip mining

Strip mining methods are generally used where the land surface and deposit are relatively horizontal (area mining), but they can also be used in hilly terrain (contour mining) where a steep slope limits the width of the area that can be mined from the mineral outcrop. Wide areas are usually mined in a succession of strips. Conditions are favourable for strip mining when the ore bodies are lying flat and close to the surface. It is sometimes economical to first remove the overlying vegetation, soil or rock to expose the ore body. A front end loader or stripping dragline, with a long-boom or long reach shovels, are commonly used for this purpose. The surface soil or overburden is stripped off and stockpiled for later land reclamation. It is often dumped into the void left by mining the previous strip to form a spoil heap. The ore body is then exposed and mined by a shovel/truck operation. The ore is hauled away and unloaded into a primary crusher. The crushed material is then stored in coarse ore bins for processing.

4.1.3 Dredging

Dredging is undertaken on rivers, ponds, lakes or sea in-shores. Dredgers come in many sizes. Two kinds of equipment, bucket line and dragline, are more commonly used. The bucket line dredgers are larger and more efficient, consisting of a continuous line of buckets that scoop the material from the gravel bank at the edge of the dredge pond and then process it by raising it to the top of the washing plant mounted in the hull. Dragline dredgers are smaller and less efficient. They employ a single bucket that digs the gravel, swings it over the feeder hopper of a floating washing plant similar to the layout in a bucket line dredger, although usually smaller. Excavation of underwater material however, can be by means of backhoe, clam shell, bucket ladder, cutter section head, suction pumps or bucket-wheel dredges.

4.1.4 Hydraulic mining

In hydraulic mining, or “hydraulicking,” a stream of water under great pressure is directed against the base of the placer gravel bank using pipes and large nozzles called giants. The water caves the bank, disintegrates the gravel, and washes the broken material to and through sluice boxes situated in convenient positions down slope.

Hydraulic mining totally disturbs large surface areas, puts much loose debris into the drainage system, and involves large surface water runoff volumes that may cause substantial damage downstream.

4.2 Major Mineral Groupings or Commodities

Several major mineral groupings are especially amenable to small-scale operations: precious stones (e.g. diamonds), pegmatite minerals (e.g. rare earths), placer deposits (e.g. gold) and industrial minerals. A comprehensive list of minerals and their suitability for small, medium and micro-enterprises in South Africa has been compiled and is provided in **Appendix A**.

Some of the more prevalent small-scale mining types that fall within the scope of this guideline are discussed below.

4.2.1 Alluvial Diamond

Small-scale diamond operations generally occur along river courses. This is because of diamonds’ alluvial origin, i.e. deposited by the action of running water in a stream. Small-scale diamond diggers use pick and shovels to dig up the gravel. The gravel is screened for diamonds and is then backfilled into the holes dug. In some cases gently sloping grease pans or grease tables serve as a concentrator of the diamonds. In larger operations, rotary pans are used.

4.2.2 Sand

Sand-winning operations have been classified into four types (Hill and Kleynhans, 1999; McDivitt *et.al*., 1990)

- **Dry-pit mining:** mining of pits on dry ephemeral streambeds and exposed sand bars with conventional shovels, trucks, bulldozers, scrapers or loaders. Dry pits are located above the water table.
- **Wet-pit mining:** involves the use of dragline or hydraulic excavators to remove sand or gravel from below the water table or in a perennial stream channel. In wet pits dewatering or partial dewatering is frequently undertaken to allow the site to be more easily excavated.

  An example of a hydraulic excavator is referred to as a water monitor – the removal of unconsolidated soft, sandy material is by use of a high-pressure water jet usually employed in conjunction with an electric or diesel pump and adequate water supplies. The stream of water is used to carry the material to a sump or collection area.
- **Bar skimming:** this requires scraping off the top layer from a gravel bar without excavating below the summer water level.
- **Mining of pits on adjacent floodplains or river terraces:** this refers to the mining of a pit that has been isolated from the main channel. Sudden changes in channel course during a flood, or in the gradual migration of the channel may breach small levees and the channel will shift into the sand or gravel pits.

It should be noted that sand-wining and alluvial diamond mining operations comprise the greatest proportion of small-scale mining operations in South Africa (Regional DME offices, *personal communication 2001*)

4.2.3 Gold

Small-scale gold miners extract gold by:

a) Panning; digging or sometimes sluicing river gravels (alluvial gold mining)
b) Crushing and panning the rich ore vein deposits, or
c) Sieving through old mine dumps.

Only the first method is covered in this guideline since the other two do not fall within our working definition.

The gold (often as fine particles) can then be concentrated and extracted using a number of chemical processes. If however, any of the chemical concentrating or amalgamation processes described below are used, they have the potential to impact significantly on water quality and resources. Regulators and miners need to therefore consult other guidelines that deal with this issue specifically since it does not fall within the scope of this particular BPG.

a) Amalgamation with Mercury: Mercury is placed in the bottom of the pan, sluice or smeared on copper plating. The fine gold amalgamates with the mercury and is then collected by driving off the mercury as vapour, retaining the gold.

   The concern with this process is two-fold: On the one hand, miners manipulate the mercury without any protection mechanism and are exposed not only to the vapours (generated when the amalgam is heated to recover the gold) but also to direct skin contact at different stages of the amalgamation process. On the other hand, part of the mercury from the amalgamation process will inevitably end up in the effluents and pollute the surrounding areas, constituting a long-term threat to the catchment areas.
b) Chloride: Mintek has successfully developed an alternative to other hazardous amalgamation methods (Mining Africa, 2000). This process is based on chloride leaching, using inexpensive and easily obtainable reagents. As the reducing reaction is highly selective, the gold product is very pure and thus commands a higher price.
c) Cyanide leaching: Low-grade ore with small residues of gold is crushed, piled on the ground, and then sprayed with a cyanide solution to extract the gold. The concern with this process is: Cyanide-laced wastewater then leaks into the surrounding areas and contaminates the ecosystems and water resources.

It has also been reported that some small-scale miners in South Africa take the gold-bearing ore to a centralized refinery for processing (Heath *et. Al.,* 2002).

4.2.4 Clay

Clay mining is generally conducted in pits and it represents a bulk mining operation i.e. the material is used directly from the pit without major beneficiation processes, which result in waste dumps. As all the clay produced is generally extracted (shovel diggers), a depression remains after mining. This depression, if not rehabilitated, may fill with water as a result of rainfall into the depression or flood-water from the surrounding area.

Generally clay pits do not pose a threat to underground water since the clay is impermeable. However, if the pit walls are not protected against erosion and storm water is allowed to pass unhindered through a clay pit, surface waters may be affected by exceptional addition of suspended solids.

If the clay is used for brick making, the bricks are often manufactured and fired on site.

4.2.5 Semi-precious Stone/Pegmatites

Semi-precious stone mining is similar to alluvial diamond mining. Diggers use picks and shovels to excavate semi precious stones from land or alluvial sources. The extraction process can be wet or dry. The predominant semi-precious stones mined are: garnet, amethyst, aquamarine, citrine, and topaz (Ashton *et al*., 2001).

Pegmatite mining is generally conducted in semi-arid environments in South Africa. Pegmatite deposits are reasonable resistant to weathering and often stand out as positive topographical features. The pegmatite minerals are inert and therefore do not react with water. The modern tendency is to mine a pegmatite in its totality, i.e. the main products are feldspar and quartz, while mica, beryl, spodumene, culombite, tantalite etc., are by-products. As the material produced is coarsely crystalline, any waste that is produced will be lumpy and inert (P. Wipplinger, CGS, *personal communication* 2002).

4.3 MINING CATEGORIES

A summary of the predominant types of small-scale mining activities that meet the criteria for this BPG, are:

Type	Description	No of Employees	Level of Mechanization	DWAF Category
Alluvial Diamond	Diggers (pick and shovel)	<5	Artisanal	C
	Mechanized with grease pans	<20	Mechanized (Trucks; Conveyor belts, etc)	C
Sand Winning	Dry pit mining	<5	Mechanized (Bulldozer)	C
	Wet Pit Mining (Drag line)	<5	Mechanized (Excavators)	C
	Bar Skimming	<5	Mechanized	C
	Mining adjacent to flood plains	<5	Mechanized	C
Alluvial Gold *	Panning and Sluicing	<5	Artisanal	A/C
Clay	Diggers	<5	Artisanal	C
Semi-precious stones	Diggers	<5	Artisanal	C
	Mechanized with grease pans	<20	Mechanized (Trucks; Conveyor belts, etc)	C

* *Where gold is extracted or concentrated using chemical means as described in Section 4.2.3, then gold mining has a potentially high impact on water quality and is therefore not within the scope of this BPG.*

Please refer to Appendix A for a more comprehensive list of commodities reported to be suitable for small-scale mining enterprises.

5

LEGISLATIVE ASPECTS

A regulatory system consists of both statutory and non-statutory components. This chapter highlights the main legislation (including regulations) and policies that are applicable to the small-scale miner defined in this BPG (refer section 3.4) with relatively low environmental impact.

It should be noted that this is not an all-inclusive list and the user of this guideline should ensure that all other applicable legislation and policies must be adhered to e.g. National Environmental Management Act (Act 108 of 1997), Environment Conservation Act (Act 73 of 1989) and Mine Health and Safety Act (Act 29 of 1996).

Please refer to **Appendix B** for a detailed legislation and guideline reference list.

5.1 Mining Permit and EMP

In terms of Section 39(2) of the Mineral and Petroleum Resources Development Act, 2002 (Act 28 of 2002) (MPRDA), any person who applies for a reconnaissance permission, prospecting right or mining permit must submit an Environmental Management Plan (EMP) as prescribed to the Regional Manager concerned for his approval. In terms of Section 5(4), no person may prospect, mine or undertake reconnaissance operations or any other activity without an approved EMP, right, permit or permission or without notifying the landowner. Furthermore, in terms of section 40, the Minister shall consult as to that with each department charged with the administration of any law which relates to any matter affecting the environment prior to granting approval.

The regional DME offices issue three types of mining authorizations in respect of all minerals:

- **A prospecting right** is issued for a period specified in the right and which may not exceed five years and can be renewed (Section 16 and 17 of the MPRDA, 2002).
- **A mining permit** is granted for smaller operations with a surface area of less than 1.5ha and shorter periods of less than 2 years (Section 27 of the MPRDA, 2002).
- **A mining right** is granted for larger operations and longer periods (more than 2 years). (Section 22 and 23 of the MPRDA, 2002)

The permits and rights are issued followed by the approval of an EMP. An EMP has been developed by the DME for the management of the small-scale mining sector. The rationale behind the development of an EMP was to provide a simplified national standard that an applicant for a prospecting right or mining permit is able to comply with in terms of the MPRDA of 2002 and regulation 52. The EMP assists applicants by providing the information that the DME requires in a simple language and in a structured, prescribed format as contemplated in Section 52(2) of the MPRDA.

5.2 Water Use Licence

The National Water Act (NWA) 1998 (Act 36 of 1998) controls the use of water. Water use in terms of Section 21 of the NWA of 1998 includes:

a) **Taking water** from a resource to use it.

b) **Storage,** such as keeping water in a dam.

c) **Diverting the flow of water** for activities such as open-cast mining.

d) **Stream-flow reduction,** such as growing crops which will use the rain water that would otherwise have reached the stream.

e) **Controlled activities,** such as irrigating with wastewater or recharging the underground water with wastewater are subject to control by the Minister.

f) **Discharging waste,** such as releasing water containing waste into a river through a pipe, canal, sewer, etc.

g) **Waste disposal** in a manner which may detrimentally impact on a water resource.

h) **Disposal of wastewater or heated water** from industries and power stations.

i) **Altering a water course,** for example when it is necessary to change the river bed or bank during industrial development.

j) **Removal of underground water,** e.g. to ensure safety in underground mining.

k) **Recreation,** e.g. water sports.

A small-scale miner must get the appropriate water use authorisation in respect of the proposed water uses that will take place with mining. Exceptions include Schedule 1 water uses (e.g. reasonable domestic use), or those that fall under a General Authorization. Please refer to **Appendix C** for more details on these exceptions.

Applications for a water use authorisation should be made prior to commencement of mining. A miner should fill in the appropriate licence forms for each water use and provide supporting documentation e.g. a technical report (refer to **Appendix D** for DWAF licence application form reference numbers and **Appendix F3** for the supporting documentation requirement checklist).

Note: *Exemptions from any of the regulations pertaining to mining and related activities (refer GN 704) does not negate the need for a water use authorisation.*

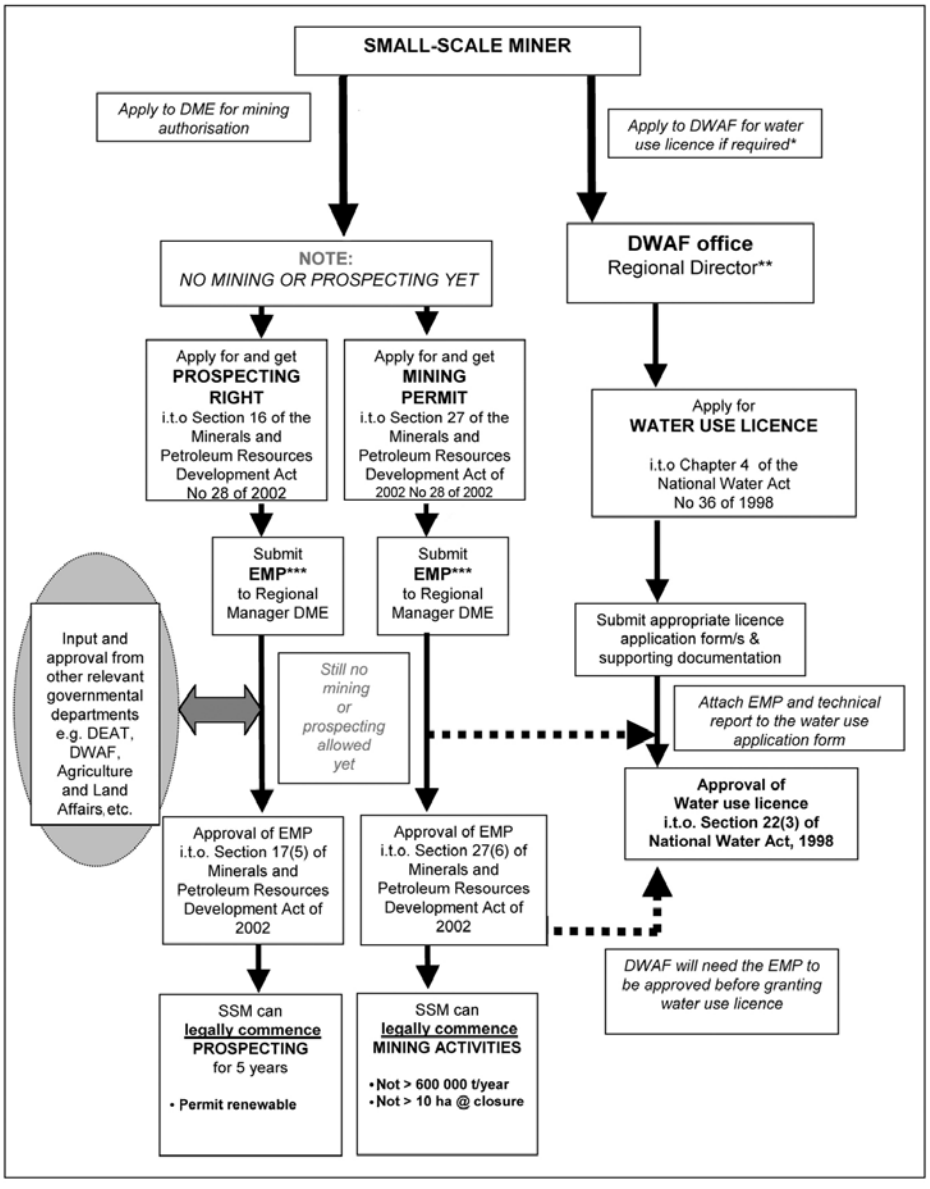
5.3 Small-Scale Miner Authorization Map

Figure 1 outlines the legislative processes involved for a small-scale miner when obtaining a mining permit, completing an EMP and obtaining a water use licence when necessary.

5.4 Other Regulations in GN 704

Regulations contained within GN 704 that are relevant to the small-scale miners and their mining activities are described below.

Figure 1: Summary of Small-Scale Miner Autorisation Procedures



* *Unless Schedule 1 use or covered by General Authorization*

** *Implementation of the regulations will be delegated to the appropriate level as soon as the necessary capacity has been created at regional or catchment level*

*** *Submit EMProgramme and not EMPlan if sampling area for prospecting is I) >25m²; ii) in sea ; iii) involves a river diversion; iv) in a sensitive environment, demarcated or designated area or feature.*

5.4.1 Restrictions on locality of mine operations and mine facilities

In terms of the Regulation 4, any residue deposit, reservoir or any other facility may not be located within the 1:100 year flood-line or within a horizontal distance of 100 metres from the watercourse (whichever is the greatest).

With the exception of the mining of alluvial materials or sand winning operations, no mining operations may take place within the 1:50 year flood-line or within a horizontal distance of 100 metres from the watercourse (whichever is greatest).

No residue or substance which causes or is likely to cause pollution of a water resource is to be placed or disposed of in the workings of any underground or opencast mine excavation, prospecting diggings, pit or any other excavation.

No sanitary convenience, fuel depots, reservoir, or depots for any substance that is likely to cause pollution of the water resource, may be located within the 1:50 year flood-line.

5.4.2 Extraction of alluvial materials

In terms of Regulation 10, no person may extract sand, alluvial minerals or other materials from the channel of a watercourse or estuary unless reasonable precautions are taken to:

- Ensure that the stability of the watercourse is not affected.
- Prevent scouring and erosion of the watercourse or estuary which may result from such operations.
- Prevent damage to in-stream or riparian habitat through erosion, sedimentation, alteration of vegetation or structure of the watercourse, or alteration of the flow characteristics of the watercourse.

Slimes dams or settling ponds may not be constructed within the 1:50 year flood-line or within a horizontal distance of 100 metres from any watercourse (whichever is the greatest).

Every person winning sand or alluvial materials must:

- Construct water treatment facilities to treat water to the prescribed standard.
- Construct stockpiles outside of the 1:50 year flood-line or a horizontal distance of 100 metres from the watercourse (whichever is the greatest).
- Implement control measures that will prevent the pollution of any water resource.

5.4.3 Use of material

In terms of Regulation 5, no person in control of a mine or activity may use any residue or substance which causes or is likely to cause pollution of a water resource.

5.4.4 Capacity requirements of clean and dirty water systems

In terms of Regulation 6, GN 704, all unpolluted water is to be confined to a clean water system and kept away from any dirty area. Clean water must be routed to a watercourse while all dirty water, including water seeping from a mine, outcrop or any other activity, must be collected into a dirty water system. Effective measures must be taken to minimize the flow of any surface water into mine workings and to route it into a watercourse.

5.4.5 Protection of Water Resources

In terms of Regulation 7, GN 704, reasonable measures need to be taken to prevent any substance that can cause pollution from entering any water resource. The mine must also ensure that the water system is kept free from any matter or obstruction that may affect the efficiency thereof.

In terms of the National Water Act (Act 36 of 1998), the level of protection of a resource will depend on the ecological management class assigned to the water resource. The reason being that an impact which poses only a slight risk to a particular ecosystem in one geographical region may result in a much higher risk in another geographical region, depending on the resilience of the adapted ecosystem, the background quality of the water, and the natural flow regime.

Mines will therefore have to consider various resource-directed elements of regulation such as:

- Catchment management plans for the receiving water-courses.
- Reserves and river classifications for the receiving water-courses.
- Requirements of other regulators and legislation.
- Downstream users and target water quality objectives.

In cases where they may not exist, the mine has two alternatives (source-directed):

a) Accept the precautionary principle and comply with a zero discharge standard or any other restrictions that DWAF imposes.

b) Develop the environmental context by undertaking the necessary studies in co-operation with DWAF and all other interested and affected parties (I&AIPs) and then reaching agreement with these parties.

5.5 Other Legislation and Guidelines

Other legislation or regulatory aspects and guidelines, that are relevant to the small-scale miner, are listed in **Appendix B.**

6

IMPACT IDENTIFICATION

Surface mining methods, including strip mining, open pit mining, dredging, and hydraulic mining, may drive environmental change of the affected land surface in the following ways (Brink *et al*., 1990):

- Changes in topography and surface drainage with the potential for increased soil erosion, long-term compaction, silting; subsidence and reduced agricultural capacity;
- Disturbance and disruption of the natural water flow regime with the potential for both surface water and groundwater pollution;
- Changes in topsoil characteristics with the potential for increased acidity and salt content, development of nutrient deficiencies or imbalances, surface crustiness or desiccation, changes in vegetation cover and land use with the potential for production of atmospheric dust and other pollution.

More specifically, physical impacts on water resources by small-scale mining include:

- the use of water for mining operations,
- de-vegetation of mine sites and riverbanks (riparian vegetation loss),
- destabilisation of river banks,
- the creation of large pits and ponding,
- erosion problems where soil, sediments and any associated contaminants are transported into streams, rivers and other water bodies, resulting in the loss or alteration of habitats for aquatic organisms, as well as changes in water quality,
- alteration of watercourses,
- sedimentation or siltation of watercourses contributing to increased suspended solids loads,
- lowering of floodplain groundwater,
- terrestrial ecological changes associated with disturbed areas, including the establishment of alien invasive plant species, altered plant community species composition and loss of habitat for indigenous fauna and flora.

The area affected can be segmented into three typical classes or groups, namely: the mine environs only (typically consisting only of the mine property), the local area (one or more properties that are adjacent to the mine property), or more widespread (regional).

6.1 IMPACT POTENTIAL

The set of impacts that any specific small-scale mining operation will have on the environment, and especially the aquatic environment, depends on:

- The type of rock, sand or ore being mined;
- The type of mining operation and the scale of operations;
- The efficiency and effectiveness of any environmental management systems that are deployed by mine management; and
- The sensitivity of the receiving environment (including scarcity of water).

Impacts can be described as:

i) **Direct** physical disturbance impacts,
ii) **Primary and secondary** pollution impacts and
iii) **Indirect** impacts.

These impacts could also have cumulative and synergistic effects and these should be distinguished as such.

6.1.1 Single versus cumulative effect

Singly, many of the effects of small-scale mining on the water environment may well be insignificant. However, when they occur simultaneously or in a haphazard way, their significance may increase by orders of magnitude. The majority of water-related impacts are localized i.e. affect the immediate vicinity of the mine only. If, however, many mines occur in the same area, then the cumulative impact may become significant and may be felt over a much larger area.

6.1.2 Water-related impacts

A list of water-related impacts, observed in small-scale mining operations (Heath *et. Al.,* 2002), is outlined in the Table 6.1 below. This table can be used to identify all the relevant potential concerns on the water environment in terms of mining type.

Table 6.1: Potential Water-Related Impacts of Different Small-Scale Mining Types:

Environmental impact	Alluvial diamond	Sand-winning	Alluvial gold panning	Clay	Semi-precious stone
Aesthetics (e.g. waste dumps; pits; loss of vegetation)	X	X	X	X	X
Bank destabilization (e.g. Excavation of flood terraces and riverbanks increases the instability of these riverbanks and enhances the likelihood of increased flood scouring)	X	X	X	-	X
Chemical contamination (e.g. Oils; Diesel; Sewage; Mercury*; Cyanide*; Chloride* or Metals*)	X	X	X	X	X
Increase in sedimentation/turbidity (e.g. Panning and operation of sluice boxes increases loads of suspended sediments in downstream reaches)	X	X	X	-	X
Watercourse alteration/ Alteration in channel hydraulics	X	X	X	-	X
Water abstraction	X	X	X	X	X
Riparian vegetation loss (Accelerated erosion of areas adjacent to workings that have been de-vegetated for construction materials or fuel wood leads to increased suspended sediment loads in nearby streams and rivers.)	X	X	X	-	X
River bed and fauna disturbance	X	X	X	-	X
Lowering of floodplain groundwater	-	X	-	-	-
Disturbance of flood attenuation	-	X	-	-	-
Ponding in floodplain	X	X	X	X	X
Loss of river sediments	X	X	-	-	X
Acid mine drainage	-	-	-	-	-
Aquatic life (e.g. Smothering of riverine habitat by silt, fish gill clogging)	X	X	X	X	X

* *Where these may occur (as indicated below), please consult other guidelines in this regard, as this is beyond the scope of this BPG.*
Mercury, cyanide or chloride – In washings if used for amalgamation or concentration.
Metals – Excavation of river sediments expose these sediments to oxidizing conditions and enhance the solubilization and release of any metal ions that may previously have been trapped as insoluble sulphides.

The majority of the water-related impacts could be successfully mitigated through timely best practice application. The principle of planning for closure at the onset of the mining activity will enable the mine to rehabilitate on a daily basis rather than only at the end of the active mining activity.

The typical life span of a small scale mine is less than a year with some operations lasting weeks only. The life cycle of mining operation consists of a number of simultaneous or sequential phases and activities, e.g. prospecting, development (including verification of the quantity and quality of ore and its amenability to various extraction and processing methods), construction, operation, staff housing and support, product stockpiling, mineral processing, waste management, rehabilitation and eventually, closure.

Different environmental interactions and possible impacts are usually associated with each of the phases of a mine's life span.

The impacts associated with each mining phase have the potential to drive environmental change in several different ways and at various scales. This ranges from local- to national-scale changes and may even give rise to international environmental changes (for example impacts in the Orange River being shared between South Africa and Namibia).

An overview of the potential environmental impacts associated with different phases of mining activities, and mineral-processing operations, is given below in Table 6.2. [Information adapted from Ashton *et al*. 2001, Heath *et al*. 2002)].

Table 6.2: Potential environmental impacts through the small scale mine life cycle

Mining Phase	Scale of Impact	Activities	Potential Environmental Impacts
Planning and Authorisation/Construction			
Exploration and surveying	Relatively small, however, the cumulative effects of exploration activities at multiple sites within an area have the potential to drive environmental change, particularly from a larger regional perspective.	• Surveys • Vehicle tracks • Vehicle and machinery fuel points • Exploration camp housing • Exploration camp sanitation systems • Waste disposal (garbage)	• Vegetation removal, damage and destruction • Habitat disturbance due to noise/vibration • Disturbance to wildlife and local residents • Soil erosion along trenches and transects • Dumping and waste • Demand on local water resources • Discharge or spillage of contaminants • Contamination of local groundwater by exposed ores • Restricted public access
Mine development – start up	Considerable changes take place as the mine infrastructure, plant and facilities are constructed, and when the ore body is first exposed. The scale and sequence of events varies from mine to mine, but always entails dramatic changes to most features of the local environment.	• Stripping/storing of soil "overburden" • Surveying and levelling of sites • Installation of mine and surface water treatment plants • Construction of mine facilities, offices and roads • Construction of storage facilities • Landscaping of site • Construction of staff housing and infrastructure	• Fauna and flora habitat loss and disturbance • Reduction in biodiversity on site • Potential loss of heritage sites • Decreased aesthetic appeal of site • Altered landforms due to construction • Altered drainage patterns and runoff flows • Increased erosion of site area • Increased siltation of surface waters • Contamination of surface and groundwater by seepage and effluent discharges • Discharge of contaminants via mine de-watering activities • Increased demand on local water resources • Ground and surface water contamination from seepage and contamination from fuel spills and leakages

Mining Phase	Scale of Impact	Activities	Potential Environmental Impacts
Operation			
NOTE: All potential impacts related to exploration, surveying and start-up, may also occur during operation			
Removal and storage of ores and waste material	The routine operational phases account for most of the environmental impacts and are considered to have the greatest potential to drive environmental change	• Stripping/storing of soil "overburden" • Waste rock stockpiles • Low grade ore stockpiles • High grade ore stockpiles	• Land alienation from waste rock stockpiles and disposal areas • Increased erosion and siltation of nearby surface waterbodies (rivers and lakes)
Milling and grinding Extraction/ Concentration	The extent to which mining operational activities act as drivers of environmental change depends in part on the type, scale, duration and magnitude of the activities, and the sensitivity of the receiving environment	• Transport of ore to crusher • Extraction and preliminary crushing of ore • Milling and grinding of ore • Flotation and chemical concentration/leaching of ore and final product • Transport of ores to smelter • Stockpiling of final product	• Ground surface disturbance • Disturbance due to noise and vibrations • Dust and fumes, mine vehicles and transportation systems • Discharge of contaminated water • Windborne dust and radionuclides • Vapour emissions from processing • Spillage of corrosive liquids
Transport of final product to market	Seldom associated with significant impacts on the biophysical environment	• Packaging/loading of final product into transportation • Transport of final product via rail link	• Disturbance due to noise, vibration and site illumination • Dust and fumes from exposed product stockpiles
Decommissioning and closure/post closure			
Mine closure and post operational waste management	Impacts often continue long after the mine has stopped production and has been closed especially if site is un-rehabilitated.	• Decommissioning of roads • Dismantling buildings • Reseeding/planting of disturbed areas • Re-contouring pit walls/ waste dumps • Water quality treatment • Fencing dangerous areas • Monitoring of seepage	• Loss of productive land for alternative uses; • Subsidence, slumping and flooding of previously mined areas • Continuing discharge of contaminants to ground and surface water via seepage • Changes in river flow regimes with sharper flow peaks and reduced dry season flows • Fauna and flora habitat loss and disturbance • Windborne dust • Dangerous areas that pose health risks and possible loss of life (e.g. pits, ponds, etc.)

6.1.3 Peripheral or indirect impacts linked to mining

The pivotal nature of mining activities, in the general development of southern Africa, means that they inevitably have had several "peripheral" or indirect impacts on the biophysical environment. A few specific examples are highlighted here to sketch the scope of the concerns (Ashton *et al*. 2001):

- The influx of miners and their families and dependents into existing and new mining areas is often accompanied by the development of informal and un-serviced settlements. In turn, these are characterized by poor or inadequate sanitation systems, with the result that nearby watercourses become contaminated with sewage and domestic garbage.
- Settlements that develop in the peripheral areas of mining operations often rely on subsistence agriculture for their livelihoods. This result in progressive de-vegetation of the areas around such mines as trees is cleared for fuel wood and to open up areas for cultivation. In extreme cases, the subsistence agriculture may extend into local wetlands or 'ambos', thereby reducing their ability to attenuate stream flows and prevent flooding.

- Increased population numbers places greater pressure on every natural resource in an area. This pressure varies from demands for fuel and water, housing and construction materials, to accelerated exposure of the catchment surface to erosion processes. Singly, many of these effects may well be non-significant. However, when they occur simultaneously, their significance may increase by orders of magnitude.

6.2 Screening Level Risk Assessment Guide

The water flowing in and out of the mining area should be managed in such a way that the supply of water downstream to other users is not affected adversely.

It is important that enough information is gathered to ensure an acceptable level of confidence in the assessment of the impacts. The steps involved in impact and screening level risk assessment of small-scale mining are outlined below:

Step 1: Identify Risk Activities and Receptors

A useful way to proceed with a screening level risk assessment process is to identify potential pollution sources, pathways and receptors as a result of the mining operation.

SOURCES:	PATHWAYS:	RECEPTORS:
Disturbance and impact on water environment as a result of:	**Transmission or propagation of source of pollution by:**	**Result of disturbances to:**
• Location of mine (proximity to water resources, proximity to sensitive areas, proximity to other miners etc) • Mineral that will be mined • Mining method to be employed • Mineral processing method to be used • Scale of operation • Ownership relations • Emissions (solid, liquid and gaseous) • Weather and Geographic conditions Rainfall; incidence of extreme weather conditions; topography; soil or rock type; depth of topsoil; composition, depth and erodability of sub-soil	• Water, soil and air. • This can occur via surface drainage channels or man –made pathways. • The rate of transmission or propagation is however dependent on, for example, site topography (hills; slopes and valleys), gradients, soil/rock permeability, weather conditions, etc.	• Humans (Surrounding communities; people downstream); • Habitats, (Flora and fauna) • Water (River catchment – surface and groundwater)

Step 2: Identify Potential and Current Water Use

Water use includes water for domestic, agricultural, recreational, industrial or natural environment purposes. Water use by mining activities can impact on current and potential water users downstream. Note should be taken of:

- existing structures and distance from proposed/ existing activities or users;
- details of reservoirs; stock watering places;
- boundary and camp fences;
- soil conservation works.

Step 3: Monitoring

It is important to note that in order to accurately determine the impacts of a small-scale mine on the water environment, a survey of the pre-mining condition should take place. This will enable the mining impacts to be compared to the pre-mining condition. Monitoring of the following should be conducted:

- Plant and fish life (and other aquatic life) in rivers,
- Stability of water control structures and riverbanks,
- Erosion and siltation,
- Chemical water quality in terms of resource requirements

- Clarity of water in rivers.

Please refer to Chapter 8 for more details concerning monitoring, reporting and auditing requirements for small-scale mines.

Step 4: Screening Level Risk Assessment

The relative impact or significance of an impact is a value judgment based on a combination of factors i.e. the nature, extent, duration, intensity and probability of the impact. A qualitative screening level risk assessment can be made using the following table (Table 6.3):

Table 6.3: Screening Level Risk Assessment Summary

IDENTIFY IMPACT	FACTORS TO CONSIDER	QUESTION TO ASK	ASSESSMENT		
MAGNITUDE/SIGNIFICANCE OF IMPACT	**Nature**	**What and how?**	**Refer to source, pathway and receptor checklist**		
	Time	**When will the impact occur?**	**Single pulse** e.g. spillage	**Intermittent** e.g. drains, soakaways	**Continuous** e.g. leaks; infiltration
	Extent	**Where will impact occur?**	Mining area	Local water resources	Regional/national Catchment area or wider
	Duration	**How long will impact last?**	**Short term** 0-6 months	**Medium term** Up to 1 year	**Long term/ Permanent** > 5 years/No mitigation will shorten impact duration
	Intensity	**Strength/force of impact?**	**Negligible/Very low/ Low** Minor disturbances to aquatic ecosystems or local water resources/ Impact temporary/ Important but easily controlled by routine management actions *	**Medium** Impacts experienced as temporary or continual loss of amenity or deterioration in water quality and can extend over both small and large areas	**High** Impacts serious and require frequent management attention and remedial action. Large scale effects on water resources, aquatic ecosystems and other water users
	Probability	**Likelihood of impact occurring?**	**Improbable/ Probable** Low probability/ Distinct probability	**Highly probable** Most likely	**Definite** Will occur regardless of prevention or mitigatory methods

- *Small-scale mining should generally fall into this category i.e. impacts can be experienced as low-intensity nuisances over a large area or as minor disturbances over a smaller area. Other water users are unlikely to experience significant loss of amenity and seldom need to implement remedial actions before using the water.*

Note: This may not be the case if several mines are operating in a small area, because the impact may be cumulative and therefore increase in intensity.

7

INTEGRATED MINE WATER MANAGEMENT

In order to manage the impacts successfully, a management strategy should be compiled. The strategy should include, definite objectives, action plans and control measures, which must be described in the EMP and can also be summarized in schedule form for the technical report that accompanies the water use licence/authorisation application.

The management strategy should be correlated with the life cycle of the mine. It is important to note that the implementation of a successful environmental management programme starts with the management of the impacts from the beginning of the operation. The programme must form an integral part of the day-to-day management activities on the mining area and the aims of the content of the EMP must be made known to all persons who are in a position to make decisions that will influence environmental protection and management.

7.1 DWAF Water Management Hierarchy

The water management strategy for a mine must also be consistent with the principles of integrated water management and must be implemented according to the following hierarchy of steps:

STEP 1: Implement pollution prevention/minimisation measures at source.

STEP 2: Implement reuse and minimisation strategies for waste water or water containing waste.

STEP 3: Implement water treatment strategies.

STEP 4: Where the measures to be taken in Steps 1 to 3 do not prevent the discharge or disposal of water containing waste in the short term, and the quality of the proposed discharge or disposal of water containing waste still exceeds the applicable waste water standard for the catchment or the water quality objectives specified by a catchment's Resource Protection Management Plan, application may be made for a phased water use licence containing:

- Extensive motivation for the water use licence, explaining social, financial and environmental implications.
- Firm commitment with a time schedule to achieve the water quality objectives.

The disposal or discharge of water containing waste, which exceeds the applicable standards, will however, only be considered as a last option and as an interim measure since it also has cost implications (charges for waste disposal/discharge).

It is important to emphasize here, that due to the nature of small-scale mining, water management objectives should be focused on steps one and two.

Furthermore, several of the measures taken as part of the first three steps will be construed as water use in terms of Section 21 of the National Water Act (Act 36 of 1998), and the appropriate water use licence/authorisation needs to be applied for.

7.2 Key Water Impact Management Areas

Generally speaking, water management of small-scale mines will focus on pollution prevention. Three key management areas for pollution prevention and impact minimization are:

- storm water management
- erosion and sediment control
- waste management

7.2.1 Storm Water Management

There are four primary principles that need to be applied in the development and implementation of a storm water management plan (SWMP):

- Clean water must be kept clean and be routed to a natural watercourse by a system separate from the dirty water system while preventing or minimizing the risk of spillage of clean water into dirty water systems.
- Dirty water must be collected and contained in a system separate from the clean water system and the risk of spillage or seepage into clean water systems must be minimized.
- The storm water management plan (SWMP) must be sustainable over the life cycle of the mine and over different hydrological cycles and must incorporate principles of risk management.
- The statutory requirements of various regulatory agencies and the interests of stakeholders must be considered and incorporated.

To further assist in the application of these primary principles, please refer to **BPG 1: Storm Water Management.**

During the SWMP development process it may be necessary to revisit the management plan actions to ensure that these are in fact achievable.

7.2.2 Erosion and Sediment Control

Successful control of erosion and sedimentation from mining activities should involve a system of best management practices, which targets each stage of the erosion process.

The most efficient approach involves minimizing the potential sources of sediment from the outset. This means limiting the extent and duration of land disturbance to the minimum needed, and protecting surfaces once they are exposed.

The second stage of the best management practice system involves controlling the amount of runoff and its ability to carry sediment by diverting incoming flows and impeding internally generated flows.

The third stage involves retaining sediment, which is picked up on the project site through the use of sediment-capturing devices. On most sites successful erosion and sedimentation control requires a combination of structural and vegetative practices.

All of these stages are better performed, using advance planning and good scheduling.

Descriptions of simple and practical best management practices, suitable for the small-scale miner are provided in **Appendix E**. Measures for erosion and sediment control, runoff and conveyance and sediment traps and barriers are described.

7.2.3 Waste Management

Wastes generally contain pollutants and present a potential risk to the water and surrounding environment if not managed effectively. Wastes include sewage, garbage, wash-water, spent oils and grease; diesel or lubricant spills etc. Wastes can be classified as biodegradable or non-degradable, hazardous or non-hazardous.

Sections 7.3.3 and 7.3.4: provides more details regarding waste disposal management at the mine site.

7.2.4 General Malpractices

A list of some “do’s and don’t’s”, regarding general malpractices observed at small-scale mining operations, is provided on the next page to assist in creating awareness of resource protection as well as water and waste management issues.

Table 7.1: List of general do's and don'ts for small-scale miners

As a Small-Scale Miner,		
DO	√	Apply for the necessary permits and licences
	√	Plan your mining operations and camp site before you start mining
	√	Minimise access roads or paths into the river and put in erosion protection measures
	√	Use only one access road to the river at a time
	√	Control run-off and erosion
	√	Put in storm water drainage trenches to divert clean storm water from your site
	√	Collect and treat dirty water from your operations
	√	Leave a buffer zone i.e. a strip of natural area between the mine site and the body of water of at least 100m
	√	Store oil, fuel and chemicals safely in designated area outside of the buffer zone
	√	Locate toilets outside of the buffer zone
	√	Keep topsoil for rehabilitation
	√	Keep topsoil separate from other soil/waste rock material
	√	Protect topsoil by keeping in a secure bunded area on high ground
	√	Stabilize pit walls
	√	Stabilize banks and beds of a river
	√	Rehabilitate as you go – it will save you time, energy and money
	√	Backfill ponds, pits or roads created
	√	Leave area as you found it
DON'T	X	Do not wait to rehabilitate till the very end
	X	Do not leave waste rock piles behind
	X	Do not leave pits open – they are a safety hazard and cause ponding
	X	Do not remove vegetation from the river or river banks without replacing it
	X	Do not dam up the river
	X	Do not mix topsoil and other soils or waste rock – keep separate for rehabilitation
	X	Do not allow loose soil removed to wash away or blow away – keep covered and place in a secure location
	X	Do not use toxic chemicals for processing – there are other safer alternatives
	X	Do not mine illegally

7.3 EMP life cycle water management

This section outlines specific requirements in relation to water resource management for mining from the EMP. They are legally binding once approval of an EMP has been obtained.

They have been arranged to correspond to the various life cycle stages of the mine i.e. on arrival, during operation, and on closure. They also focus on activity at a mine site rather than specific mining type or commodity viz.:

- Establishing access roads to the site
- Access to the river bed, dams, or pans
- Establishing surface infrastructure at the site
- Establishing the campsite/office sites
- Establishing toilet facilities, waste water and refuse disposal
- Establishing the vehicle maintenance yard and secured storage areas
- Establishing residue deposit and processing areas
- Establishing stockpile and sand processing areas
- Establishing processing areas and waste piles
- Establishing settling and clarification ponds
- Establishing access roads to the site

Establishing access road to the site

REQUIREMENTS
• **Watercourses, drainage canals and steep gradients shall be avoided as far as possible.** • **Adequate drainage and erosion protection in the form of berms, contour humps or cut-off shall be provided where necessary.**
SEQUENCE OF ACTIONS
On Arrival
• Topsoil shall be removed form all areas where physical disturbance of the surface will occur. The topsoil removed shall be stored in a bund wall on the high ground side of the mining area outside the 1: 50 flood level within the boundaries of the mining area. • Topsoil shall be kept separate from overburden and shall not be used for building or maintenance of access roads. • The topsoil stored in the bund wall shall be adequately protected from being blown away or being eroded.
During Operation
• Dust control on the access road. The liberation of dust into the atmosphere shall be controlled by: spraying water or other non-toxic dust allaying agents, by limiting the speed of haul trucks or by other suitable approved means. • Regular maintenance of the access road shall be to the satisfaction of the Director: Mineral Development and the road shall have an acceptable surface, be free from erosion damage and have effective drainage, preventing the impounding/ponding of water.
On Closure
• Roads that will no longer be used shall be ripped or ploughed and if necessary, appropriately prepared to ensure the re-growth of vegetation. • Materials, which may hamper re-growth of vegetation, must be removed prior to rehabilitation and disposed of in an approved manner.
IMPORTANT POINTS
• Try where possible to use existing road structures. • Maintenance of access road on the mining area: If trucks hauling sand or other traffic, which is associated with this mining operation, are the only user of access roads, then maintenance of the access road will be the sole responsibility of the holder of the mining authorization. • Whenever a mining authorization is suspended, cancelled or abandoned or if it lapses and the holder does not wish to renew the permit, any access road or portion thereof, constructed or upgraded by the applicant for their purpose and which will no longer be required by the surface owner/tenant shall be rehabilitated to the satisfaction on the Director: Mineral Development in consultation with other departments.

Access to the river bed, dams, or pans

REQUIREMENTS

- **The position of the river access together with all planned future access points must be indicated on the layout plan.**
- **The location of the access to the river channel across the riverbank shall be at a point of the river bank where the least excavation and damage to vegetation will occur, and shall not be wider than that which is reasonably required.**
- **Mining will not be conducted closer than 1.5 times the height of the bank from the edge of the river channel and in such a manner that the stability of the bank of the river is not affected.**
- **In the case of areas that exclude mining through a special condition, no mining shall take place in these areas and mining shall not be conducted within 100m of these areas.**
- **Apply for a water use licence for altering the bed, banks or characteristics of a watercourse.**

SEQUENCE OF ACTIONS

On Arrival

- Adequate precaution shall be taken that the affected section of the bank of the river is adequately protected from scour or erosion.

During Operation

- Access to the riverbed or for the purpose of mining; conducting excavations; launching pump rafts, etc, shall be through the use of only one access at a time.
- When constructing the access across the bank of the river, the top seed bearing layer of soil will be removed to a depth of 500 mm and stored in a soil dump not less than 20 m away from the channel of the river.
- When rehabilitating the access point, the original profile of the river bank will be re-established through backfilling the access point with the original material excavated or other suitable material.
- The canalisation/redirection of the flow of the river over different parts of the riverbed shall be made in such a manner that the following is adhered to at all times.
    - That the flow of the river is not impeded in anyway and that damming upstream does not occur.
    - That the redirection of the flow does not result in scour or erosion of the river.
    - That well points or extraction pumps in use by other riparian users are not interfered with or that canalisation does not impede the extraction of water from these points.

On Closure

- The goal of rehabilitation, with respect to the area from which the sand has been extracted, is to leave the area level and even, containing no foreign debris or other materials.
- All scrap, and other foreign materials shall be removed from the bed of the river and disposed of as per other refuse (see Section on next page), whether these accrue from the mining operation or are washed on to the site from upstream.
- Removal of these materials shall be on a continuous basis while the mine is operating and not only at the start of rehabilitation.
- Tailings in the form of boulders, rocks or oversized gravel screened out during the mining of sand will be spread over as wide a portion of the mined river bed as possible or, if buried, shall be covered by a minimum of 500 mm of sand, if at all practically possible.
- Where reeds or other riverine vegetation has been removed from areas for the mining of sand, these shall be systematically re-established in the approximate areas they occurred before mining.
- An effective control programme for the eradication of invader species and other alien plants may be required.

IMPORTANT POINTS

- The mining of sand shall only take place within the approved demarcated mining area.
- If riverine vegetation is present in the form of reeds or wetland vegetation, the presence of these areas must be entered in the EMP and indicated on the layout plan. On assessment of the application, the Regional Manager may limit the mining of sand in these vegetated areas or other portions of these areas as a special condition of the mining authorization.
- Final acceptance of the rehabilitated river access points will only be awarded after the vegetation has re-established to a point where the Director: Mineral Development is satisfied that the river bank is stable and able to withstand high river flow conditions.
- Damage may occur from a situation where high floodwaters scour and erode access points in the process of rehabilitation over the riverbank or an access point presently in use. In these events, repair of such damage shall be the sole responsibility of the holder of the mining authorization.
- Repairs to the riverbank should ensure the reinstatement to its original profile immediately after such event has occurred and the river has subsided to a point where repairs can be undertaken.

Establishing surface infrastructure at the site
Establishing the campsite/office sites
Establishing toilet facilities, waste water and refuse disposal
Establishing the vehicle maintance yard and secured storage areas

REQUIREMENTS

- **No camp or office site shall be located closer than 100 metres from a stream, spring, dam or pan.**
- **Chemical toilet facilities (preferred) or other approved toilet facilities such as a septic drain, shall be used and sited on the camp site in such a way that they do not cause water or other pollution.**
- **The vehicle maintenance yard and secured storage area will be established outside of the flood plain, above the high flood level mark within the boundaries of the mining area.**

SEQUENCE OF ACTIONS

On Arrival

- The area chosen for these purposes shall be the minimum, reasonably required for the purpose, and which will involve the least disturbance to the vegetation.
- Prior to development of the approved area, the top seed-bearing layer of soil to a depth of 500 mm shall be removed and stored in a bund wall on the high ground side of the area. The height of this bund wall shall not exceed 1.5 metres.
- In cases where toilet facilities are linked to existing sewerage structures, all necessary regulatory requirements concerning construction and maintenance shall be adhered to.
- The storage areas/buildings shall be securely fenced and all hazardous substances and stocks such as diesel, oils, detergents etc. shall be stored therein. Drip pans, a thin concrete slab or a PVC lining shall be installed in such storage areas/ buildings viz. bunded area.

During Operation

- All effluent water from the camp washing facility shall be disposed of in a properly constructed French drain, situated as far as possible, but not less than 100 metres, from a stream, river pan, dam or borehole.
- Only domestic type water shall be allowed to enter this drain and any effluents containing oil, grease or other industrial substances shall be collected in a suitable receptacle and removed from the site, either for resale or for appropriate disposal at a recognised facility.
- Spills should be cleaned up immediately by removing the spills together with the polluted soil and disposing thereof at a recognised facility to the satisfaction of the regulators.
- **Non-biodegradable refuse** (such as glass bottles, plastic bags metal, scrap, etc.) shall be stored in a container at a collecting point and collected on a regular basis and disposed of at an **authorised disposal facility.** Precautions shall be taken to prevent any refuse from spreading on and from the campsite.
- **Biodegradable** refuse generated from the camp site, vehicle yard, storage area or any other area shall either be handled as above or be buried in a pit excavated for that purpose and by covering it with layers of soil, incorporating a final 0,5 metre thick layer of topsoil (if practical) or as specified by the local authority, if applicable.
- Suitable covered receptacles shall be provided and conveniently placed for waste disposal. All used oils, grease or hydraulic fluid shall be placed therein and these receptacles will be removed from the site on a regular basis for disposal at a recognized or licensed disposal facility.

On Closure

- On completion of mining, all buildings, structures or objects on the camp/office sites, shall be completely removed (unless new uses of the building have been agreed) and the site should be fully rehabilitated.
- On completion of mining, the campsite/office site will be rehabilitated through the removal of all facilities, waste and any other feature constructed or established during use of the campsite.
- All areas, devoid of vegetation/grass or where soils have been compacted due to traffic, shall be scarified or ripped and, if necessary appropriately ensure the regrowth of vegetation.
- French drains shall be compacted and covered with a final layer of topsoil to a height of 10 cm above the surrounding ground surface.

IMPORTANT POINTS

Equipment used in the mining process, particularly in the bed of the river, must be adequately maintained, such that during operation they do not spill oil, diesel, fuel or hydraulic fluid.

Establishing residue deposit and processing areas
Establishing stockpile and sand processing areas
Establishing processing areas and waste piles

REQUIREMENTS

- **Stockpile and sand processing areas for the mined sand products shall not be established within 20 metres of the edge of the river channel.**
- **Processing areas and waste piles shall not be established within 100m of the edge of any river channel or other water bodies.**
- **The areas chosen for this purpose shall be the minimum reasonably required and that which will involve the least disturbance to vegetation.**
- **Apply for a water use licence for disposing of waste in a manner, which may detrimentally impact on a water resource.**

SEQUENCE OF ACTIONS

On Arrival

- The location and dimensions of the area are to be indicated on the layout plan and once established, all stockpiling and further processing of sand will be confined to these areas and no stockpiling or processing will be permitted in areas not correctly prepared.
- Prior to development of the approved area, the top seed-bearing layer of the soil shall be removed to a depth of 500 mm and stored in a bund wall on the high ground side of the area. The height of this stockpile wall shall not exceed 1.5 metres.

During Operation

- The river bed may serve as a stockpile area for sand products or for products awaiting further treatment, provided such stockpiles are at least 10 metres away from water flowing within the river bed.
- The stockpiles in the riverbed shall further be limited to no more than 24 hours average production, and placed in such manner that the least impedance of flow will be experienced should the level of the river rise. If the mining of sand is temporarily suspended for any reason, the stockpiles within the bed of the river must be flattened until operations are resumed.
- Any waste material generated from the mining of sand in the riverbed will be dealt with as described in Section 7.3.3 above.

On Closure

- On completion of mining, the surface of the stockpile and processing areas outside the riverbed shall be scarified to a depth of at least 500 mm, graded even and the topsoil previously stored adjacent to the site in a bund wall returned to its original depth over the area.
- The area shall be appropriately prepared, if necessary, (e.g. fertilized and seeded), to ensure the regrowth of vegetation.

IMPORTANT POINTS

- Where a depression in the ground in which water can gather has formed, attention will be given to the outflow of water to prevent concentration of the run-off and thus prevent erosion.
- Stockpiles must be protected and not compacted.
- Tailings from the extraction process must be so treated and /or deposited that it will in no way prevent or delay the rehabilitation process.

Establishing settling and clarification ponds

Ponds are usually established for two basic purposes, viz.:

Settling ponds: As a primary facility, to allow drainage of sand, when pumped from the bed of the river.

Clarification ponds: To serve as a facility to settle fines which will allow the effluent to be returned to the river (suspended matter to meet catchment standard, as determined by the Department of Water Affairs and Forestry).

REQUIREMENTS

- **The settling ponds shall not be located within the flood plain and will be sited in such a manner so as to cause the least disturbance to vegetation.**
- **Design, construct, maintain and operate any dam or tailings dam that forms part of dirty water systems to have a minimum freeboard of 0.8 metres above the full supply level (*Government Notice No. 704,* Section 6e, 1999).**
- **The position of the ponds, their size, depth and distance from the edge of the river channel shall be indicated on the layout plan.**
- **The final clarification pond shall be sized such that water discharged conforms to the water quality objectives in terms of the National Water Act, 1998 (Act 36 of 1998).**
- **Apply for a water use licence whenever disposing of waste in a manner that may detrimentally impact on a water resource.**

SEQUENCE OF ACTIONS

On Arrival

- After the position of the ponds and their size has been approved, the area is to be stripped of top seed bearing layer of soil to a depth of 500 mm. This soil thus removed shall be stored on the high ground boundary of the area in the form of a bund wall.
- Construction of the pond walls shall be from material excavated from within the area of the pond. The walls of the pond shall be constructed level and be given an overflow consisting of sized pipes installed a minimum of 800 mm down from the top of the wall (i.e. 800 mm freeboard) and of length to discharge fully into the next pond.
- In the case of the final clarification pond, the overflow pipes will be of such length that they discharge not less than 1.5 metres into the river.
- Under no circumstances will the overflow from one pond to another, or from the final clarification pond to the river be allowed to flow across the ground or in excavated earth trenches.

During Operation

- Erosion damage to the pond walls from rain or spills will be repaired and filled in on a regular basis.
- Screen tailings: tailings from screens used at the settling ponds shall be collected and may be used as road fill.

On Closure

- Settling ponds will be rehabilitated after first spreading tailings from the tailings dump evenly over the floor of the ponds, should this be the method chosen to rehabilitate tailings.
- The tailings will then be covered through spreading the previously excavated material from the pond's wall evenly over the area.
- The topsoil previously stored adjacent to the site shall then be returned to its original depth over the area.
- The area shall be appropriately prepared, if necessary, to ensure the re-growth of indigenous vegetation.

IMPORTANT POINTS

- Construction of one pond will only be allowed, if in the opinion of the Regional Manager or his representative in consultation with the Department of Water Affairs and Forestry, if the overflow from this pond has been clarified and that the level of suspended matter of this overflow is within the local catchment standard, allowing the water to be returned to the river.
- In considering the above two basic uses, it is very seldom that the construction of only one pond will suffice. In virtually all cases one pond is required for processing or drainage and the second to clarify. (Monitoring and quality testing of this water will be required on a regular basis, as determined by the Department of Water Affairs and Forestry.)

8

MONITORING AND REPORTING

Monitoring has two parts. The first monitors the way individual miners comply with their water use licence/authorisation conditions and EMP reports. The second monitors the actual quality of the water resource itself and compares it to the resource quantity and quality objectives that are set for that particular resource or catchment. Corrective measures are then taken, including prosecutions where necessary. The regulators determine the frequency and points of compliance.

Note: *Any property or land, in respect of which a water use has been authorised, must be made available for inspection by authorized person, in terms of the National Water Act, 1998 (Act 36 of 1998).*

A number of useful checklists are provided in **Appendix F** for purposes of evaluation and auditing. These are:

a) Basic requirements of licences and permits for the small-scale miner
b) Regulators checklist
c) Water licence application checklist
d) Audit checklist

Reporting is discussed below from two perspectives, that is: the miner (holder of mining authorisation) and the regulators/lead governmental agents.

A: The Miner

The holder of the mining authorization may have to carry out regular monitoring of and reporting on all the environmental management measures. This is in order to ensure that the provisions/ guidelines contained in the EMP and other relevant legislation are being adhered to. Several EMPs require that a six monthly compliance report be submitted to DME and DWAF for review. Moreover, monitoring or assessment of the pre-mining conditions should be compared to conditions during the life cycle of the mine.

B: The Regulators

The DME and DWAF as the lead governmental agents also have roles to play with regards to management of water and environmental impacts associated with small-scale mines.

i) Compliance reporting

The regulators must determine the frequency of reporting and points of compliance. If the small-scale mining operation is predicted to have an impact on the resource then a monitoring programme needs to be agreed upon with the authorities.

Suitably qualified persons must conduct the resource compliance monitoring programme (water quantity and quality). In the case of relatively small operations and determinations of cumulative impact, this will generally be the responsibility of the DWAF or relevant local water management authority (e.g. catchment management agency). Otherwise, where capacity exists, compliance monitoring is the responsibility of the holder of the water use licence or mining uthorization. It would generally consist of the following:

Water quantity – flow, aquatic ecosystem requirements

Water quality – pH, electrical conductivity, suspended solids (turbidity) and biological aspects (in accordance to DWAF's River Health Programme) such as invertebrates (SASS), fish (FCII), riparian vegetation, habitat integrity.

Invertebrates, fish and vegetation together give a good picture of the ecological integrity of a site and reflect the condition of the bio-physical habitat which are described by the remaining components, *i.e.* habitat integrity, water quality, hydrology and geomorphology. Changes to the stream biota must therefore be assessed against a background of possible changes to channel morphology and channel condition.

Care should also be taken that groundwater (e.g. borehole water in the area) is not affected significantly by the mining activity

ii) Inspections and monitoring

DME's regional offices should inspect the small-scale mines on six-monthly basis. If the DME finds water pollution occurring then they should inform DWAF's regional office who then sends out an official to investigate.

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5 **Best Practice Guidelines (BPG) for Water Resource Protection Management in the South African Mining Industry: Department of Water Affairs and Forestry**

G1. Storm Water Management

G2. Water and Salt Balances

G3. Water Monitoring Systems

H3. Water Reuse and Reclamation

H4. Water Treatment

A3. Water Management in Hydrometallurgical Plants

A4. Pollution Control Dams

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LIST OF ABBREVIATIONS

BPG	Best Practice Guideline
DME	Department of Minerals and Energy
DWAF	Department of Water Affairs and Forestry
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan/Programme
GN	Government Notice
ha	hectare
m	metre
mm	millimetre
s	second
SASS	South African Scoring System
SMME	Small, Medium, and Micro Enterprises
t	Ton

GLOSSARY OF TERMS

For the purposes of this guideline the following glossary of terms has been used:

Term	Description
Bank	a) In the case of a stream or river, the ground bordering upon and within the high flood zone of the stream or river above whichever area is the wider; and b) In the case of a dam, pan or lake means the ground bordering upon the high-water mark of the dam, pan or lake and all ground within 100 metres of such high-water mark in an outward direction.
BMP	Best Management Practice System
Catchment *(National Water Act 36 of 1998)*	Area from which any rainfall will drain into the watercourse or water-courses or part of a watercourse, through surface flow to a common point or common points.
Clean water system *(GN 704 of 1999)*	Includes any dam, other form of impoundment, canal, works, pipeline and any other structure or facility constructed for the retention or conveyance of unpolluted water.
Dirty water system *(GN 704 of 1999)*	Includes any dam, other form of impoundment, canal, works, pipeline, residue deposit and any other structure or facility constructed for the retention or conveyance of water containing waste.
Disturbed area	All areas, which have been disturbed by prospecting /mining or areas that have been undermined.
Flood plain or zone	The central part of a river including the flood line that would be aligned on either side of a river. The surface area around the riverbed or natural channel in which water flows regularly or intermittently that will be covered with water during a specific rainfall event due to the rainfall within the catchment area finding its way to the river and increasing its flow and banks.
Freeboard	The capacity above or remaining within a water containment facility besides its normal operating level. This additional capacity left is there to accommodate larger than normal rainfall events.
Instream Habitat *(National Water Act 36 of 1998)*	Includes the physical structure of a watercourse and the associated vegetation in relation to the bed of the watercourse.
Mine (noun) *(Minerals and Petroleum Resources Development Act (MPRDA), 2002 (Act 28 of 2002)*	a) Any excavation in the earth, including the portion under the sea or under other water or in any tailings, as well as any borehole, whether being worked or not, made for the purpose of searching for or winning a mineral; or b) Any other place where a mineral deposit is being exploited.
Mine (verb) or mining *(GN 541 of 2002)*	Operation or activity directed at extracting any mineral from any mineral resource on, in or under the earth, water or any residue deposit whether by underground or open working or otherwise, and includes any operation or activity incidental thereto.
Mining activity *(GN 704 of 1999)*	Any mining related process on the mine including the operation of washing plants, mineral processing facilities, mineral refineries and extraction plants. The operation and use of mineral loading and off-loading zones, transport facilities and mineral storage yards whether situated at the mine or not, in which a) any substance is stockpiled, stored, accumulated or transported for use in such process or b) out of which process any residue is derived, stored, stockpiled, accumulated, dumped, disposed of or transported.

Term	Description
Mining area *(Minerals and Petroleum Resources Development Act (MPRDA), 2002 (Act 28 of 2002)*	The area comprising the subject of any prospecting permit or mining authorization, including – a) any adjacent surface of land; b) any non-adjacent surface of land, if it is connected to such area by means of any road, railway line, power line, cableway or conveyor belt; and c) any surface of land on which such road, railway line, power line, pipeline, cableway or conveyor belt is located.
Mining permit *(Minerals and Petroleum Resources Development Act (MPRDA), 2002 (Act 28 of 2002)*	Means a permit issued in terms of section 27(6)
Mining right *(Minerals and Petroleum Resources Development Act (MPRDA), 2002 (Act 28 of 2002)*	Means a right to mine granted in terms of section 23(1)
Prospecting *(GN 541 of 2002)*	Intentional searching for any mineral by means a) which disturb the surface of the earth, including the portion under the sea or under other water or b) in or any residue stockpile or residue deposit, in order to establish the existence of any mineral and to determine the extent and economic value thereof.
Prospecting right *(Minerals and Petroleum Resources Development Act (MPRDA), 2002 (Act 28 of 2002)*	Means the right to prospect granted in terms of section 17(1).
Residue *(GN704 of 1999)*	Includes any debris, discard, tailings, slimes, screenings, slurry, waste rock, foundry sand, beneficiation plant waste, ash and any other waste product derived from or incidental to the operation of a mine or activity and which is stockpiled, stored, or accumulated for potential re-use or recycling or which is disposed of.
Riverine environment	The stratigraphic sequence encompassing the 'river' or 'stream, the sediment, the underlying paleodrainage bedrock and the sub-surface groundwater flows, the surface biota, animals, soil, wetlands as well as man-made infrastructure.
Subsoil	Those layers of soil and weathered rock, immediately beneath the topsoil, that overlay the hard rock formation.
Topsoil	Means the layer of soil covering the earth and which provides a suitable environment for the germination of seed, allows the penetration of water, is a source of micro-organisms, plant nutrients and in some cases seed, of a depth of 0,5 metre or any other depth as may be determined by the regulators for each mining area.
Watercourse *(National Water Act 36 of 1998)*	a) A river or spring; b) A natural channel in which water flows regularly or intermittently; c) A wetland, lake or dam into which, or from which, water flows. d) Any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks.
Watercourse alteration/River diversion *(National Water Act 36 of 1998)*	Any action which gives rise to an alteration in the course of a stream which runs in a defined channel, whether or not such a channel is dry during any period of the year.

APPENDIX A: MINERAL COMMODITIES SUITED FOR SMALL, MEDIUM, AND MICRO ENTERPRISES (SMMES)

The table below has been compiled by Paul Wipplinger (CGS) using the commodities listed and described in "The Mineral Resources of South Africa: Handbook, Council for Geoscience" (Wilson and Anhaeusser, 1998) and "Small-Scale Mining: A guide to appropriate equipment" (McDivitt, Lock, et. al., 1990).

In the table, a distinction is made between commodities where mining by the small-scale mining sector is a) suited for SMMEs (unreservedly possible), b) exploitation by SMMEs questionable (reservedly possible), and c) not suitable for exploitation by SMMEs (not possible). The inhibiting factors in the b) reservedly and c) not possible classes, are related to capital requirements to bring an economic operation based on that commodity into life, as well as regulatory factors relating to polluting substances (e.g. acid producing wastes and others) released by the operation, the control thereof being beyond the financial scope of small-scale mining operations.

COMMODITY	SUITED FOR SMMEs	EXPLOITATION BY SMMEs QUESTIONABLE	NOT SUITABLE FOR EXPLOITATION BY SMMEs
Aluminium (Bauxite)		#	#
Antimony		#	#
Arsenic			#
Barite	#		
Cadmium			#
Chromium/Chromites	#	#	
Coal			#
Cobalt			#
Copper			#
Corundum	#		
Diamond:			
Alluvial diamond	#		
Kimberlite	#		
Dimension stone:			
Granite		#	#
Marble	#	#	
Slate	#		
Quartzite	#	#	
Sandstone	#		
Flagstone	#		
Verdite and Soapstone	#		
Dolomite	#		
Evaporites:			
Salt	#		
Soda and soda ash		#	#
Potash		#	#
Boron		#	#
Bromine		#	#
Fluorspar	#		
Garnet	#		
Gemstone	#		

COMMODITY	SUITED FOR SMMEs	EXPLOITATION BY SMMEs QUESTIONABLE	NOT SUITABLE FOR EXPLOITATION BY SMMEs
Gold:			
Witwatersrand		#	#
Other rock-hosted		#	#
Unconsolidated Sediments	#		
Graphite	#		
Gypsum	#		
Industrial minerals:			
Aggregate	#		
Andalusite	#		
Clay and brick-making material	#		
Gravel	#		
Kyanite	#		
Perlite	#		
Phlogopite	#		
Pumice	#		
Road-constructing materials	#		
Sand	#		
Silicon and Silica		#	#
Sillimanite	#		
Stone and dimension stone	#		
Talc and pyrophylite	#		
Wollastonite	#		
Zeolite	#		
Iron	#	#	
Kieselguhr (Diatomaceous Earth)	#		
Lead			#
Limestone	#	#	
Magnesite/Magnesium		#	#
Manganese	#	#	
Mercury			#
Molybdenum			#
Nickel			#
Oil and gas			#
Other carbonaceous fuels:			
Peat	#		
Lignite	#	#	
Oil shale		#	#
Pseudo coal		#	#
Pegmatite minerals:			
Beryl	#		
Bismuth	#		
Columbium	#		
Feldspar	#		
Lithium	#		
Mica	#		
Tantalum	#		
Niobium	#		

COMMODITY	SUITED FOR SMMEs	EXPLOITATION BY SMMEs QUESTIONABLE	NOT SUITABLE FOR EXPLOITATION BY SMMEs
Platinum Group Metals (PGM)		#	#
Phosphate		#	#
Rare earth minerals		#	#
Silver		#	
Sulphur and pyrite			#
Thorium		#	#
Tin	#		
Titanium	#	#	
Tungsten	#		
Uranium		#	#
Vanadium		#	
Vermiculite	#		
Zinc			#
Zirconium /Hafnium		#	#

APPENDIX B LEGISLATION AND GUIDELINE REFERENCE LIST

The relevant legislative aspects are addressed in the following categories:

- DWAF legislation
- DME legislation
- Other legislation
- DME Guidelines
- SABS Guidelines

B1 DWAF Legislation

Act/Government Notice/Policy	Important Section(s)/Regulation(s)
National Water Act (Act 36 of 1998)	12; 19; 20; 21; 22; 23; 26; 27; 28; 29; 30; 31; 36; 39; 117-123; 145; 151 and 154
GN 704 of 4 June 1999 *(Regulations on use of water for mining and related activities aimed at the protection of water resources.)*	3, 4, 5, 6, 7, 8, 10, 12
Water Services Act (Act 108 of 1997)	7
GN 387 of 14 April 2000 (Registration of water use)	

B2 DME Legislation

Act/Government Notice/Policy	Important Section(s)/Regulation(s)
MPRDA of 2002 and associated Regulations *(Authorisations to prospect and to mine; Rehabilitation of surface; Notice of commencement or cessation of mining; Offences)*	16, 17, 22, 23, 27, 39. Regulation 52
Mine Health and Safety Act (Act 29 of 1996)	

B3 Other Legislation

Act/Government Notice/Policy	Relevant Section(s)/Regulation(s)
Constitution of the Republic of South Africa (1996)	22; 24; 25; 32; 34; 36; 38 and 39
National Environmental Management Act (Act 107 of 1998)	23, 24, 28, 30, 31, 32, 33 and 34
Environment Conservation Act (Act 73 of 1989) *(Provisions regulating environmental impact assessments read with GN 1182 and 1183 of 1997)*	20 (1); 21 and 22
Conservation of Agricultural Resources Act (Act 43 of 1983) *(Prohibition and control measures for spreading of weeds and invader plants)*	5 and 6
Atmospheric Pollution Prevention Act (Act 45 of 1965)	

B4 DME Operational Guidelines

The Department of Minerals and Energy (DME), in revising the *Aide-Memoire,* have developed a Mining Environmental Management (MEM) guideline series. This series is structured to have three tiers of guidance as follows:

- MEM framework describing overarching policy and structure.
- Procedural and content of report guidance for each phase of a mine.
- Supporting and technical guidance.

With regard to the third tier of guidance, various supporting and technical guidelines either exist or have to be developed for various environmental or management components. The BPGs for resource protection, while being a DWAF initiative that is primarily intended to define and promote integrated water management in the mining industry, will also be included into the third tier of guidance and will also be adequately referenced in the MEM guidelines.

B5 SABS Guidelines

SABS 0286 of 1998 presents the code of practice for mine residues.

[4] *http: www.maden.hacettepe.edu.tr/dmmrt/dmmrt320.html*

APPENDIX C PERMISSIBLE WATER USES

National Water Act 1998 (Act 36 of 1998)

Section 22 states that a person may only use water

a) Without a licence
   (i) if that water use is permissible under Schedule 1
   (ii) If that water use is permissible as a continuation of an existing lawful use; or
   (iii) If that water use is permissible in terms of a general authorization issued under section 39
b) If the water use is authorized by a licence under this Act; or
c) If the responsible authority has dispensed with a licence requirement under sub-section (22(3)) i.e. if it is satisfied that the purpose of the Act will be met by the grant of a licence, permit or other authorization under any other law.

C1 Schedule 1

Permissible Use of Water

(Sections 4 (1) and 22 (1) (*a*) (i) and Item 2 of Schedule 3)

Schedule 1 authorises the reasonable use of water for domestic purposes, for small gardening and for animal watering. Because of their limited extent, these uses will not have a significant impact on water resources and no further authorisation is required in respect of them.

(1) A person may, subject to the National Water Act (Act 36 of 1998):-
   (a) take water for reasonable domestic use in that person's household, from any water resource to which that person has lawful access;
   (b) take water for use on land owned or occupied by that person, for-
      (i) reasonable domestic use;
      (ii) small gardening not for commercial purposes; and
      (iii) the water of animals (excluding feedlots) which graze on that land within the grazing capacity of that land,

      from any water resource which is situated on or forms a boundary of that land, if the use is not excessive in relation to the capacity of the water resource and the needs of other users;
   (c) store and use run-off water from a roof;
   (d) in emergency situations, take water from any water resource for human consumption or firefighting;
   (e) for recreational purposes-
      (i) use the water or the water surface of a water resource to which that person has lawful access; or
      (ii) portage any boat or canoe on any land adjacent to a watercourse in order to continue boating on that watercourse; and
   (f) discharge-
      (i) waste or water containing waste; or
      (ii) run-off water, including storm water from any residential, recreational, commercial or industrial site,

      into a canal, sea outfall or other conduit controlled by another person authorised to undertake the purification, treatment or disposal of waste or water containing waste,

subject to the approval of the person controlling the canal, sea outfall or other conduit.

(2) An entitlement under this Schedule does not override any other law, ordinance, bylaw or regulation, and is subject to any limitation or prohibition thereunder.

C2 General Authorisations

The Minister may, under part 6 of chapter 4 and by notice in the *Government Gazette*, give general authorisation for certain water uses.

The use of water under a general authorisation does not require a licence until the general authorization is revoked. A general authorization may be restricted to a particular water resource, a particular category of persons, a defined geographical area or periods of time and requires conformity with other relevant laws. DWAF will publish general authorization in the Gazette after public consultation

Government Notice 1191 (1999)

General Authorisations in terms of Section 39 of the National Water Act 1998.

The authorizations permitted in terms of this schedule replace the need for a water user to apply for a licence in terms of the National Water Act provided that it is within the limits and conditions set out in the authorisation

Schedule 1: The taking of water from a water resource and storage of water. (Section 21(a) and (b)).

Schedule 2: Controlled activities:

Irrigation of any land with waste or water containing waste generated through any industrial activity or by a water work (Section 21(e)).

Schedule 3: Discharge of waste or water containing waste into a water resource through a pipe, canal, sewer or other conduit; and

Disposing in any manner of water, which contains waste from or which has been heated in any industrial or power generation process (Section 21(f) and (h)).

Schedule 4: Disposing of waste in a manner which may detrimentally impact on water resource (Section 21(g)).

Government Notice 398 (2004)

General Authorisations, in terms of Section 39 of the National Water Act 1998.

The authorizations permitted in terms of this schedule replace the need for a water user to apply for a licence in terms of the National Water Act provided that it is within the limits and conditions set out in the authorisation

Schedule 1: Impeding or diverting the flow of water in a watercourse. (Section 21(c)).

Schedule 2: Altering the bed, banks or characteristics of a watercourse (Section 21(i)).

Schedule 3: Removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people (Section 21(j)).

C3 Water Use Licences

- Water uses may be authorised by a licence in terms of the National Water Act (Act 36 of 1998). Parts 7, 8, 9 and 10 of Chapter 4 of the National Water Act deal with licences.
- Any person not otherwise entitled to use water may apply for a licence under part 7 of Chapter 4.
- The application must go through a public participation process and interested persons may object. Section 27(1) lists the considerations, which the licensing authority (which could be a catchment management agency or the Minister) must apply. Among these are whether water use is efficient and beneficial, in the public interest and also the strategic importance of the water use and its effect on other water users.
- The licensing authority must give reasons for its decisions not to approve a licence.
- There is an appeal against decisions of licensing authorities to an independent body known as the Water Tribunal.

APPENDIX D: DWAF LICENCE APPLICATION FORM REFERENCE NUMBERS

Licence application forms can be obtained from the DWAF regional offices or downloaded from their web site www.dwaf.gov.za

The application form reference numbers for each type of water use licence are given in the table below:

DW756/7/8/9	Part 1 of licence application
DW773	Taking water from a water resource
DW774	Storing water
DW775	Impeding or diverting the flow of water in a watercourse
DW776	Engaging in a stream flow reduction activity
DW765	Engaging in a controlled activity--irrigation of any land with waste or water containing waste generated through any industrial activity or by a waterworks
DW766	Discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduit
DW767	Disposing of waste in a manner which may detrimentally impact on a water resource
DW780	Disposing of water which contains waste from, or which has been heated in, any industrial or power generation process
DW781	Altering the bed, banks or characteristics of a watercourse
DW782	Removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people
DW783	Using water for recreational purposes

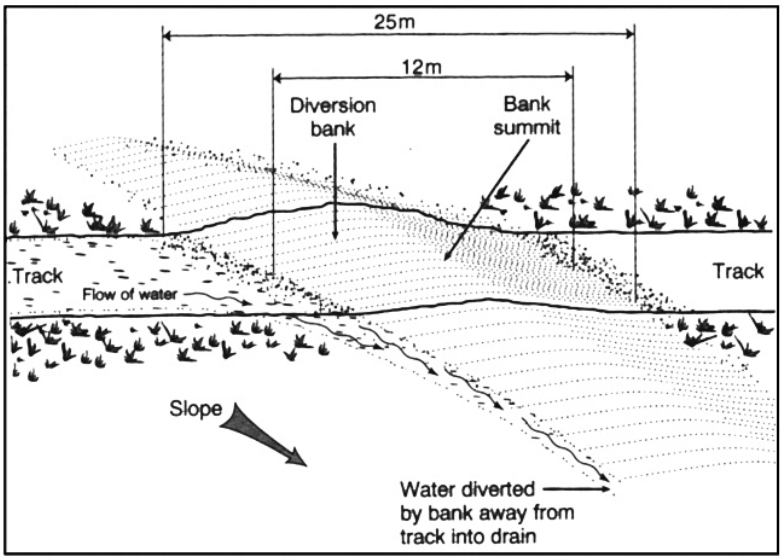
The Department also requests for additional information on the licencing forms DW 777, DW 778, DW 779, DW 780 and DW 808. These supplementery forms can also be downloaded from the DWAF website.

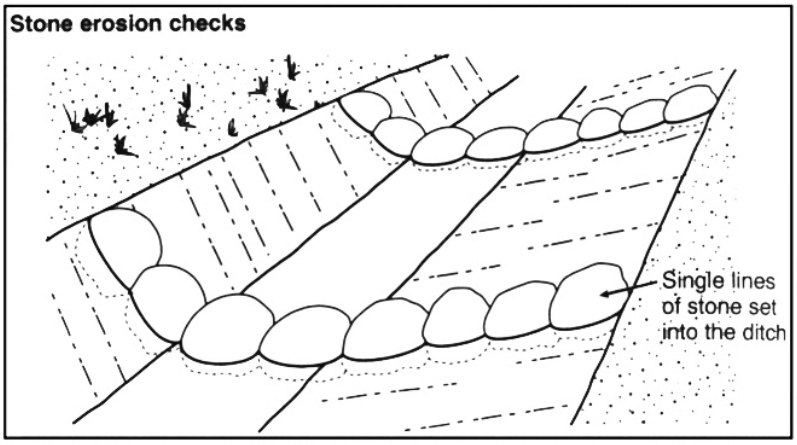
APPENDIX E PROPOSED BEST MANAGEMENT PRACTICES

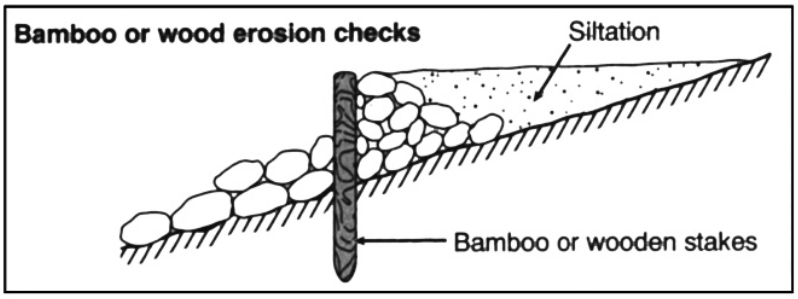
E1 Erosion and sediment control

Berm/Contour hump/Cut-off: A narrow earth or stone ridge built along or across roads or trails to divert rain away from the roads into vegetated areas. Logs can also be used to reinforce the berm if required.

Erosion control measure examples



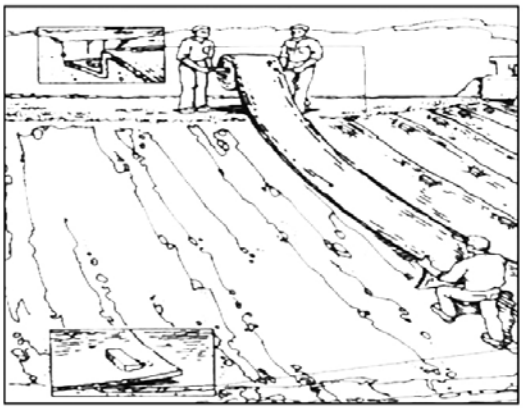




Dust Control: Watering, mulching, sprigging, or applying geo-textile materials to construction area to prevent soil loss as dust. Re-deposited dust can become a source of sediment in runoff. Control measures should be applied routinely and thoroughly in drier seasons and climates for effective dust control.

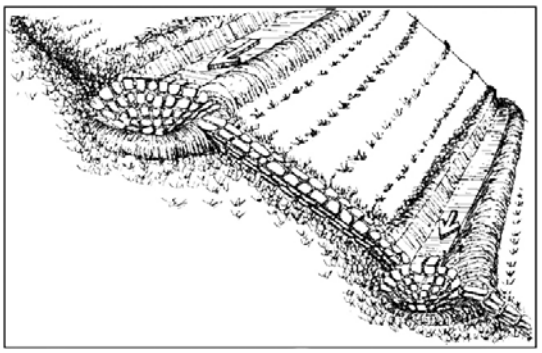
Mulching: A protective blanket of grass or other plant residue, gravel, or synthetic material applied to the soil surface to minimize raindrop impact energy and runoff, foster vegetative establishment, reduce evaporation, insulate the soil, and suppress weed growth. Mulch provides immediate protection, and grass or straw mulch is also typically used as a matrix for spreading plant seed. Organic mulches, such as grass, straw, wood chips, and shredded bark, have been found to be the most effective. Grass or straw typically requires some kind of tacking, such as liquid emulsions or netting. Netting may also be needed to hold mulch in place on slopes. Mats made from a wide variety of organic and synthetic materials are useful in establishing grass in channels and waterways, and they promote seedling growth (Smolen et al., 1988). Mulching assists in the first, source reduction, and second, conveyance, stages of a Best Management Practice (BMP) system.

On some slopes, mulch blankets or mats of grass or wire mesh are used to hold soil in place until grass grows up and takes root



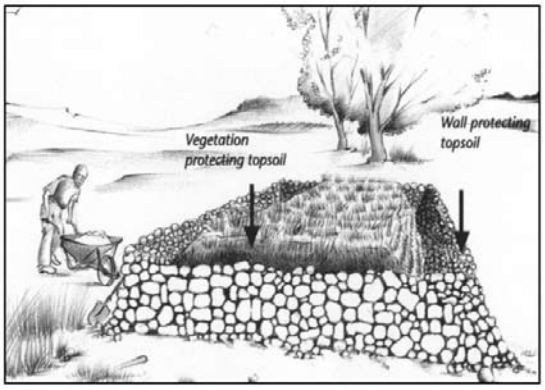
Riprap: A layer of stone designed to protect and stabilize areas subject to erosion, slopes subject to seepage, or areas with poor soil structure. Riprap is used on slopes where vegetation cannot be established, channel slopes and bottoms, stormwater structure inlets and outlets, slope drains, stream banks, and shorelines. It should be a well-graded mixture of stone sizes, and should be underlain by a filter blanket of gravel, sand and gravel, or synthetic material to prevent soil movement into or through the riprap (Smolen et al., 1988). Riprap can assist in all stages of a BMP system.

Water drainage way protected against erosion by rock lining



Top soiling: Preserving and subsequently using the upper, biologically active layer of soil to enhance final site stabilization with vegetation. Top soiling should not be conducted on steep slopes. Stockpiled soil should be contained with sediment barriers, and temporarily seeded for stability. Surfaces, which will receive topsoil, should be roughened just prior to spreading the soil to improve bonding. Spread topsoil should be lightly compacted to ensure good contact with the subsoil. Topsoil can act as a mulch, promoting final vegetation establishment, increasing water infiltration, and anchoring more erosive subsoil, assisting in the first, source reduction, and second, pollutant transport, stages of a BMP system (Smolen et al., 1988).

Topsoil protected by bund wall



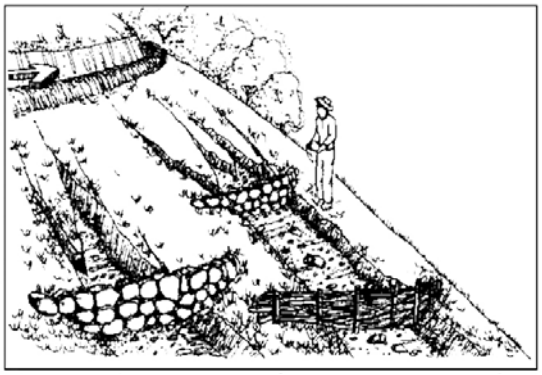
Bund walls: Walls that are built around something like a pile of topsoil to prevent it from being washed away. The walls can be made of any suitable material such as planks, rocks or soil.

Bund walls are also constructed around the perimeter of an open pit to minimise access and improve pit wall stability. Bund walls are generally constructed from rockfill and situated at least 10 m from the potentially unstable pit edge zone or final pit wall crest. The least weathered or hardest rock material should be used wherever possible. The bund wall may be supplemented with appropriate surface stabilisation or a properly constructed fence.

E.2 Runoff control and conveyance

Energy Breaks: Rocks or gabions are placed on a slope to guide the run-off and slow it down. The water is directed along an extended and winding path. This limits its erosion potential before it reaches the receiving watercourse.

Contour diversion ditch and energy breaks for gully control



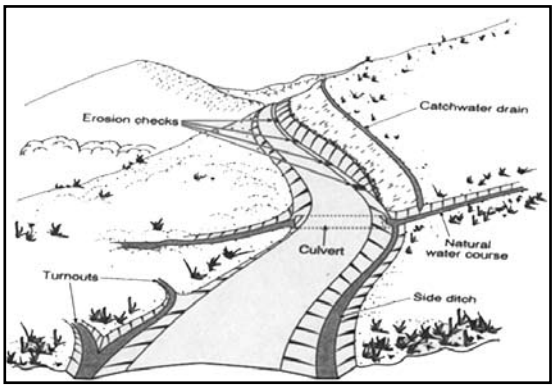
Grass-Lined Channel: A swale vegetated with grass, which is dry except following storms, and serves to convey specified concentrated stormwater runoff volumes, without resulting in erosion, to disposal locations. Typical uses include roadside swales, outlets for runoff diversions, site stormwater routing, and drainage of low areas. Channels should conform to the natural drainage patterns. Channels are not meant to collect sediment, as it will reduce their conveyance capacity. Lining with geo-textile or other material is required if design flows are to exceed one metre per second. Channel vegetation should be allowed to establish before flows are introduced (Smolen et al., 1988). Channels assist in the second, conveyance stage of a BMP system.

Hardened Channels: Channels with erosion-resistant linings of riprap, paving, or other structural material designed for the conveyance and safe disposal of excess water without erosion. Hardened channels replace grass-lined channels where conditions are unsuitable for the latter, such as steep slopes, prolonged flows, potential for traffic damage, erodible soils, or design velocity over 2 metre per second (Smolen et al., 1988). Channels assist in the second, conveyance stage of a BMP system.

Paved Flume: A small concrete-lined channel to convey water down a relatively steep slope without causing erosion. Flumes serve as stable, permanent elements of a stormwater system receiving drainage from above a relatively steep slope, typically conveyed by diversions, channels, or natural drainage ways. Setting the flume well into the ground is important, particularly on fill slopes. Some means of energy dissipation should be provided at the outlet, and an inlet bypass route should be available for extreme flows (Smolen et al., 1988). Flumes assist in the second, conveyance stage of a BMP system.

Runoff Diversions: Structures that channel upslope runoff away from erosion source areas, divert sediment-laden runoff to appropriate traps or stable outlets, or capture runoff before it leaves the site, diverting it to locations where it can be used or released without erosion or flood damage. Diversions include graded surfaces to redirect sheet flow, diversion dykes or berms, which force sheet flow around a protected area, and stormwater conveyances (swales, channels, gutters, drains, sewers), which intercept, collect and redirect runoff (USEPA, 1992). Diversions can be either temporary or permanent in nature. Temporary diversions include excavation of a channel along with placement of the spoil in a dike on the down gradient side of the channel, and placement of gravel in a ridge below an excavated swale. Permanent diversions are used to divide a site into specific drainage areas, should be sized to capture and carry a specific magnitude of design storm, and should be constructed of more permanent materials. A *water bar* is a specific kind of runoff diversion that is constructed diagonally at intervals across a linear sloping surface such as a road or right-of-way that is subject to erosion. Water bars are meant to interrupt the accumulation of erosive volumes of water through their periodic placement down the slope, and divert the resulting segments of flow into adjacent undisturbed areas for dissipation (Smolen et al., 1988). Runoff diversions assist in the second, conveyance stage of a BMP system.

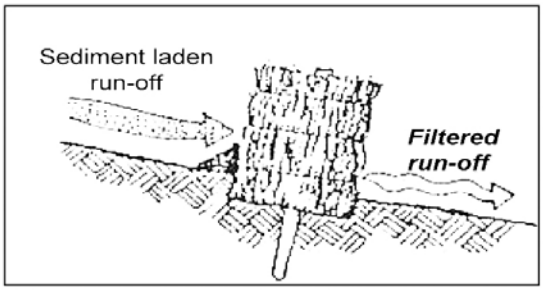
Road drainage management examples



E3 Sediment traps and barriers

Bush barriers: Temporary sediment barriers constructed of bush, weeds, vines, root mat, soil, rock, or other cleared materials piled together to form a berm, and located across or at the toe of a slope susceptible to sheet and rill erosion.

Bush barrier/sedimentation trap



Sediment Trap: A small, temporary ponding basin formed by an embankment or excavation to capture sediment from runoff. Traps are most commonly used at the outlets of diversions, channels, slope drains, or other runoff conveyances that discharge sediment-laden water. It is important to consider provisions to protect the embankment from failure from runoff events that exceed the design capacity. Plan for non-erosive emergency bypass areas. Make traps readily accessible for periodic maintenance. High length-to-width ratios minimize the potential for short-circuiting. The pond outlet should be a stone section designed as the low point (Smolen et al., 1988). Sediment traps assist in the third, capture stage of a BMP system.

APPENDIX F CHECKLISTS

F1 Basic Requirements of Rights or Permits for Small-Scale Mines

	Prospecting right and mining permit or authorization	Water use licence
Legislation reference	Section 16 or 27 of Minerals and Petroleum Resources Development Act, No 28 of 2002	Chapter 4 of National Water Act, No 36 of 1998
Who can apply	Owner of land/miner	Owner or legal occupier/ user of land e.g. miner
Procedure	a) Apply for mining authorisation. b) Collect EMP form and complete. c) Make 6 copies (one to be kept by the miner). d) Submit to DME, Regional Manager	a) Collect relevant licence application form (*see Appendix D).* b) Apply for licence by completing the relevant licence form and providing supporting documentation (*see Appendix F3).* c) Submit to DWAF Regional Director.
Where	DME- Regional office	DWAF- Regional office
Document/s required	EMP	Licence form and supporting documentation (*see Appendix F3*)
Cost	Yes - non-refundable fee	Yes - non-refundable fee
Duration	Prospecting right: < 5 years Mining permit: < 2 years Mining right: > 2 years	Valid for <5 years
Renewable	Yes	Yes
Performance reports	Yes - frequency determined by regulator	Yes

F.2 Regulators Checklist

	Questions	Answers			
Starting up a mining operation					
1.	Does this operation qualify for an EMP?	Yes	No		
2	Does the owner have permission to carry out mining activity/mineral right?	Yes	No		
3	Has the EMP been submitted?	Yes	No		
4	Which licence application is required for this operation?				
5	Is the relevant information provided?	Yes	No	Request more information	
Expanding/ current mining operation					
1	Has the operation registered its water use with DWAF?	No	Registered (has receipt)		
2	What is the status of the EMP for this operation?	None	Prepared	Submitted	Approved
3	When was the EMP last updated?	<1 year	1-2 years	>2 years	
4	Is the EMP available for auditing purposes?	Not available	Available		
5	Is there a water use licence?	None	Applied	General authorisation or directive granted	Licence
6	Is there a valid permit for where there is process emission?	None	Applied	Needs to apply	

F.3 Water Use Licence Application Checklist

Before the mine is opened/started, or before old workings are expanded or re-developed, the small-scale miner may need to apply for a water use licence. Supporting documentation needs to accompany the licence application in the form of a technical report.

It is important to note that the small-scale miner can refer to the relevant completed section of their EMP in the technical report where applicable to avoid duplication. A copy of the EMP must then also be attached to the technical report.

The following checklist is helpful when considering what should be included as supporting information in the technical report for the regulator to assess the application effectively:

- Mining method and type used
- Category of mine (i.e. A, B or C)
- River catchment where mining will take place
- Name of water resource impacted or used
- Type of water resource impacted or used (river, spring, borehole, dam, wetland, scheme etc)
- Geographic location of water use activity
- Reliability of water resource (e.g. water always available; dry during certain seasons; frequently dry)
- Volume (quantity) of water used
- Quality of water used
- Period of water use
- Weather conditions e.g. flood risk
- Existence of any sensitive landscapes or demarcated/ designated areas
- Receiving water quality objectives
- How the area drains
- How the mine or the expansion or redevelopment thereof will change the drainage
- Distance of mine from watercourse
- How water will be abstracted
- How water run-off from the area will be controlled
- Are clean and hygienic sanitation facilities provided?
- Are pollution management measures in place or planned? (i.e. control structures for prevention of water pollution)
- If mining operation will impede or divert watercourse - distance after impedance or diversion from original position
- If mining operation will result in wastewater discharge – nature of wastewater; disposal method etc.

F.4 Audit Checklist

The following checklist is helpful when conducting an audit of the operations and performance of the environmental management programme/plan.

DIVISION	QUESTION	TICK BOX
Have water management plans for the most critical impacts been implemented or addressed?		
Water management	Is water run-off from the area controlled and effective?	
	Have steps been taken to minimize disturbances or damage to • The river; • The riverbanks; • The area 50m each side of the river?	
	Is the water run-off from mobile and truck washing bays/facilities controlled and effective?	
	Are the premises safe from flood damage and soak-aways? • Yes; • Minor disruptive flooding - not enough to stop operations; • Occasional flooding experienced or possible.	
	Are there steps taken to prevent soil erosion? Has eroded sediment been prevented from entering rivers, drains or adjacent properties?	
	Does the mining development plan show sequence stripping, berm location vegetation protection strips and drainage etc.?	
	Is water conservation being conducted? (Water recycling; water reuse)	
	Is wastewater being treated or reused (reclaimed)?	
	Is wastewater being treated before it is discharged?	
	Is water quality monitored above and below the operation?	
	Is the water quality monitoring consistent with hazards identified in the risk assessment?	
	Are boreholes monitored?	
	Are clean and hygienic sanitation facilities provided (toilet and hand washing)?	
	What type of sanitation facility is provided? • French drain; • Portable unit; • Septic tank; • Flush toilet connected to municipal sewer.	
	Is there a slimes dam or sludge collection pond? If yes, Is slurry material contained in slimes dam with an overflow pipe installed? Is the minimum free board >0.8m? Is there a return channel around the dam to handle overflow material?	

Soil and ground protection (cont)	Are hazardous substances stored safely and in a clearly marked and enclosed area?	
	Are fuel tanks above ground in a bunded area?	
	Is the oil stored in designated areas with a bund wall/drip trays?	
	Is there an effective oil trap, which is frequently emptied?	
	Are cut-off drains from the workshops and wash bays present and effective?	
	In the event of a spill, is suitable absorbent material used? • nothing; • sawdust/sand; • cement; • absorbent mates; booms, socks etc; • sphagnum moss based absorbent.	
Erosion control	Has topsoil been removed and stored before working in an area?	
	Is topsoil stored separately from overburden (the sub-soil and deeper material)?	
	Is rehabilitation taking place?	
	Have non-invasive and indigenous plants been used for rehabilitation or landscaping?	
	What measures does the mine carry out to combat erosion including stockpiles, roadways, plant area and mining area?	
	How effective are the erosion control methods?	
Waste control	Is there a scrap and waste disposal procedure?	
	Is there an area where waste materials can be collected?	
	Is all hazardous waste removed off the premises and taken to an approved site for disposal?	
	Are sufficient bins/containers/skips provided at these premises?	
	Has a certificate been supplied by the hazardous waste remover?	
Dust monitoring	Have steps been taken to reduce dust in • the mining area, • in the plant area; • at the stockpiles; • on the roads; • in the loading areas?	
Rehabilitation	Is the rehabilitation plan detailed and suitable for the current progress?	
	Are there plans for closure (including mine, roads, buildings, plant, other infrastructure and security)?	
Mine financial planning	Is the current financial provision adequate for scheduled rehabilitation, monitoring and ramification of environmental damage?	
Training	Has any environmental training been provided for workers?	
Physical inspections	What is the general state of operations?	
	In what state is the crushing and screening equipment?	
	In what condition are the buildings and workshops?	
	How good is the appearance of the actual mining area?	
	How is the plant life and fish life in the rivers?	
	Do the workers understand the importance of protecting water resources and how to do so?	