Series A: Activity Guidelines



A1.1

BEST PRACTICE GUIDELINE

Small-Scale Mining (User 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 (Standard Format)

- ***A1.1: User format (English)***
- A1.2: User format (Zulu)
- A1.3: User format (Sotho)

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.

We are deeply indebted to the steering committee members, officials of the Department of Water Affairs and Forestry and stakeholders who participated in the meetings and stakeholder workshops held during the development of the series of Best Practice Guidelines for their inputs, comments and kind assistance.

The Department would like to acknowledge the authors of this document, as well as the specialists involved in the process of developing this Best Practice Guideline. Without their knowledge and expertise this guideline could not have been complemeted.

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:

RESOURCE PROTECTION AND WASTE MANAGEMENT HIERARCHY

Step 1: Pollution Prevention

↓

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 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 below.

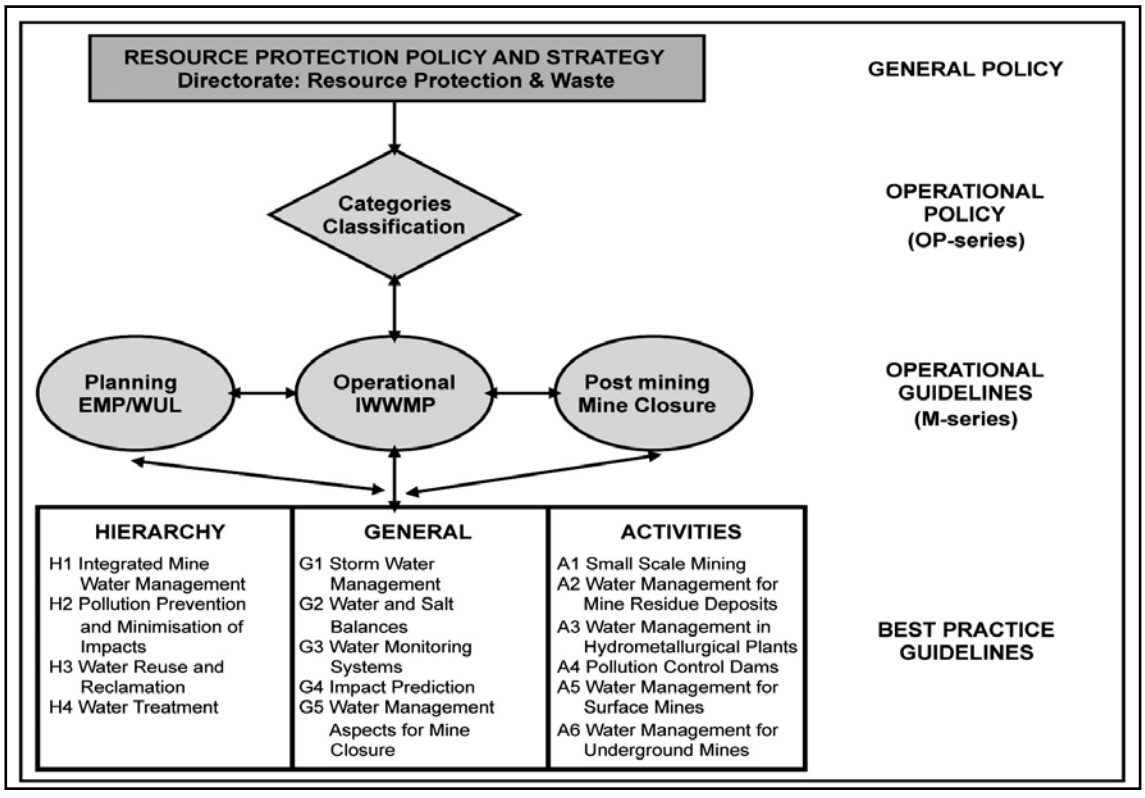
The overall Resource Protection and Waste Management Policy sets out the interpretation of policy and legal principles as well as functional and organisational arrangements for resource protection and waste management in South Africa.

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 Managment
- 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

FIGURES

TABLES

1 WHY WAS THIS DOCUMENT WRITTEN?

This BEST PRACTICE GUIDELINE was written for small-scale miners in South Africa.

It is a simple, easy-to-use document that gives practical advice on the very important topic of water management in the small-scale mining sector. This document

- Provides a simple guide to the licences, permits or authorisations you require as a small-scale miner;
- Outlines the responsibilities you have as a small-scale miner to ensure protection of our water resources;
- Assists you in identifying potential areas of concern and impact for each type of small-scale mining;
- Describes the main basic measures that you need to take to prevent and minimize your impact on water resources;
- Clarifies what is required by the Department of Water Affairs and Forestry (DWAF) regulators to satisfy them that you have correctly applied the water pollution prevention and minimization measures at each stage of the life cycle of your mine;
- Describes the use of an Environmental Management Plan (EMP).

This particular guideline has been prepared in <u>two formats:</u>

i) This document is called the User format. It was written for small-scale miners. It is available in English, Zulu and Sotho.

ii) Another format of the same guideline has been prepared for DWAF officials, such as water pollution control officials and environmental management personnel. This we call the Standard format, because it is the same format that most other departmental guidelines follow. It is very similar to this User format document, but has more detail. You can obtain and use both of these formats.

An <u>introductory handbook</u> for small-scale miners has also been written. It is called "*Environmentally Friendly Mining - Water Management Guidelines for Small–Scale Mining"*. This handbook was produced by the Water Research Commission. Its reference number is Report TT170/02.

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c/o Frederika Street and 18th Avenue
Rietfontein
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Private Bag X03
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2

DEPARTMENT OF WATER AFFAIRS AND FORESTRY (DWAF) GUIDELINE SERIES

DWAF has produced a number of Best Practice Guideline documents for water management and resource protection at mines.

The topics that are included in these guidelines are:

BPG H1: Integrated Mine Water Management

BPG H2: Pollution Prevention and Minimisation of Impacts

BPG H3: Water Reuse and Reclamation

BPG H4: Water Treatment

BPG G1: Storm Water Management

BPG G2: Water and Salt Balances

BPG G3: Water Monitoring Systems

BPG G4: Impact Prediction

BPG G5. Water Management Aspects for Mine Closure

BPG A1: Small Scale Mining – (**Standard** Format)

BPG A1.1: Small-Scale Mining – (User Format - English)

BPG A1.1: Small-Scale Mining – (**User** Format - Zulu)

BPG A1.1: Small-Scale Mining Practices – (**User** Format - Sotho)

BPG A2: Water Management for Mine Residue Deposits

BPG A3: Water Management in Hydrometallurgical Plants

BPG A4: Pollution Control Dams

BPG A5: Water Management for Surface Mines

BPG A6: Water Management for Underground Mines

3

IS THIS THE CORRECT DOCUMENT FOR YOU TO USE?

This guideline was written for small-scale miners who do certain types of mining and have limited impacts on water resources. The information on this page will tell you if this guideline will be useful to you, or whether you should rather use other guidelines in the DWAF Guidelines series. A list of these other guidelines is given on the previous page.

If you answer yes to most of these questions, then this guideline is for you!

- Is your mining operation one of the following sizes?
  - **micro** (less than 5 employees)
  - **very small** (5 - 20 employees)
  - **small** (20 - 50 employees)
- Do you work on a portion of land 1.5 hectares (ha) in size or smaller?
- Does your level of mechanization fall into the following range?
  - **No mechanization -** this involves artisans using picks and shovels. The main objective/ motivation is subsistence.
  - **Limited mechanization** - mining is for more than subsistence. It involves mechanization on a limited scale (e.g. one truck, one front-end loader and a mechanical pan/washer).
  - **Mechanized -** mining is not subsistence-oriented and uses extensive mechanical equipment (several trucks, front-end loaders and mechanical equipment for the processing of ore).
- Is yours a **surface** mine that involves **mining of one type of mineral**?
- Does your mining operation have a **limited impact on the water environment**?
- Does your mining operation **avoid using chemicals or chemical processes**?
- Does your mining operation **exclude material that contains sulphide**?

If you answered no to some of these, it may be that another guideline document will be more useful to you. Look at the list of guidelines on the previous page.

If you said yes to most of these questions then this guideline is for you. The main mining types that are included in this guideline are:

- *Alluvial diamond mining*
- *Alluvial gold panning (gravity separation)*
- *Sand winning*
- *Clay extraction*
- *Alluvial semi-precious stone mining*.

The list of mining types given above describe what most small-scale miners, like yourself, would be doing. There are other mining types that are also covered by this guideline. These types are listed in **Appendix B**.

4

WHAT LAWS OR PROCEDURES DO YOU NEED TO KNOW ABOUT?

The main legal documents covering environmental and water management that small-scale miners need to know about are:

1) The **Environmental Management Plan** (EMP). Section 39 and Regulation 52 of the Minerals and Petroleum Resources Development Act, 2002 (Act 28 of 2002) requires small-scale miners to submit an EMP. The forms and the application process are administered and coordinated by the Department of Minerals and Energy (DME). The MPRDA and its regulations require the applicant to demonstrate in the Environmental Management Plan that the applicant has the financial means and has made sufficient and acceptable pecuniary financial provision for the remediation of environmental damage or management of environmental damage before the approval of Environmental Management Plan.
2) The **Water Use Licence/ Authorisation.** A small-scale mine may need an approved Water Use Licence or Authorisation if its water use falls into certain categories. A water use authorisation is required in terms of the *National Water Act, 1998 (Act 36 of 1998)* and is administered by the Department of Water Affairs and Forestry (DWAF). All water uses need to be registered with DWAF (complete application forms obtainable from DWAF) (See the Water Use Authorisation list on page 5 and page 36.)
3) **Regulations** on the use of water for mining and related activities. Section 26(1) of the National Water Act 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.

1 MINING PERMITS AND EMPs

When you decide to start a small-scale mine you will first have to get authorisation for this from the DME. Which authorisation you apply for depends on the scale and duration of what you want to do, as follows:

- A prospecting right is issued for a period specified in the right and which may not exceed five years (can be renewed). A prospecting right may be renewed once for a period not exceeding three years.
- A mining permit is granted for smaller operations (with a surface area of less than 1.5ha and shorter periods (less than 2 years). A mining permit is valid for the period specified in the permit which may not exceed a period of two years and may be renewed for three periods each of which may not exceed one year.
- A mining right is granted for larger operations and longer periods (more than 2 years). A mining right may be renewed for further periods, each of which may not exceed 30 years at time.

Small-scale mines generally do not have the same impacts as larger mines, so an Environmental Management Plan (EMP) was developed and this is the correct document

to use. Your completed EMP must be submitted to the Regional Manager at the DME office in your region, for approval of either a prospecting right or a mining permit. This document is required in terms of Section 39 and Regulation 52 of the MPRDA. The EMP deals with the surface of land involved in any prospecting or mining operations.

Once you have compiled and submitted your EMP you must wait for approval to start mining. In terms of Section 5 (4) of the MPRDA, no mining operations may start until approval has been obtained. Once the EMP has been approved, you will be issued with, either, a prospecting right or a mining permit, depending on the nature of your application.

Your mining operation will go through several stages, from the start-up phase through to closure and final rehabilitation. We call this the **life cycle of the mine**. In order to manage the impacts successfully, your EMP should be linked with these phases. The EMP needs to deal with possible impacts from the very beginning of the project.

The plan must form a part of the day-to-day management activities on the mining area and the contents of the EMP must be made known to all people on the mine, for some in much more detail than for others, depending on what environmental protection and management responsibilities they have.

5 THE WATER USE LICENCE

The National Water Act, (Act 36 of 1998), is based on the principles of sustainability, efficiency and equity, meaning that the protection of water resources must be balanced with their development and use.

So in addition to being issued with a prospecting permit, mining permit or mining licence, a small-scale miner may also need to get a **water use authorisation** for the proposed water uses that will take place, except in certain cases. The different kinds of water uses are described in the box below. The water use licence will be approved only if the EMP is also approved.

Applications for a water use authorisation /licence must be made in good time, such that approval can be granted before a water use activity can begin. A miner should fill in the appropriate licence forms for each kind of expected water use and provide supporting documentation. The main supporting document required is a technical report. To make the technical report easier to write, you can refer to sections in your EMP, because most of what the technical report requires has already been done in this document. If you refer to any document you must attach it to the technical report. **Appendix A** at the end of this guideline gives the DWAF licence form reference numbers and **Appendix C3** gives a checklist of what information is needed in the technical report.

The different kinds of water use that are described in Section 21 of the National Water Act include:

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 opencast mining.

d) **Reducing stream-flow,** such as growing crops, which will use the rainwater that would otherwise have reached the stream.

e) **Controlled activities**, such as irrigating with wastewater or recharging the underground water with wastewater; such activities 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 that may harm a water resource.

h) **Disposing 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 mining development.

j) **Removing underground water,** for example to ensure safety in mining.

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

The National Water Act groups the different categories of water use, according to the amount of impact (damage) they might have on water resources, as follows:

Schedule 1 Uses are mainly domestic use with little or no potential for impact. No permit, authorisation or licence is required. These water uses are called Schedule 1 Uses because they are a basic right as described in Schedule 1 of the South African Constitution. For example, you do not need permission to set up toilets on your site, or to provide access to drinking water. Just ensure that you use suitable standards of sanitation such as a Ventilated Improved Pit latrine (VIP) that is more than 50 metres from a watercourse or well.

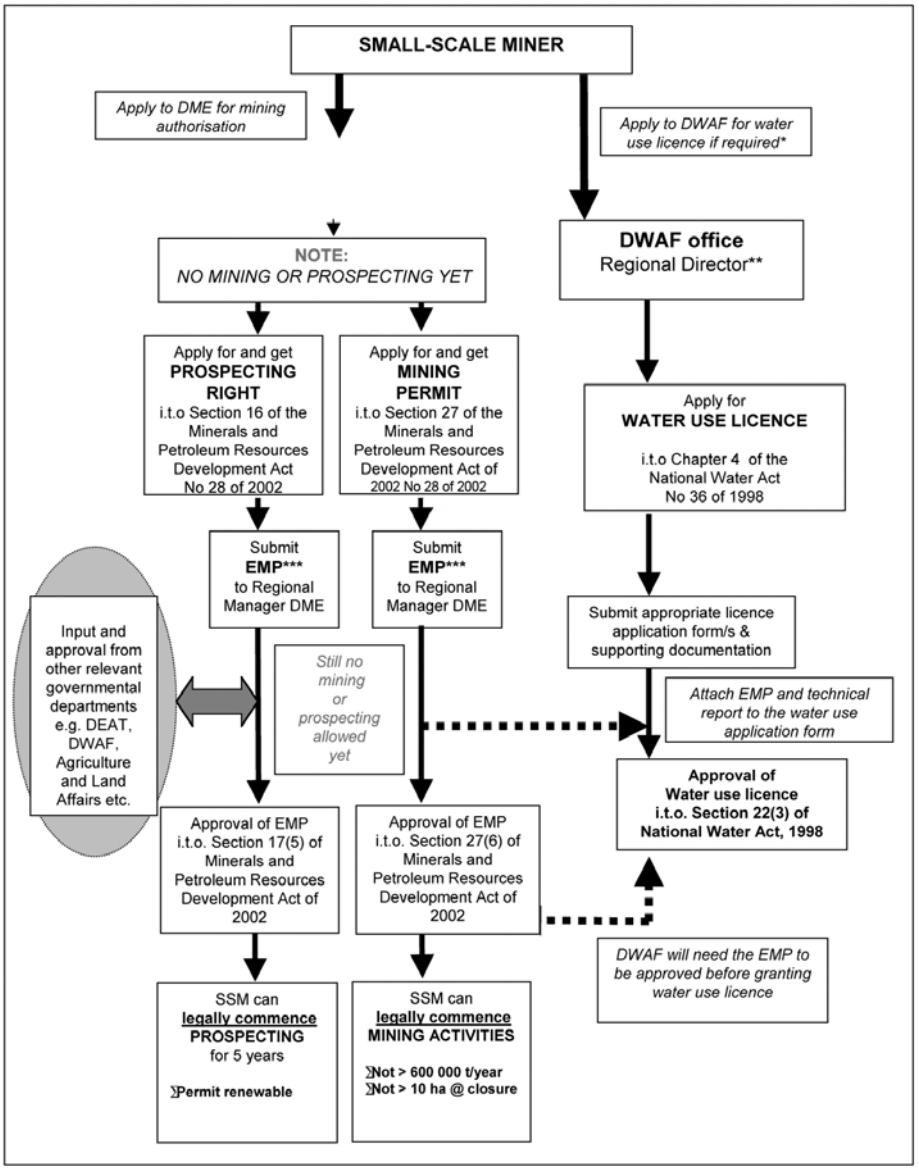
General Authorised Uses are those that need to be registered with DWAF using a water use registration form. These water uses do not need a water use *licence* because they have a low potential for damaging water resources. A General Authorisation will therefore not apply to

certain identified and listed sensitive areas. Appendix D of this guideline gives detailed information about water authorisations and where they apply. (There are **specific** examples of water uses for items (a), (b), (e), (f), (g), and (h) that have general authorisations.)

Licensed Uses are those activities that if not controlled, would have a high potential for unacceptable impact on water resources. These would be uses such as discharging waste into a watercourse. If you fall into this category, then you must apply for a licence to use water. Licences are subject to stringent conditions that specify the quality of wastewater being discharged or disposed of in order to protect the water resource. See **Appendix D** for more information, or discuss it with your regional DME or DWAF office. (Examples of water uses listed above that may require a water use licence are items (a), (b), (c), (d), (e), (f), (g), (h), (i) and (j) and where General Authorisations do not apply).

Figure 1 describes the procedures that a small-scale miner must follow to obtain a mining permit, complete an EMP and obtain a water use licence.

Figure 1: Summary of Small-Scale Miner Autorisation Procedures



6

WHAT WATER-RELATED IMPACTS DO YOU NEED TO KNOW ABOUT?

The different types of mining have different impacts on water resources. Some types of mining have many impacts on water resources and some have fewer impacts. This table helps you to work out the kinds of impacts your operation will probably have on water resources.

To use the table below (Table 1) you need to find the column heading for your type of mining. Then look down that column. Every time you find a cross, read about the kind of impact in the box on the left. If you find a dash, you can take it that the impact described in the box on the left is unlikely to be caused by your type of mining operation.

Table 1: Environmental impacts from different mining operations

Environmental impact	Alluvial diamonds	Sand-winning	Alluvial gold panning	Clay	Semi-precious stones
Aesthetics (e.g. discard dumps; pits; loss of vegetation)	X	X	X	X	X
Bank destabilization 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 • Oils/Diesel spillage • Sewage *There are many other kinds of chemical contamination, most are more serious than the above. See the guideline documents listed on page 2 for more information.*	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
Diverting flow of water	X	X	X	-	X
Water abstraction	X	X	X	X	X
River bed and fauna disturbance	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 also leads to increased suspended sediment loads in nearby streams and rivers.	X	X	X	-	X
Alteration in channel hydraulics	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 • Smothering of riverine habitat by silt, fish gill clogging	X	X	X	X	X

7

WHAT IS YOUR LEVEL OF RISK?

The table on the previous page showed you what kinds of impacts your type of mining might have on our water resources. Maybe there is very little risk that those impacts are serious, or maybe there is a very high level of risk. It is important that you assess your level of risk so that the remedial steps you take are appropriate. You do not want to spend a lot of money if there is a low level of risk, but if you cannot assess your risk, you might end up with major problems.

This page describes two general principles, i.e. (i) impact potential (how likely it is that your operation will have an impact on the environment) and (ii) cumulative effect (combined impact of many mining operations). The table on the following page helps you to put these principles into practice.

Impact Potential

The impacts that a small-scale mining operation might have on the environment, and especially the aquatic (water) environment, depends on:

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

Single versus cumulative effect

On their own, many of the effects of small-scale mining on the water environment may not have much impact. However, if these impacts occur at the same time, or if there are many small mines in the area, their impact will be much higher.

ASSESSING YOUR LEVEL OF RISK

Prevention is better (and cheaper) than cure.

There are many impacts that mining can have on the environment and on water resources in particular. It is important to assess what your level of risk is, so you can take steps to prevent the problems before they happen.

You can use the table below (Table 2) to help you assess your level of risk. You should do this assessment as part of developing your EMP, as well as at regular intervals during operations. By assessing where you might have the more serious problems you can take steps early on, while the solution will still be cheap and easy to implement. Another major benefit of using this assessment is that DME and DWAF officials will be using a very similar tool to assess your EMP and water use licence application as well as when they come to inspect your operation.

How to use this assessment tool

First think of a mining activity, for example removal of riverbank vegetation, or a possible problem that might happen unexpectedly, for example diesel spillage. When you have chosen such an example, look at each of the factors in the column on the left (i.e. frequency, extent, duration etc.) and decide for each one whether your problem will have a low impact, a medium impact, a high impact or a severe impact. For each factor (frequency, extent etc.), place a cross in the impact box that you think applies.

Table 2: Assessing the significance of impacts

	Low impact	Medium impact	High impact	Severe impact
Frequency	Single event, unlikely to be repeated e.g. spillage	Not regular, but does happen more than once	Regular, but intermittent e.g. soakaways; drains	Continuous e.g. leaks; infiltration
Extent	Limited to only in the mining area	Local water resources. Limited to a 5 km radius of mining area.	Catchment area. Limited to a 50 km radius of mining area.	Wider (regional/national) Can spread to other provinces or regions
Duration	Short term - 0-6 month. Events that will not happen more than once in 6 months	Medium term Up to 1 year	Long term - 5 years	Permanent - No mitigation will shorten impact duration
Intensity	Negligible/Very low Minor disturbances to aquatic ecosystems or local water resources; impact temporary	Low 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 requires frequent management attention and remedial action. Large scale effects on water resources; aquatic ecosystems and other water users
Probability	Improbable Low probability.	Probable Distinct probability.	Highly probable Most likely.	Definite Will occur regardless of prevention or mitigatory methods.

Your assessment

How many of your crosses appeared in the third (high impact) or fourth (severe impact) columns?

Small-scale mines (mainly the kinds that this guideline document was written for) should fall into the second column, sometimes the first. If even one of your crosses appears in the third or fourth column, you have a problem that needs attention. The next few pages will help you decide what kind of action you could take. In particular, you should look carefully at the pages under the section heading "EMP Life Cycle Water Management." This section gives you specific actions that you can take to prevent or repair problems at the various stages in the life cycle of a mine. These actions are, in fact, compulsory by law, so it is very important that you study them.

PREVENTION BEFORE CURE – SOME PRACTICAL ADVICE

DWAF has developed a set of steps that helps you to prevent problems before they become more serious and need to be repaired. DWAF's steps are:

STEP 1: Prevent or minimise pollution of water or generation of waste.

STEP 2: If you cannot prevent water pollution, reuse wastewater or water that contains waste (the water that has been polluted by you) rather than disposing of it.

STEP 3: If you cannot reuse the water, treat the wastewater so that you can reuse it before considering disposing of it.

STEP 4: Steps 1 to 3 may not be enough to prevent the discharge or disposal of wastewater. It may be that the quality of the polluted water still exceeds the applicable wastewater standards. In such a case you need to apply for a phased water use license containing:

- Extensive motivation for the water use authorisation, explaining social, financial and environmental implications.
- Firm commitment with a time schedule within which you will work towards achieving the specified water quality objectives.

The disposal or discharge of water containing waste, which exceeds the applicable standards, will only be considered as a last resort and as an interim measure.

In most cases a small-scale mine will cover its water pollution problems in **Steps 1 and 2.** If you need to move on to Steps 3 and 4, it would be better to consult a water treatment professional.

8

THREE KEY AREAS WHERE PREVENTION MEASURES NEED TO BE TAKEN

Steps 1 and 2 as referred to in chapter 7, are based on preventing problems before they become serious. Prevention of problems can be taken in three main areas of your operation. These are:

- STORM WATER MANAGEMENT
- EROSION AND SEDIMENT CONTROL
- WASTE MANAGEMENT

Before you start mining and when you prepare your EMP or technical report for a water use authorisation, you need to include plans for these three key areas indicated above. All of these principles will be far better applied through using advanced planning and good scheduling.

Storm Water Management

There are four principles that you need to include in a **storm water management plan:**

Clean water (e.g. rainwater) must be kept clean and be routed to a natural watercourse by a system separate from the dirty water system. You must prevent clean water from running or spilling into dirty water systems.

Dirty water must be collected and contained in a system separate from the clean water system. You must prevent dirty water from spilling or seeping into clean water systems.

The storm water management plan must apply for the entire life cycle of the mine and over different hydrological cycles (rainfall patterns).

The statutory requirements of various regulatory agencies and the interests of stakeholders must be considered and incorporated into the storm water management plan.

Erosion and Sediment Control

There are three principles that you need to include in an **erosion and sediment control plan**.

Minimise the potential sources of sediment (small particles) from the outset. This means limiting the extent (area) and duration (time period) of land disturbance to the minimum needed, and protecting surfaces once they are exposed.

Control the amount of runoff and its ability to carry sediment by diverting incoming flows and slowing down flows that come from inside the mining area.

Retain sediments that are 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 (building required) and vegetative (planting required) practices.

Descriptions of simple and practical measures suitable for the small-scale miner are provided in **Appendix E** of this guideline document.

Waste Management

Wastes include sewage, garbage, wash-water, used oils and grease; diesel or lubricant spills etc. Wastes generally contain pollutants and present a potential risk to the water and surrounding environment if not managed effectively. Wastes can be classified as biodegradable or non-degradable, hazardous or non-hazardous. Please refer to the next section of this guideline called “EMP Life Cycle Water Management” for more details regarding waste disposal measures at the mine site.

Examples of the key management measures described above are also illustrated in the **drawing** (Figure 2) on the next page.

A list of general “do’s and don’ts”, for small-scale miners, is also provided in Table 3.

Figure 2: Drawing Illustrating "Key Management Area" Examples

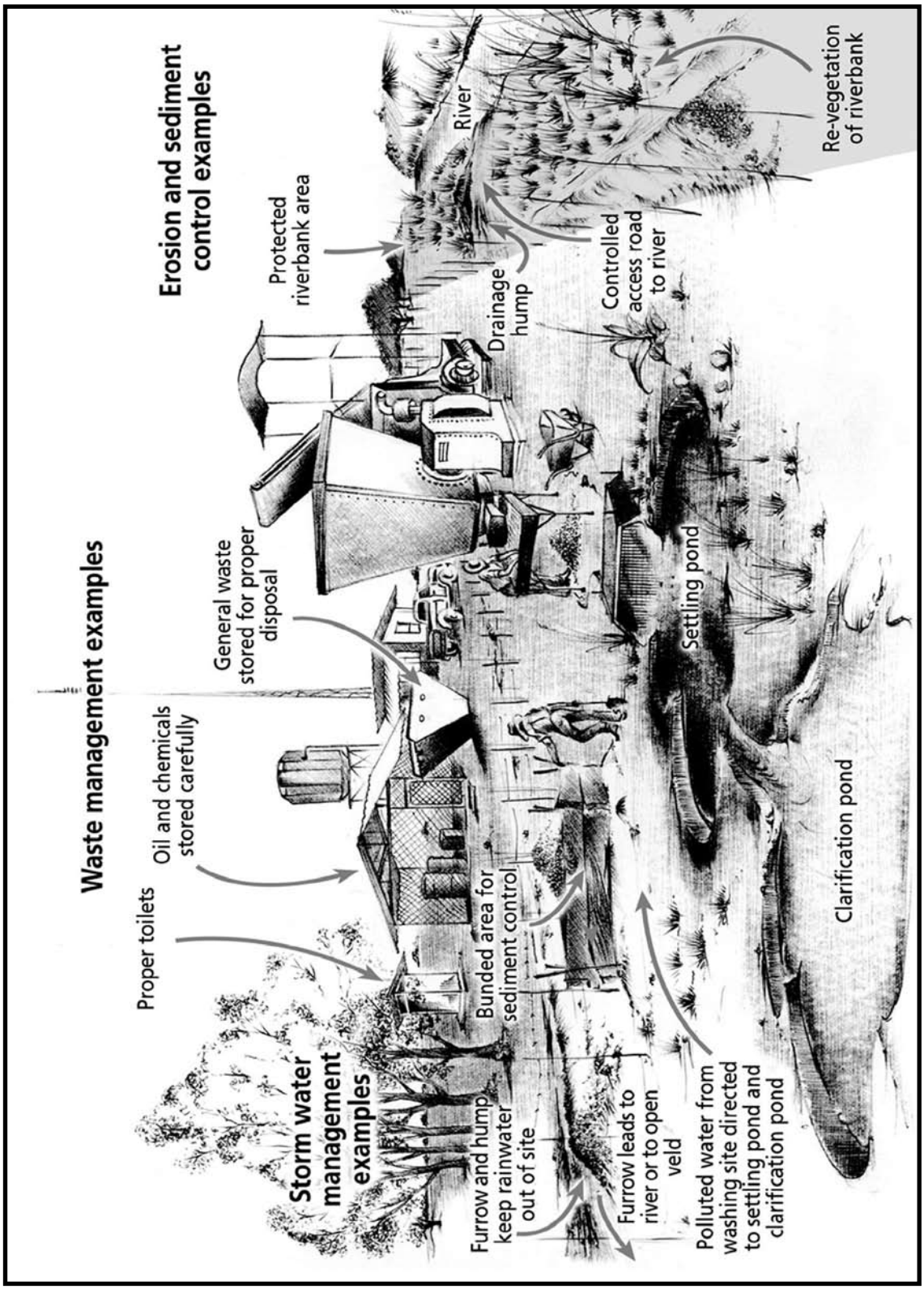


Table 3: List Of General Do's And Don'ts For Small-Scale Miners

AS A SMALL-SCALE MINER		
DO	√	Apply for the necessary permits and authorisations
	√	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. strip of natural area between the mine site and the body of water of at least 100m
	√	Store oil, fuel and chemicals safely in closed containers in designated area outside of the buffer zone
	√	Locate toilets outside of the buffer zone
	√	Keep topsoil (top seed-bearing layer of soil) for rehabilitation when you are finished mining
	√	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 (make natural) as you go - it will save you time, energy and money
	√	Backfill ponds, pits or roads created – even out or level area to look the way it looked before you started
	√	Leave area as you found it (rehabilitate)
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

9

EMP LIFE CYCLE WATER MANAGEMENT

The following section outlines specific requirements in relation to water resource management for mining from the EMPs. They are legally binding once approval of the EMP has been obtained. They also can be included or referenced as supporting information needed for a water use authorisation.

The requirements 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 activities at a mine site rather than specific mining type or commodity, such as:

A Access roads to the site

B Access to the river bed, dams, or pans

C Establishing surface infrastructure at the site
- i) Campsite/office sites
- ii) Toilet facilities, waste water and refuse disposal
- iii) Vehicle maintenance yard and secured storage areas

D Establishing residue deposit and processing areas
- i) Stockpile and sand processing areas
- ii) Processing areas and waste piles

E Establishing settling and clarification ponds (also see Figure 2)

A ACCESS ROADS 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 from 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 year 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 (cover).

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, as well as 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 DME 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. This will include placing back the stored topsoil and planting/seeding.
- 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 users of access roads, then maintenance of the access road will be the sole responsibility of the holder of the mining authorization.
- Whenever a mining permit 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 of the DME in consultation with other departments.

B 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 authorisation 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 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 C: Establishing surface infrastructure on the site - 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 DME 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 DME 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.

C ESTABLISHING SURFACE INFRASTRUCTURE AT THE SITE

I) CAMPSITE/OFFICE SITES
II) TOILET FACILITIES, WASTE WATER AND REFUSE DISPOSAL
III) VEHICLE MAINTENANCE 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 pollution 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. bunding 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 container and removed from the site, either for resale or for appropriate disposal at a licenced facility.
- Spills should be cleaned up immediately by removing the spills together with the polluted soil and disposing thereof at a licenced 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 a **licenced 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 containers shall be provided and conveniently placed for waste disposal. All used oils, grease or hydraulic fluid shall be placed therein and these containers 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 DME requests that the buildings be left) 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 ploughed or ripped and, if necessary appropriately ensure the re-growth of vegetation (plant or seed).
- 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.

D ESTABLISHING RESIDUE DEPOSIT AND PROCESSING AREAS

I) STOCKPILE AND SAND PROCESSING AREAS
II) 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 authorisation 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 C above.

On Closure

- On completion of mining, the surface of the stockpile and processing areas outside the riverbed shall be ploughed/ripped 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 re-growth 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.
- Residue from the extraction process must be so treated and /or deposited that it will in no way prevent or delay the rehabilitation process.

E ESTABLISHING SETTLING AND CLARIFICATION PONDS

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

***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 or clarified water to be returned to the river (suspended matter to meet catchment standard, as determined by the DWAF).

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 (*Regulation 704*).**
- **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 authorisation whenever disposing of waste in a manner that may detrimentally impact on a water resource including the discharge of waste water into 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 0.8 m down from the top of the wall (i.e. 0.8 m 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: residue 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 DME, in consultation with the DWAF, 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 DWAF.)

10

MONITORING PERFORMANCE AND REPORTING

Monitoring has two parts. The first monitors the way individual miners comply with their water use authorisation conditions and EMP reports. The second monitors the actual quality of the water resource itself and compares it to the resource quality objectives that are set for that particular resource or catchment. Corrective measures are then taken, including prosecutions where necessary. The regulators determine 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 an authorized person, in terms of the National Water Act, 1998 (Act 36 of 1998).

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

a) Basic requirements of water use authorisations and permits for small-scale miner

b) Regulators checklist

c) Water use authorisation application checklist

d) Audit checklist

Reporting is discussed below from two perspectives, that is: the miner and the regulators/ lead governmental agents.

A: The Holder of the mining authorization

The holder of the mining authorization must 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 relevant legislation are being adhered to. A condition in an EMP may require that a six monthly compliance report be submitted to DME 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 water quality then a monitoring programme needs to be agreed upon with the authorities. Suitably qualified persons must conduct the compliance water quality monitoring programme. 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 authorisation or mining authorisation. It would generally consist of the following:

- Water quality – pH, conductivity, suspended solids (turbidity)
- 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. 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 a six-monthly basis. If the DME finds water pollution occurring then they should inform DWAF's regional office who then send out an official to investigate.

11

WHO DO YOU CONTACT FOR ASSISTANCE?

For technical, business and financial support: National Small-Scale Mining Development Framework

Private Bag X59
Pretoria 0001
Tel: 012-317-9412 **Fax: 012-320-4268**

For prospecting rights, mining permits and EMPs: Department of Minerals and Energy
www.dme.gov.za

Head Office
Tel: (012) 317 9000 **Fax: (012) 322 3416**

Eastern Cape Region Private Bag X6076 PORT ELIZABETH 6000 Tel: (041) 585 3862/4/6 Fax: (041) 585 3881	Free State Region Private Bag X33 WELKOM 9460 Tel: (057) 352 8235 Fax: (057) 357 1241	North West Region Private Bag A1 KLERKSDORP 2570 Tel: (018) 464 1631 Fax: (018) 462 9036/9	Northern Cape Region Private Bag X6093 KIMBERLEY 8300 Tel: (053) 830 0800 Fax: (053) 832 5631	Mpumalanga Region Private Bag X7279 WITBANK 1035 Tel: (013) 656 1448 Fax: (013) 690 3288
Gauteng Region Private Bag X5 BRAAMFONTEIN 2017 Tel: (011) 358 9700 Fax: (011) 339 1858	KwaZulu-Natal Region Private Bag X54307 DURBAN 4000 Tel: (031) 333 9400/1/2/3 Fax: (031) 333 9403	Northern Cape Region Private Bag X14 SPRINGBOK 8240 Tel: (027) 712 1957 Fax: (027) 712 1959	Limpopo Region Private Bag X9467 POLOKWANE 0700 Tel: (015) 287 4700 Fax: (015) 287 4729	Western Cape Region Private Bag X9 ROGGEBAAI 8012 Tel: (021) 419 6105 Fax: (021) 419 6260

For water use authorisations: Department of Water Affairs and Forestry
www.dwaf.gov.za

Director General Head Office Private Bag X313 PRETORIA 0001 Tel: (012)-336-7500 Fax: (012)-326-2715	Chief Director: Eastern Cape Private Bag X7485 KING WILLIAM'S TOWN 5600 Tel: (043)-642-1045 Fax: (043)-642-1737	Regional Director: Free State PO Box 528 BLOEMFONTEIN 9300 Tel: (051)-430-3134 Fax: (051)-430-8146	Regional Director: Gauteng Private Bag X995 PRETORIA 0001 Tel: (012)-392-1300 Fax: (012)-392-1304	Chief Director: KwaZulu-Natal PO Box 1018 DURBAN 4000 Tel: (031)-336-2700 Fax: (031)-304-9546
Regional Director: Mpumalanga Private Bag X11259 NELSPRUIT 1200 Tel: (013)-759-7303 Fax: (013)-752-4185	Regional Director: North West Private Bag X5 MMABATHO 2735 Tel: (018)-384-3270/9 Fax: (018)-384-0913	Regional Director: Northern Cape Private Bag X6101 KIMBERLEY 8300 Tel: (053)-831-4125 Fax: (053)-831-4534	Chief Director: Limpopo Province Private Bag X9506 POLOKWANE 0700 Tel: (015)-290-1200 Fax: (015)-295-3215	Regional Director: Western Cape Private Bag X16 SANLAMHOF 7532 Tel: (021)-950-7100 Fax: (021)-946-3666

Other useful contact numbers

Department of Environmental Affairs and Tourism
Tel: (012) 310 3911 **Fax: (012) 322 2682**

Department of Land Affairs
Private Bag X833
Pretoria
0001
Tel: (012) 312 8911 **Fax: (012) 323 7124**

LIST OF ABBREVIATIONS

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

GLOSSARY OF TERMS

For the purposes of this guideline the following glossary of terms have 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
Catchment *(National Water Act 36 of 1998)*	Area from which any rainfall will drain into the watercourse or watercourses 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)	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 *(Minerals and Petroleum Resources Development Act (MPRDA), 2002 (Act 28 of 2002)*	Any operation or activity for the purposes of winning any mineral 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 right or mining permit, 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 *(GN 704 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 (change) 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: DWAF LICENCE APPLICATION FORM REFERENCE NUMBERS

Licence application forms can be obtained from regional offices or downloaded from the DWAF web site www.dwaf.gov.za. The application form reference numbers for each type of water use authorisation 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 B: 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	#		
Gold:			
Witwatersrand		#	#
Other rock-hosted		#	#
Unconsolidated Sediments	#		
Graphite	#		
Gypsum	#		
Industrial minerals:			
Aggregate	#		
Andalusite	#		

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

APPENDIX C: USEFUL CHECKLISTS

C1 BASIC REQUIREMENTS OF LICENCES OR PERMITS FOR SMALL-SCALE MINES

	Prospecting right or mining permit	Water use authorisation
Legislation reference	Section 16 or 27 of Minerals and Petroleum Resources Development Act, 2002 (Act 28 of 2002)	Chapter 4 of National Water Act, 1998 (Act 36 of 1998)
Who can apply	Owner of land/miner	Owner or legal occupier/ user of land e.g. miner
Procedure	a) Apply for prospecting right or mining permit. b) Collect relevant forms and complete. c) Make 6 copies (one to be kept by the miner). d) Submit to DME, Regional Manager	a) Collect relevant authorisation application form (*See Appendix A)* b) Apply for authorisation by completing the relevant licence form and providing supporting documentation (*see Appendix C3).* c) Submit to DWAF Regional Director.
Where	DME- Regional office *(see pg 21)*	DWAF- Regional office *(see pg 21)*
Document/s required	EMP	Licence form and supporting documentation (*see Appendix C3*)
Cost	Yes - non-refundable fee	Yes - non-refundable fee
Duration	Prospecting right: < 5 years Mining permit: < 2 years Mining right: > 2 years	Valid for 5-40 years
Renewable	Yes	Yes
Performance reports	Yes - frequency determined by regulator	Yes

C2 REGULATOR'S 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 authorisation?	None	Applied	General Authorisation or directive granted, Existing Lawfull Water Use	Licence
6	Is there a valid permit for where there is process emission?	None	Applied	Needs to apply	

C3 WATER LICENCE APPLICATION CHECKLIST

Before a 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 authorisation. **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
- Receiving water quality objectives for affected resource
- Weather conditions e.g. flood risk
- Existence of any sensitive landscapes or wetlands demarcated/designated areas
- 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.

C4 AUDIT CHECKLIST

The following checklist is helpful when conducting an audit of the operations and performance of the environmental management 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 and 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	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? a) nothing; b) sawdust/sand; c) cement; d) absorbent mates; booms, socks, etc; e) sphagnum moss based absorbent.	

Division	QUESTION	TICK BOX
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?	

APPENDIX D: PERMISSIBLE WATER USES

National Water Act, 1998 (Act 36 of 1998)

Section 22 of the National Water Act, 1998 (Act 36 of 1998) 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 granting of a licence, permit or other authorization under any other law.

D1 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
      (ii) 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 stormwater 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.

D2 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: 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: 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)).

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)).

D3 WATER USE LICENCES

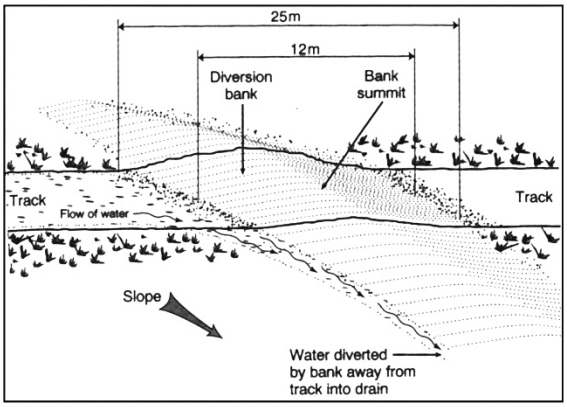
- Water uses may be authorised by a licence in terms of the National Water Act (Act 36 of 1998). Parts 7, 8, 9 and 10 of Chapter 4 of the National Water Act deal with licences.
- Any person not otherwise entitled to use water may apply for a licence under part 7 of Chapter 4.
- The application must go 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 uses 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.

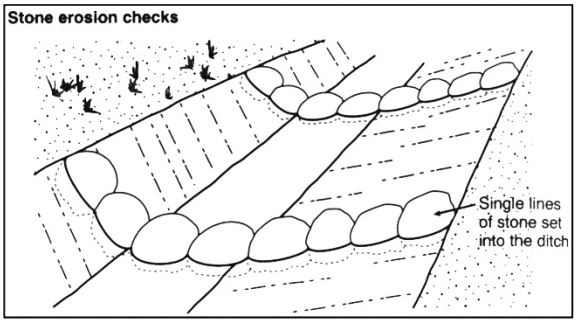
APPENDIX E: PROPOSED BEST MANAGEMENT PRACTICES

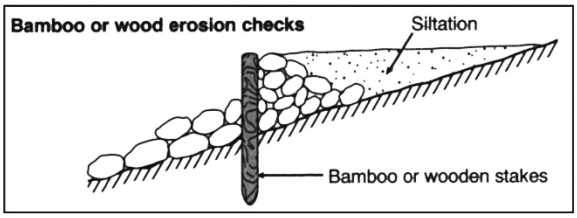
E1 EROSION AND SEDIMENT CONTROL

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





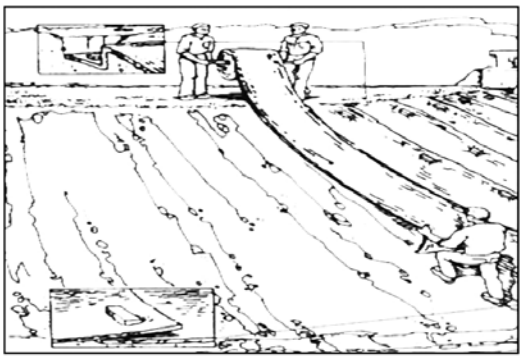


Dust Control: Watering, mulching, sprigging, or applying geo-textile materials to construction area to prevent soil loss as dust. Re-deposited dust can become a source of sediment in runoff. Control measures should be applied routinely and thoroughly in drier seasons and climates for effective dust control.

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

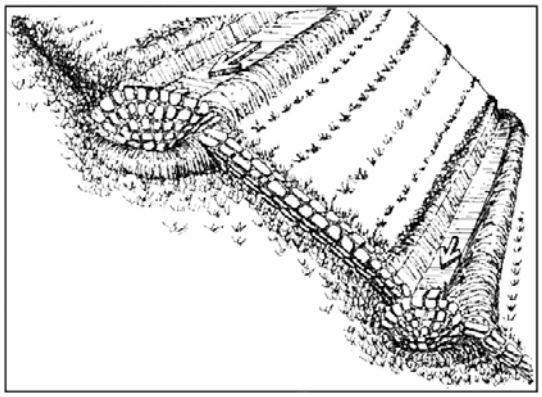
on slopes. Mats made from a wide variety of organic and synthetic materials are useful in establishing grass in channels and waterways, and they promote seedling growth (Smolen et al., 1988). Mulching assists in the first, source reduction, and second, conveyance, stages of a Best Management Practice (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



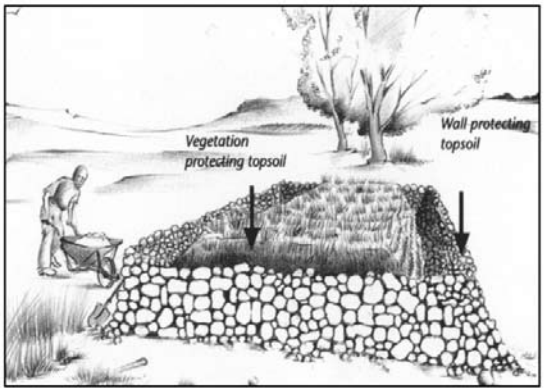
Riprap: layer of stone designed to protect and stabilize areas subject to erosion, slopes subject to seepage, or areas with poor soil structure. Riprap is used on slopes where vegetation cannot be established, channel slopes and bottoms, stormwater structure inlets and outlets, slope drains, stream banks, 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

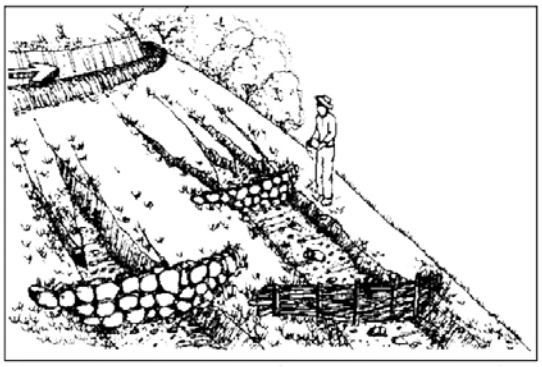


Bund walls: Walls that are built around something like a pile of topsoil to prevent it from being washed away. The walls can be made of any suitable material such as planks, rocks or soil. Bund walls are also constructed around the perimeter of an open pit to minimise access and improve pit wall stability. 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

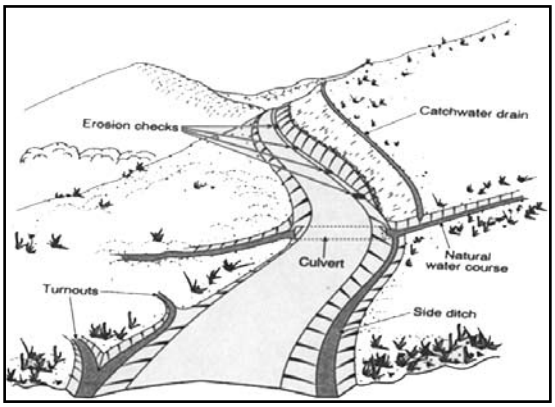


Grass-Lined Channel: A swale vegetated with grass, which is dry except following storms, and serves to convey specified concentrated stormwater runoff volumes, without resulting in erosion, to disposal locations. Typical uses include roadside swales, outlets for runoff diversions, site stormwater routing, 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.

Road drainage management examples

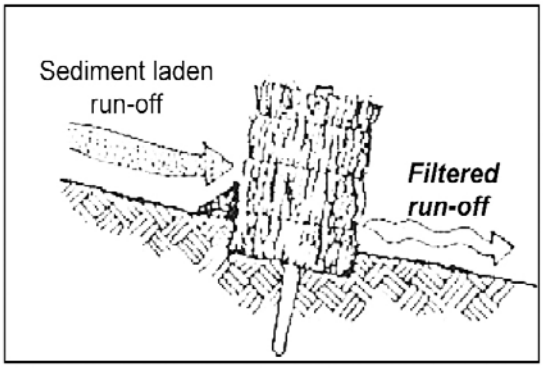


Runoff Diversions: Structures that channel upslope runoff away from erosion source areas, divert sediment-laden runoff to appropriate traps or stable outlets, or capture runoff before it leaves the site, diverting it to locations where it can be used or released without erosion or flood damage. Diversions 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.

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.