PROJECTS AND CONSTRUCTION

PHASE

3

Desalination Plant - Orano
Swakopmund
Erongo
Namibia

ACKNOWLEDGEMENTS

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NAMIBIAN CHAMBER OF MINES
One of the publication's joint initiative partners and key stakeholders, is the Namibian Chamber of Mines (CoM).

The CoM is an industry body that aims to effectively promote, encourage, protect, foster and contribute to the growth of responsible exploration and mining in Namibia, to the benefit of the country and all stakeholders.

NAMIBIAN CHAMBER OF ENVIRONMENT
Another of the publication's joint initiative partners and key stakeholders, is the Namibian Chamber of Environment (NCE).

One of the core NCE objectives is to promote best environmental practices, including habitat rehabilitation, and to support efforts to prevent and reduce environmental degradation and pollution. This project aligns to several of the NCE core objectives.

OTJIKOTO GOLD MINE
Case studies supplied:
- Corporate social responsibility
- Rehabilitation

DUNDEE PRECIOUS METALS TSUMEB
Case studies supplied:
- Air quality monitoring

TREKKOPJE MINE
Case studies supplied:
- Securing a mine's water supply
- Restoration trials

SKORPION ZINC
Case studies supplied:
- Water management

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DEBMARINE NAMIBIA
Case studies supplied:
- Environmental monitoring

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Case studies supplied:
- Powerline monitoring

NAMIBIAN URANIUM ASSOCIATION
Case studies supplied:
- Namibia's uranium SEA

HUSAB MINE
Case studies supplied:
- Water quality monitoring
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NAMDEB
Case studies supplied:
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- Tailings Management
- Air Quality

ENVIRONMENTAL COMPLIANCE CONSULTANCY
Authors of this publication
Contact details:
+264 81 669 7608
info@eccenvironmental.com

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FOREWORD

The first two decades of the 21st century have starkly revealed our unprecedented impact on the natural world. The level of impact threatens our very existence. Climate change, biodiversity loss and pollution are at the top of the list. No longer can we do business as usual, with sectors being isolated from one another, and business focusing only on the financial bottom line. We need a new approach that is more holistic, inclusive and responsible. In short, we need a "profit, people and planet" triple bottom line approach whereby companies generate profit for shareholders and national revenue while simultaneously improving people's lives and safeguarding the planet from climate change, biodiversity loss and pollution. This new holistic and responsible approach to business will not necessarily reduce profit but can certainly enhance opportunities, attract discerning investors, increase sector resilience and social acceptance, reduce risk and reputation damage, and leave a nett positive legacy.

This Best Practice Guide applies the new triple bottom line approach to the Namibian mining sector to ensure a lasting legacy for mining companies, the country and her people. From the outset this initiative embraced transparent governance and a collaborative approach which involved the Namibian government – the Ministry of Mines and Energy and the Ministry of Environment and Tourism; the private sector – the Chamber of Mines and its member mining companies; and the environmental civil society sector – represented by the Namibian Chamber of Environment.

Namibia is rich in a variety of mineral deposits such as zinc, gold, uranium and diamonds, some of which are considered world-class. The Namibian Government recognises the importance of prospecting and mining to social and economic development, as expressed in various national development plans. Equally important is Namibia's commitment to ensuring a safe and healthy environment. The Best Practice Guide for mining in Namibia highlights leading practices in social, economic and environmental aspects at all stages of the mining life cycle, namely Exploration, Projects and Construction, Operations, and Mine Closure and Completion. Further, this Best Practice Guide brings together all the regulatory requirements for the mining sector from all government agencies into one reference document, with links to download forms, submit reports, etc. The Guide is available in electronic format, and we would encourage all mining companies to ensure that it is available to their staff, management, boards of directors and investors.

The Namibian mining industry strives to play an active role in sustainable development by implementing world class environmental practices in their operations. Through the implementation of these practices, exploration and mining companies can maintain a good relationship with regulators, lawmakers, investors and the communities in which they operate. This guide is ultimately aimed at assisting the Namibian mining industry to implement their "planet, people and profit" approach as they develop Namibia's mineral resources, by delivering practical mining solutions that are benchmarked against best practices and striving for ever more ambitious legacy impacts.

Finally, the mining sector has taken the lead in Namibia by being the first economic sector to develop such a Best Practice Guide. It is our wish that other sectors follow suit and that, sector by sector, we implement a "planet, people and profit" philosophy and programme of action across Namibia.

Tom Alweendo, MP
Minister of Mines and Energy

MINISTRY OF ENVIRONMENT AND TOURISM
REPUBLIC OF NAMIBIA
2019 -11- 19
OFFICE OF THE MINISTER
PRIVATE BAG 13346, WINDHOEK

Pohamba Shifeta, MP
Minister of Environment and Tourism

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DEFINITIONS AND ABBREVIATIONS

ABA	Acid-Base Accounting
AMD	Acid Mine Drainage
ANC	Acid Neutralising Capacity
As	Arsenic
B	Boron
BOD	Biological Oxygen Demand
$CaCO_3$	Calcium Carbonate
Cl_2	Chlorine
Cn	Cyanide
CO	Carbon Monoxide
COD	Chemical Oxygen Demand
CoM	Chamber of Mines
Cr	Chromium
Cu	Copper
DO	Dissolved
EC	European Commission
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EMS	Environmental Management System
EPL	Exclusive Prospecting Licence
F	Fluoride
FeS_2	Iron (II) disulfide- Pyrite
$FeSO_4$	Iron (II) Sulfate
FOG	Fats, Oil, Grease
H_2O	Water
JORC	Joint Ore Reserves Committee
MPA	Maximum Potential Acidity
MBAS	Methylene Blue Active Substances
MET	Ministry of Environment and Tourism
ML	Mining Licence
MME	Ministry of Mines and Energy
MPA	Maximum Potential Acidity
Na	Sodium
NAF	Non-Acid Forming
NAPP	Net Acid Producing Potential
NCE	Namibian Chamber of Environment
NGOs	Non-Government Organisations
NO_2	Nitrogen Dioxide
O_2	Oxygen
O_3	Ozone
PAF	Potentially Acid Forming
Pb	Lead
PM	Particulate Matter
PM_{10}	Particulate Matter less than 10 µm in aerodynamic diameter
S	Sulphide
SAMREC	South African Mineral Resource Committee
SANS	South African National Standards
SO_2	Sulphur Dioxide
TDS	Total Dissolved Solid
TSP	Total Suspended Particles
TSS	Total Suspended Solid
WB	World Bank
WHO	World Health Organization
Zn	Zinc

PART ONE

SETTING THE SCENE

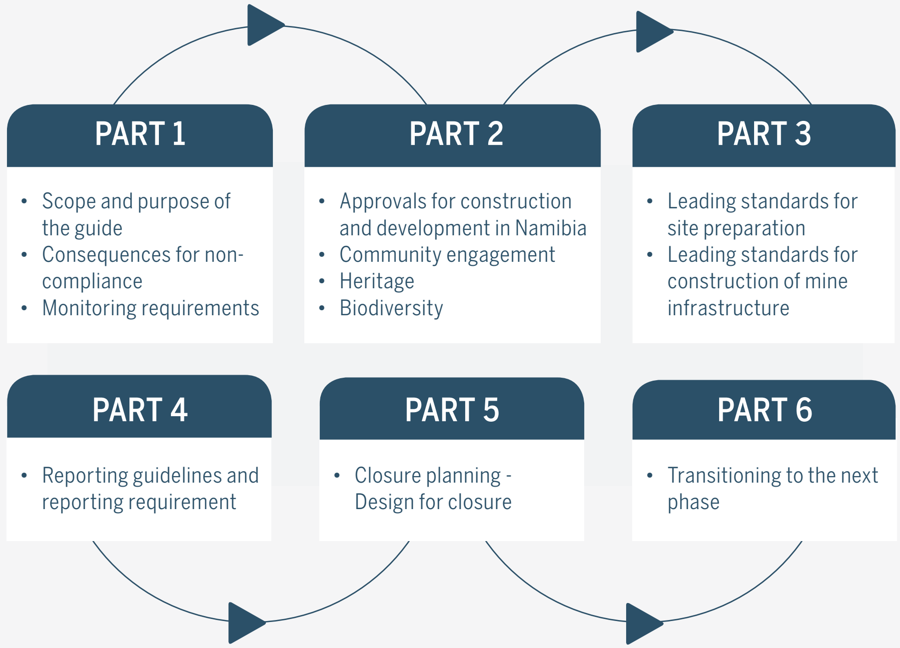
Once the findings of the exploration phase indicate that a mineral resource exists in sufficient quantity and grade, planning for the projects and construction phase can commence. This phase has several distinct activities, many of them overlapping. Once the researching, planning, permitting and authorisation process is complete, activities can advance into physical projects and construction work (Toovey, 2011). Extensive paperwork, design and pre-development planning, budgeting and report preparation are all part of this phase. Plans are made in accordance with the proposed technological design and mining method—with an emphasis on safety, economic viability, technological efficiency and environmental (see www.icmm.org). In summary, the projects and construction phase refers to a period during which the mine infrastructure and facilities are planned and constructed, as a series of systematic steps with a multidisciplinary approach. Typical activities of the projects and construction phase can be clustered as follows:

- Feasibility studies, research, planning and permitting
- Mine site preparation by land clearance and blasting, levelling and removal of vegetation
- Mine infrastructure construction, including administration buildings, headframes and mechanical workshops
- Installation of linear infrastructure such as roads, waterlines, power lines and substations
- Preparation of mine-specific infrastructure (e.g. tailings storage facility, mine dumps, storage yards, processing plant, comminution lines, stockpiles, crushers, etc.)

1.1 HOW TO USE THE FRAMEWORK

This part of the Best Practice Guide highlights leading practices throughout the mine's projects and construction phase. The guide also incorporates the legislative framework, reporting requirements and additional information, to ensure easy and streamlined navigation throughout this phase, in accordance with both Namibian and international leading best practices and setting "Leading Standards". Illustrated in FIGURE 1 are key issues addressed in each section of this guide.

[FIGURE 1]
Key issues addressed in each section of the best practice guide for the projects and construction phase



1.2 MINING LICENCE APPLICATION

After fruitful exploration activities, the holder of an Exclusive Prospective Licence (EPL) may apply for a Mining Licence (ML), before commencing with the projects and construction phase. An application for an ML is done in compliance with the Minerals (Mining and Prospecting) Act, No. 33 of 1992, Sections 90-101. When successful, an ML is issued for a period not more than twenty-five (25) years, or Life of Mine. Renewal periods should not exceed 15 years at a time.

A ML is not solely issued to maintain the title and rights over a resource—the applicant must adhere to certain requirements, conditions and approvals stipulated by law.

MINING LICENCE APPLICATIONS REQUIREMENTS
When applying for a ML, the following requirements need to be met:

- The company must be registered in Namibia
- The application must be accompanied by an Environmental Clearance Certificate issued by the MET
- The applicant must have a sound mining budget and program
- Proof of the company's capability to finance the mining project needs to be provided
- Proof of a sound track record in mining should be provided
- A completed pre-feasibility study has to be available
- A detailed design and plans for the mine and processing plant should be available
- The availability of experts to carry out the proposed mining project needs to be warranted
- A sound report detailing the reserves and resources should be submitted, e.g. Joint Ore Reserves Committee (JORC), or South African Mineral Resource Committee (SAMREC) etc. compliant

1.3 BASELINE STUDY REQUIREMENTS

It is essential for the applicant to be familiar with baseline study requirements and what specific monitoring is required at an early stage. Baseline studies are particularly important, to reflect on a before-and-after scenario, since the establishment of a mine can have a decisive influence and change on its surroundings. Baseline studies may include information about abiotic factors (climate, topography, soils, surface and groundwater), biotic factors (plants, animals and ecological functioning) or even socio-economic factors (demography, land use, etc.). The Environmental Impact Assessment (EIA) process may stipulate—and even include—some of these baseline requirements especially as far as environmental information is concerned.

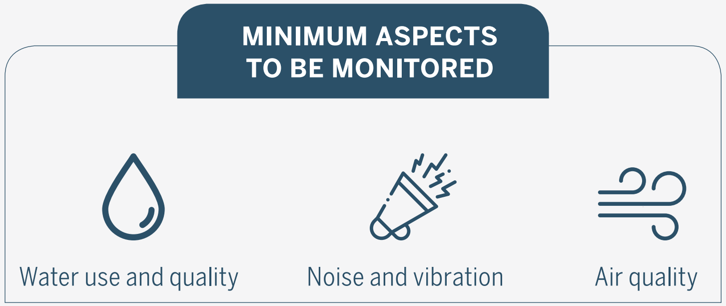
One of the most important baseline studies implied is on air quality. Air quality might be affected by dust, gaseous and nuisance emissions, fumes and odours, and the background conditions of these aspects are essential for monitoring air quality against. Dust and gaseous emissions require immediate monitoring, as well as the establishment of a network of meteorological measuring points. Dust requires the monitoring of particulate matter (PM), in PM_{10}–format, but the monitoring program may require simultaneous measurement of total suspended particles (TSP) or $PM_{2.5}$ as well. The monitoring of these aspects will have much more meaning when background information from a baseline study is available.

In a similar fashion, it could be advantageous to conduct baseline studies on the sense of place as well, since the establishment of a mine can have a decisive influence on aspects such as noise, vibration and aesthetics.

1.4 ASPECTS TO BE MONITORED

Procedures are used to determine which key impacts or components need to be monitored and managed during the different stages of a mine life cycle. Compliance and a risk-based approach is typically used to achieve this objective, and it incorporates the following aspects:

- Legal requirements are clearly determined and serve as a minimum standard for environmental protection and the associated monitoring that is required Baseline studies are used to identify social, environmental and economic values and create management and monitoring programs
- An environmental and social impact assessment has been conducted. This enables stakeholders and regulators to review the possible impacts and the implied management and mitigation measures
- Ongoing monitoring programs are initiated and a system of reporting is in place, in order to assess historic performance and real-time performance.
- The minimum environmental impacts that require monitoring during the projects and construction phase are illustrated in FIGURE 2.



[FIGURE 2]
Aspects and impacts to be monitored during the projects and construction phase

Site selection is a crucial step in the development of a new project or the capacity expansion of an existing project. This is governed by various aspects, such as resources availability, construction and the placement of infrastructure and services, as well as environmental conditions such as air quality, water resources, noise and vibration, and waste generation.

Exploration and mining activities are most likely to impact the original environmental conditions and may have an effect on public health (e.g. air quality) and public concerns (e.g. water use) too. If a project does not take cognisance of these potential impacts—as proposed in the EIA or related documents such as an Environmental Management Plan (EMP) and Mine Closure Plan—this may go beyond tarnishing the company's image and reputation. Hence, to be at the forefront of environmental best practices, while at the projects and construction phase, methodological approaches and management measures should be well articulated, to minimise possible environmental bearings.

This section of the Best Practice Guide focuses in particular on air quality, noise and vibration, water quality, and social performance during the projects and construction phase of the mining life cycle.

Air quality

During the projects and construction phase, dust is generated by several mega-activities, such as earthmoving and access road construction. In fact, there is the potential to generate more dust than during the operational phase. Controlling dust emissions needs to be given special attention when operating in and around sensitive areas, and baseline monitoring will continue during this phase. There may be a need to monitor dust emissions using dust-monitoring instruments, which are strategically placed at the boundary or in sensitive areas. The dust monitoring instruments allow for early detection when allowable dust levels are exceeded. The Namibian Atmospheric Pollution Prevention Ordinance, No. 11 of 1976 does not make provision for any ambient standards for individuals and institutions to comply with. In the absence of a Namibian legislative and regulatory framework on air quality, standards and guidelines derived from the World Bank (WB), World Health Organization (WHO), European Commission (EC) and South African National Standards (SANS) are in use in Namibia—as contained in TABLE 1.

Accordingly, standards are determined based on international best practices for particulate matter less than 10 µm in aerodynamic diameter (PM_{10}), dust fall, sulphur dioxide (SO_2), nitrogen dioxide (NO_2), ozone (O_3), carbon monoxide (CO), lead (Pb) and benzene (National Committee SABS, 2009; Liebenberg-Enslin, 2012).

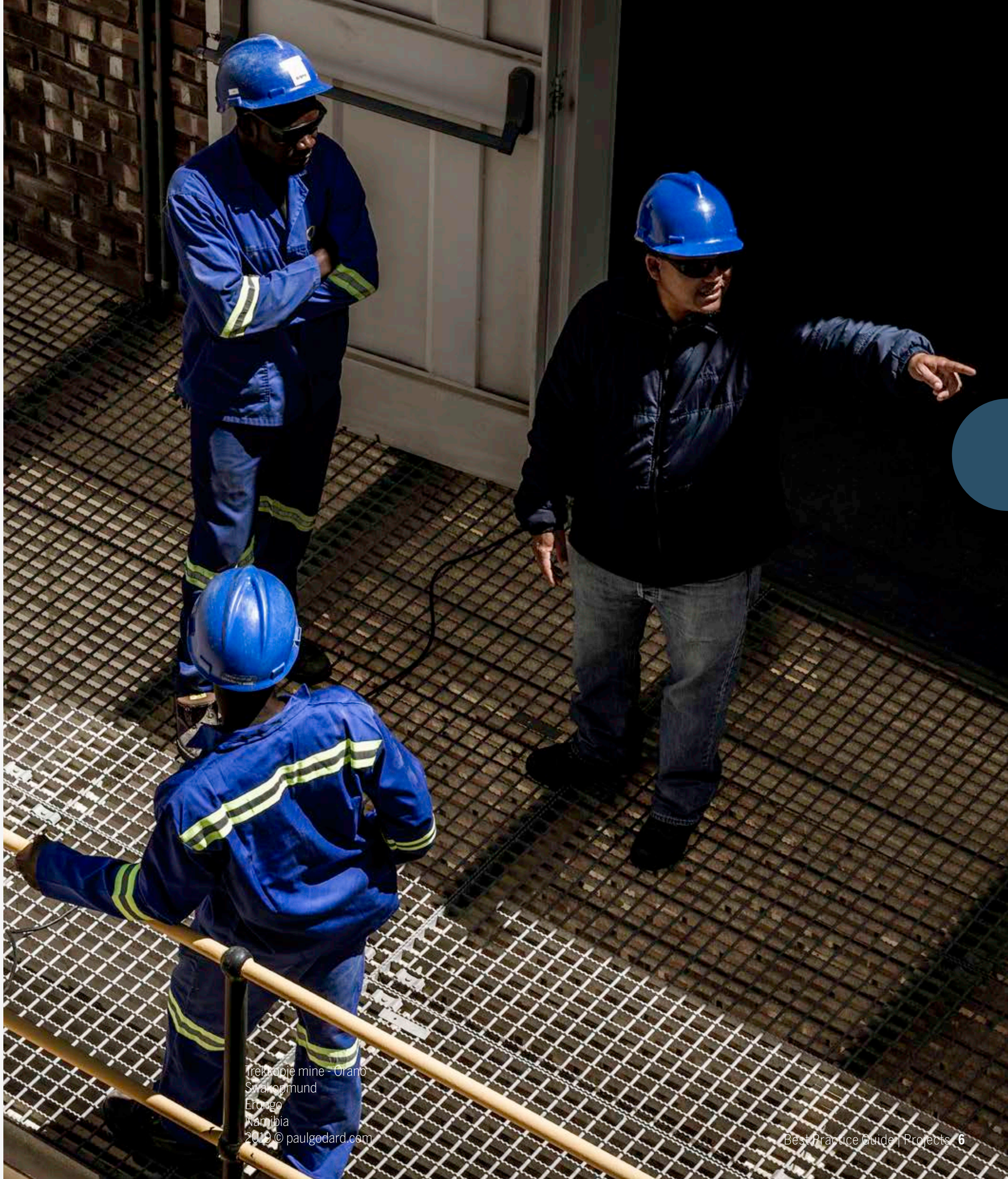


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TABLE 1 | Standards for air quality

POLLUTANT	AVERAGING PERIOD	WHO GUIDELINES (µg/m³)	EU DIRECTIVES (µg/m³)	SOUTH AFRICA STANDARDS NAAQS (µg/m³)
Particulate matter (PM_{10})	1 year	70 (IT-1) 50 (IT-2) 30 (IT-3) 20 (guideline)	40 (n)	50 (l) (f) 40 (m) (f)
	24 hours	150 (IT-1) 100 (IT-2) 75 (IT-3) 50 (guideline)	50 (o)	120 (l) 75 (m)
Particulate matter ($PM_{2.5}$)	1 year	35 (IT-1) 25 (IT-2) 15 (IT-3) 10 (guideline)	25 (u)	25 (q)(r) 20 (q)(s) 15 (q)(t)
	24 hours	75 (IT-1) 50 (IT-2) 37.5 (IT-3) 25 (guideline)	-	65 (q)(r) 40 (q)(s) 25 (q)(t)
Sulphur dioxide (SO_2)	1 year	-	20 (d)	50
	24 hours	125 (IT-1) 50 (IT-2) (a) 20 (guideline)	125 (c)	125 (f)
	1 hour	-	350 (b)	350 (g)
	10 minutes	500 (guideline)	-	500 (h)
Carbon monoxide (CO)	1 hour	30 000 (guideline)	10 000	30 000 (g)
Nitrogen dioxide (NO_2)	1 year	40 (guideline)	40 (i)	40
	1 hour	200 (guideline)	200 (j)	200 (g)

Since Namibia does not have any ambient air quality standards or guidelines, a recent study in the Erongo Region (Airshed, 2019) determined guidelines to provide the necessary performance indicators for the region as part of an Air Quality Management Plan. In the study all sources of air pollution in the region were addressed, pollutants identified and quantified (where possible), and the significance thereof determined. Two primary natural sources / events have been identified – windblown dust during East-wind conditions, and sea salts from the ocean.

The study found that, based on measured data to date, the South African National Ambient Air Quality Standards (SA NAAQSs) for PM_{10} seems to be the appropriate limit for the region and the WHO Interim-Target 3 (WHO-IT3) limit for $PM_{2.5}$ and recommends that the SA NAAQS limit for PM_{10} and the WHO-IT3 for $PM_{2.5}$ is adopted. Allowable exceedance days due to East-wind conditions (7 days) and the presence of sea salt (16 – 22 days) are proposed, either accounted for as additional days where exceedances are allowed or as a margin of tolerance. Furthermore it is recommended that the allowable days of exceedance should be re-evaluated after a year of data collection and analysis for specifically the sodium content in the PM_{10} concentrations.

Recommendations of the study include Dust Management Plans for all operational sites (mines, exploration sites and quarries); annual reporting of dust fall levels and PM_{10} concentrations to the authorities; dust suppression at construction sites (as well as annual reporting on dust mitigation measures); update and improvement of the current emissions inventory; establishing a monitoring regime to enhance source apportionment of PM concentrations and sodium content; and continuation with PM_{10} and meteorological monitoring.

Noise and vibration monitoring

It is leading practice to monitor noise and vibration during the projects and construction phase; in doing so, a mine has a continuous record of noise levels during this phase, and enables comparison to baseline (background) information, as well as all the other phases of the mining life cycle. It is wise to not only follow regulatory requirements, but also to practice precautionary principles in considering potential public concerns and to ensure thorough communication processes with stakeholders in this regard.

Blasting events, for example, need to be announced, and one of the means of communicating these events efficiently, is through the use of text messages to alert stakeholders prior to blasting.

SANS (10103) are used to address the way environmental noise measurements are to be assessed and taken in Namibia. SANS provides guidelines on the recommended noise levels, and the typical recommended noise levels are contained in TABLE 2.

TABLE 2 | General standards for effluents

TYPE OF AREA	EQUIVALENT CONDITIONS RATING LEVEL (LREQ,T) FOR OUTDOOR NOISE Day-time LReq,d (a) (dBA)
Rural districts	45
Suburban districts with little road traffic	50
Urban districts	55
Urban districts with business premises and roads	60
Central business districts	65
Industrial districts	70

LReq, d = The LAeq rated for impulsive sound and tonality in accordance with SANS 10103 for the daytime period, where the daytime period is from 06:00 to 22:00.

Water quality

Potential contamination and alterations of surface and groundwater during the projects and construction phase requires close monitoring. This involves the setting up of monitoring stations at an early stage, to indicate possible sources of contamination and possible flow changes to surface water bodies and aquifers. Groundwater is usually monitored by creating boreholes for sampling.

Any mine intending to discharge waste or effluent water should apply for a discharge permit under section 21(5) and 22(2) of the Water Act (Act 54 of 1956). The standards are subject to changes as soon as the Water Resources Management Act, No. 11 of 2013 is commenced. TABLE 3 indicates the general standards for Article 21 Permits (effluents).

TABLE 3 | General standards for effluents

DETERMINANTS	MAXIMUM ALLOWABLE LEVELS
Arsenic	0,5 mg/l as As
Biological Oxygen Demand (BOD)	no value given
Boron	1,0 mg/l as B
Chemical Oxygen Demand (COD)	75 mg/l as O
Chlorine, residual	0,1 mg/l as Cl_2
Chromium, hexavalent	50 µg/l as Cr (VI)
Chromium, total	500 µg/l as Cr
Copper	1,0 mg/l as Cu
Cyanide	500 µg/l as CN
Dissolved Oxygen, (DO)	at least 75% saturation
Detergents, Surfactants, Tensides	0,5 mg/l as MBAS
Fats, Oil and Grease (FOG)	2,5 mg/l (gravimetric method)
Fluoride	1,0 mg/l as F
Free & Saline Ammonia	10 mg/l as N
Lead	1,0 mg/l as Pb
Oxygen, Absorbed (OA)	10 mg/l as O
pH	5,5 – 9,5
Phenolic Compounds	100 µg/l as phenol
Phosphate	1,0 mg/l as P
Radioactivity	below ambient water quality of the recipient water body
Sodium	not more than 90 mg/l Na more than influent
Sulphide	1,0 mg/l as S
Temperature	35°C
Total Dissolved Solids (TDS)	not more than 500 mg/l more than influent
Total Suspended Solids (TSS)	25 mg/l
Typical faecal coli	no typical coli should be counted per 100 ml
Uranium	15-500 µg/l as U
Zinc	5,0 mg/l as Zn

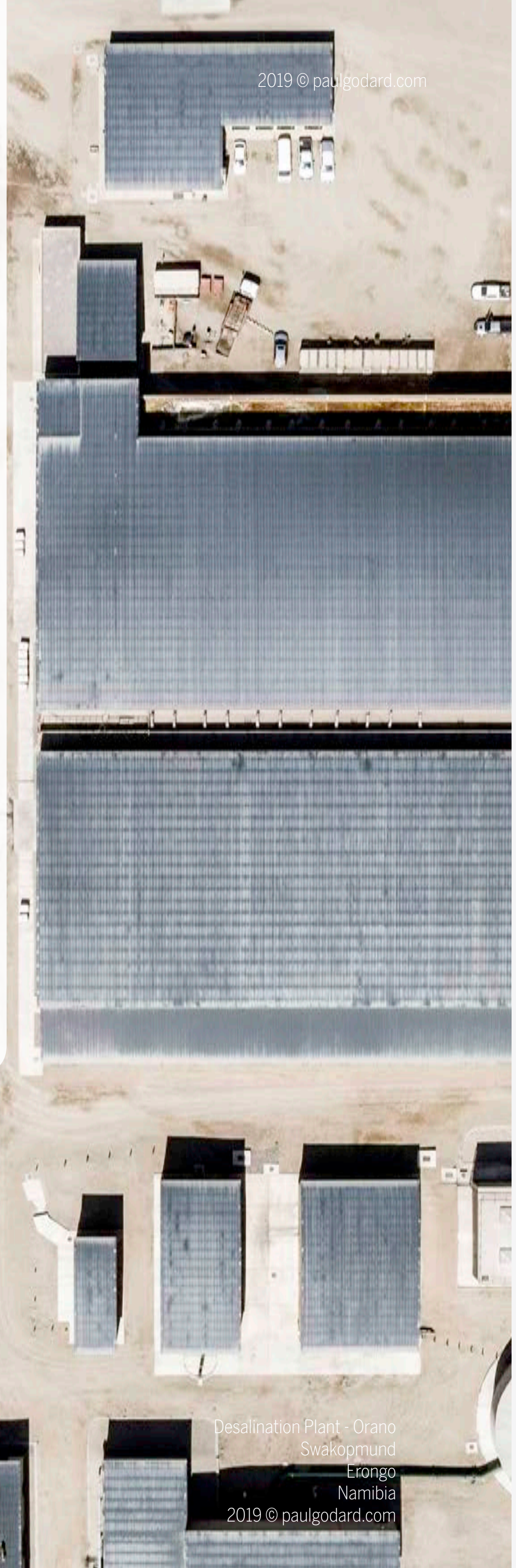
If an operation supplies its own drinking water, Potable Drinking Water Standards need to be added.

Social performance

During the projects and construction phase, there is typically an influx of people, and this presents several economic benefits, as well as possible social challenges. In addition, the influx of people can be fuelled by the expectation of employment and compensation for relocation, aspects which require proactive attempts to avoid disappointments, confrontation and opposition.

Moreover, the expectations of a new mine underline the importance of a socio-economic baseline study and an early start on communications and a community relations program that engages the public. Socio-economic impacts need to be monitored as a precautionary principle and to ensure that a platform for building good relations with stakeholders is ensured.

One of the key considerations in Namibia is to employ as many local people as possible, depending on the availability of skilled manpower. For this reason, it is essential to have a socio-economic baseline study, which includes information about the skills and qualifications of local people.



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PART TWO

KEY ACTIVITIES AND BASIC MANAGEMENT REQUIREMENTS

The projects and construction phase of the mining life cycle may take several months—up to two years or more—depending on the location, size of development, and complexity of the regulatory framework and review processes. Pre-construction steps include several civil tasks and may also include the building of camps for construction workers. Other steps for the site development may involve earthworks and land clearance, relocation of wildlife and keystone plants, installation of the main mine access and building of internal roads and crossings, the installation of a water supply and other linear infrastructure, and preparations for the construction of the processing plant area.

During the projects and construction phase, a company needs to adhere to all requirements set out in permits and other legal documents. It is also imperative to undertake all activities during this phase with special consideration towards environmental sustainability by applying the mitigation hierarchy: As a first step, the mitigation hierarchy prescribes that all efforts must be made to avoid impact; if this is not possible then the impact must be minimised as far as possible; and those impacts that cannot be avoided or minimised must be managed and remediated as far as possible. If successfully applied, this approach may assist in avoiding unnecessary environmental harm, allow pragmatic and adapting decisions, and help to create a positive reputation. Moreover, this approach may also create significant cost savings in terms of rehabilitation and closure.

2.1 KEY MANAGEMENT TASKS IN THE PROJECTS AND CONSTRUCTION PHASE

It is during the projects and construction phase of the mining life cycle that vital decisions are considered for the long-term goals, which may influence and impact the sustainability of a mine.

SOME OF THE TASKS THAT REQUIRE CRITICAL MANAGEMENT DECISIONS DURING THIS PHASE ARE:

- Minimise environmental damage and limit rehabilitation requirements
- Establish good community relations with stakeholders
- Initiate a comprehensive monitoring and auditing program to maintain continuous records
- Manage socio-economic expectations—as an employer and source of additional income in the local economy

2.2 RISK MANAGEMENT DURING THE PROJECTS AND CONSTRUCTION PHASE

To adequately manage risk throughout the projects and construction phase, risk management principles need to be effectively applied. Ultimately, the objective of risk management is to reduce the probability and impact of risks. During the projects and construction phase, many new risks may emerge, and it is essential to identify all of these risks and potential impacts, to quantify the magnitude of the risks, and to set in place the most appropriate and effective mitigation methods. Risks associated with this phase may either bear positive or negative impacts that need to be managed. Hence, the risk management process during the projects and construction phase triggers planning for strategic ways of assessing and dealing with uncertainties during the projects and construction phase and beyond.

Prominent risks associated with the projects and construction phase can be grouped under the following headings: Health, Safety, Environment, Community, and Compliance. However, some of these risks may imply considerations for production, reputation, and closure as well. It is therefore important to take a management approach that aims for a long time frame, as well the cumulative risk potential.

A wide range of risk assessment approaches are available to the mining industry. The effectiveness of risk management at any site is measured by the effectiveness of the controls implemented. Typical questions for reflection include: Are the controls applicable and appropriately designed? Are the controls implemented as intended? Are the controls in place measured in terms of progress and performance? It is essential to introduce risk assessment techniques suited to the application and information needs of the specific site during this phase. In general, more complex techniques deliver more accurate results—but may require more time, increased cost, and the involvement of specialists. Additionally, it becomes inevitable to train and upskill people in the use and purpose of risk analysis and management. Furthermore, risk assessment is not a once-off process, but requires regular reviews of the outcomes.

Communication is increasingly emphasised in contemporary risk approaches—before, during and after the entire process. Key elements of a typical contemporary risk approach include the following:

- Communicate and consult
- Establish the context
- Identify the sources of hazard or threat
- Identify risks
- Analyse risks
- Evaluate risks
- Treat risks
- Monitor and review

Communication is important for sharing information about the context and background of a project with stakeholders—internally as well as externally. Understanding the context and background clarifies the nature of activities, the range of potential impacts, assists with the identification of stakeholders, and enables the stakeholders to list all sources and causes of hazards and threats on an inventory. In this way, all unwanted outcomes, pathways and receptors, vulnerabilities and perceptions can be identified. Once the hazards and threats are known, a clear description of the risk and its contributing factors (what and why) and occurrences (when and where) is needed, in order to identify and describe the risk and to analyse its potential impact on the environment, organisation or activity. Risk analysis is done qualitatively (simple and easy but unlikely to withstand scrutiny) as well as quantitatively (warrant uniformity, and is good to point out critical risks, but not always applicable to all kinds of risk assessments, e.g. environment, community). This enables a risk rating and suggests specific controls. The tools most commonly used to evaluate risks, are consequence and likelihood tables. From their evaluation it is possible to deduce treatment needs, options and priorities. A wide range of treatment options to prevent, correct and avoid, and to allocate resources, are available—elimination, substitution, engineering, administrative (procedure-based) controls, and personal protective equipment. Outputs from the risk identification process need to be documented, in order to communicate risk events. It serves also as a point of reference when developing strategies to identify key intervention points and to develop appropriate actions. At the same time, a risk register is handy when monitoring and reviewing risks after some time has elapsed, to consider changed circumstances, such as the implementation of a strategy or changes to the business, environment, regulations, or social conditions.

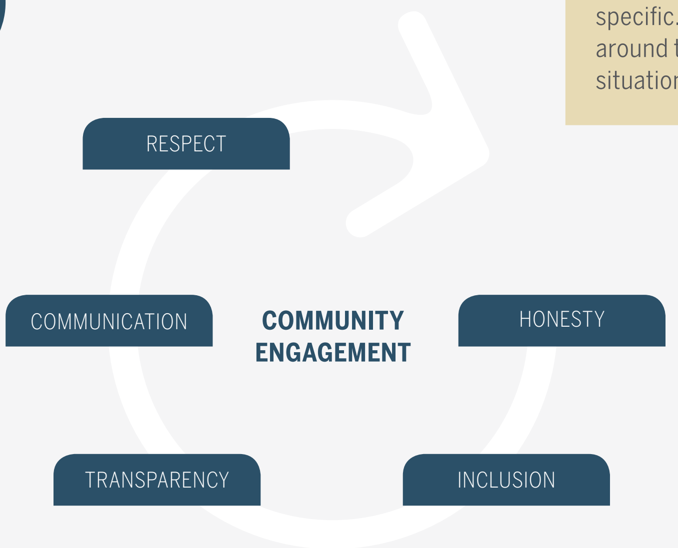
2.3 COMMUNITY ENGAGEMENT

Continuous involvement of stakeholders that may be affected directly and indirectly by the mining life cycle, often places different emphasis on the social, environmental and economic aspects of sustainability, as relationships between a company and its stakeholders evolve. For example, cultural and social issues may be more important to local and neighbouring people during the exploration phase. On the other hand, some stakeholders might be satisfied if rehabilitation measures meet performance targets for several decades after the projects and construction phase.

Assuming that community engagement processes have started with communication and community-related activities during the exploration phase, the emphasis during the projects and construction phase shifts towards the building and strengthening of relations and the establishment of sustainable principles. Put differently, it means that community engagement during the projects and construction phase ensures that no dependency is created and that stakeholders are left behind in a better position than before.

To establish principles of sustainability during this phase, a company should embrace socio-economic advancements through contributions of value in the communities in which it operates. This could include building relationships based on open, respectful and transparent communication, which promotes better understanding of the impacts on the social and physical environment as illustrated in FIGURE 3. Community and social investment should be in line with the requirements of Namibia's Mining Charter (see appendix toolkit). The Charter, directed by the Chamber of Mines of Namibia (CoM), aims at positively and proactively addressing sustainable and broad-based economic and social transformation in the Namibian mining sector (Rossing Uranium Limited, 2018).

[FIGURE 3]
Key requirements for successful community engagement



NB! One should bear in mind that community engagement is to a large extent site/company specific. So, it should be designed around the needs of the local situation and community.

In addition to the key requirements mentioned in FIGURE 3, a company should further consider values such as being subtle to local cultural norms and modifying the engagement process to accommodate those norms; having an early start to allow time for learning, understanding and getting to know each other; supporting community organisations and structures; and having realistic expectations for all parties.

Consultation is part and parcel of public participation, with a wide range of stakeholders, including local people and neighbours, authorities and regulatory officials, shareholders, employees and non-governmental organisations. Community engagement is not a generic approach, but companies should employ a combination of various processes that encourage different stakeholders to engage in ways that are best suited to them. In Namibia, one of the platforms used to invite public participation is through local newspapers and radio announcements. Thus, the choice of processes and instruments will depend on the demands of the stakeholders, the complexity of the agenda and issues involved, the levels of literacy, cultural appropriateness, gender considerations, resources available, and the development phase of the mining life cycle. Building on the foundation laid during the exploration phase, good consultation during the projects and construction phase includes the following features (International Council on Mining and Metals, 2012):

- Considering the views and opinions of stakeholders on issues impacting the community before making decisions
- Making the purpose of consultation clear and documenting the consultation processes, to indicate compliance
- Providing feedback to stakeholders on how their inputs have influenced decisions
- Enforcing regular stakeholder consultation sessions by means of a communication platform with representatives from both the exploration company and stakeholders and an agreed interaction schedule

2.4 HERITAGE

Heritage—legacies of tangible attributes in their widest sense—could potentially be impacted by various activities during the mining life cycle, and also during the projects and construction phase.

Disobeying the National Heritage Act, No. 27 of 2004, by relocating or disturbing the position of a fixed protected object / artefact can lead to a fine of up to N$100,000.

Assuming that an early archaeological assessment (in the area where the projects and construction phase is planned) has been conducted, it would be wise to maintain existing, and to implement additional, management measures with regard to heritage. Great awareness about the history, archaeology, ethnicity, culture, norms and religions within the project area is advantageous, because in doing so, any possible conflicts between the local people, neighbours and the proponent, are minimised. Furthermore, it shows commitment to the respect of public opinion and precautionary principles.

2.5 BIODIVERSITY

The projects and construction phase has the potential to affect biodiversity, both directly and indirectly. Direct or primary impacts can result from any activity that involves land clearance and earthworks, including road construction and preparation for construction, overburden stripping, impoundment of water or discharges of water, or the air (such as dusts or emissions). Direct impacts are usually readily identifiable and can easily be managed through the mitigation hierarchy and measures stipulated by the EMP. Indirect or secondary impacts can result from knock-on changes induced by construction activities and create delayed and collective impacts. They are habitually harder to identify immediately and to manage proactively. Assuming that a solid biodiversity baseline study has been done as part of an EIA, and that all biodiversity risks and potential impacts are managed according to the EMP, it would be wise to maintain existing, and to implement additional, management measures as early as possible. In fact, as a precautionary principle, biodiversity management should be initiated during the exploration phase and continue well after mine closure. It is, however, not only limited to the areas affected by the activities during the projects and construction phase, but should consider all relevant surrounding sites and the ecological functioning of the larger landscape as well.

The primary focus of this Best Practice Guide is to grab the attention of management personnel during the projects and construction phase, to ensure biodiversity management as a leading practice. Research and monitoring activities are vital components in the management of impacts incurred on biodiversity and the rehabilitation employed following disturbances. Furthermore, companies that attain the highest biodiversity management standards are those that use the findings of research and monitoring activities for continued improvement, and this is a key element of Environmental Management Systems (EMS).

2.6 SECURING A MINE'S WATER SUPPLY

Like many industries, the mining industry requires access to a reliable supply of water to effectively carry out operations; from supplying drinking water to site workers, washing ore, managing dust emissions, tailings, and wastewater services, etc. Moreover, water can be sourced from surface or groundwater systems, varying from site to site and depending on the size and location of the mine and volume of water required for different ore types. As shown in the case study below, Orano Mining Namibia has ensured water security for its operations through the construction of a seawater desalination plant.

TREKKOPJE MINE

is owned by Orano (France) and operated by Orano Mining Namibia.

LOCATION:

Trekkopje Mine is located 70 km north-east of Swakopmund in the Erongo Region, Namibia.

BRIEF DESCRIPTION:

Trekkopje Mine is a large, low-grade uranium deposit in calcretised river sediments, with the main mineralisation covering an area of 14 x 3 km. Mining will take place in shallow open pits with an average depth of 16 metres. The mining process will involve blasting, loading and hauling. The ore will be crushed to <38 millimetres with subsequent agglomeration of the fines to the coarser fraction. The crushed ore will be stacked on a heap leach pad, which extends over an area of 3 km by 810 m, and washed over a 40-day period with fresh water to remove chlorides and sulphates. This will be followed by 160 days of alkaline leaching with sodium carbonate and sodium bicarbonate. The uranium will be extracted from the leach solution in ion exchange columns and precipitated to produce sodium diuranate (yellowcake) for export to France. An "on-off" heap leach pad will be used to reduce the mine's footprint and allow progressive rehabilitation of the mine. Trekkopje was placed under care and maintenance in 2012. Orano has completed two pilot-testing phases and several process improvement studies to prove that large-scale alkaline heap leaching for uranium is feasible. Pilot and full-scale production facilities have been completed, including heap leach pads, crushers and processing plants, as well as roads, powerlines and pipelines. To secure the mine's water supply, Orano has constructed a seawater desalination plant at Wlotzkasbaken, 35 km north of Swakopmund.

KEY ISSUE(S) ADDRESSED:

This case study addresses the issue of sustainable water provision to mines and the potential conflict with other water users. Members of the public tend to see mining companies as major water consumers who are "wasting" precious water resources that could otherwise be used for domestic or agricultural purposes. The International Council on Mining and Metals recommends that the use of water should be socially equitable, environmentally sustainable and economically beneficial, and achieved through a stakeholder-inclusive process that involves site and catchment-based actions.

In South Africa, for example, Anglo American and South32 (formerly BHP Billiton) are treating mine waste water, to solve regional water problems, in partnership with the eMalahleni municipality. They have built a water reclamation plant that currently treats more than 30 million litres of acid rock drainage per day, transforming 16 million litres into drinking water for more than 80 000 consumers in a highly water-stressed, cash-poor, and rapidly growing urban municipality. It has reduced to net-zero Anglo American's reliance on external water sources, since the recycled water meets the water needs of its mining operations in the area.

To maintain their social licence to operate, mining companies operating in water-scarce areas should consider developing their own supply, not only if their site is far from a supply network, but also to avoid competition with other users. If possible, best practice would allow the public to benefit from mine water infrastructure, either immediately or after mine closure. This has worked well in the case of Trekkopje, because the spare capacity of the Erongo Desalination Plant is available to supplement the Namibian Water Corporation's regional groundwater supply scheme. Without it, Husab Mine could not have started production.

KEY BULLET POINTS:

- Orano's initiative to provide its own water supply, resulted in the construction of a desalination plant, which has turned into an important asset for the country's economic development
- In a commendable display of best practice, mining companies (Langer Heinrich Uranium, Rössing Uranium and Swakop Uranium) have shouldered the full cost of desalinated water, while residents only pay the groundwater tariff.

DESCRIPTION OF THE CASE STUDY:

The Erongo Desalination Plant, one of the largest reverse osmosis plants in Southern Africa, is located 35 kilometres north of Swakopmund and was commissioned in 2010. It is wholly-owned by Orano and managed by AVENG Water Treatment. The plant was initially built to supply water to Trekkopje Mine. When the water supply situation at the coast was assessed during the project feasibility study, it became clear that the local aquifers were already used to full capacity and unable to support another major consumer. The only viable alternative, i.e. seawater desalination, had already been identified in the government's Central Namib Area Water Master Plan in 1996. Orano therefore decided to construct a desalination plant as close as possible to the mine. The design provided for a capacity of 20 million cubic metres per annum according to the initially estimated water demand, though later optimisation studies reduced this figure to 12-14 million cubic metres per annum.

To accommodate future increases in demand, the desalination plant can be upgraded to 26 million cubic metres within the existing buildings, while a second seawater intake pipe was provided to enable a further extension to 45 million cubic metres. Seeing that

CASE STUDY

Trekkopje mine - Orano
Swakopmund
Erongo
Namibia
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Trekkopje mine - Orano
Swakopmund
Erongo
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the groundwater resources were running out, it was planned from the start that the plant would be integrated into the regional water supply scheme after the end of mining (10 years). However, a lack of groundwater recharge forced NamWater to reduce pumping to a more sustainable rate as early as 2013. To make up for the shortfall, Orano and NamWater concluded an agreement to augment the groundwater supply to the coastal region with desalinated water. The pipeline from the plant to Trekkopje Mine was connected to NamWater's pipeline from Henties Bay to Swakopmund. Omaruru River groundwater and desalinated water are mixed in the pipeline, which incidentally results in a lower salinity and hardness of the water supplied to all users.

The Erongo Desalination Plant is subject to Namibia's legislation and standards in terms of health, safety and the environment. To ensure that the water quality complies with the standards used in Namibia, regular independent tests are conducted and reported to the regulatory authorities. The water is also replenished with all the minerals the body needs, so that it is safe for human consumption. Impact studies by independent experts prior to the approval of the plant, predicted no major effects of the brine discharge on marine life around the outlet. This has been confirmed by monitoring of the seawater quality and marine life.

The addition of desalinated water has allowed NamWater to keep meeting the Central Namib's water demand, while operating the wellfields sustainably. This is important because the continued availability of relatively cheap groundwater will protect domestic consumers from steep water tariff increases, which would be unavoidable if the entire supply were sourced from the more expensive desalination process. In a commendable display of best practice, mining companies (Langer Heinrich Uranium, Rössing Uranium and Swakop Uranium) have shouldered the full cost of desalinated water, while municipalities are still charged as per the gazetted groundwater tariff.

In conclusion, the Erongo Desalination Plant serves as an example of a symbiosis between mine and public water supply, securing the economic growth of the Erongo Region and Namibia as a whole.

REFERENCE

ICMM & ICF (2017): *Shared water, shared responsibility, shared approach*. www.commdev.org and www.icmm.com

2.7 WASTE WATER MANAGEMENT

Namibia is a dry country with limited surface water resources and a high dependency on groundwater resources. Protection of surface and groundwater reserves is a high priority. To any operation best practice management of domestic and industrial waste water as well as effluent, is thus essential.

Mine water is produced in various ways at a mine site, and the water produced can vary in quantity, quality, and environmental contamination potential. Effluents can be caused by wash-down, refining, scrubbers, flotation, leaching, or concentration. Other waste water derived from kitchens, ablution blocks, change houses and workshops, ends up in a sewage system.

The objectives of Article 21 Permits are to regulate the disposal of effluents produced by an operation and to prevent the spread of groundwater pollution from effluent or waste disposal sites. The permit sets maximum allowable levels for various standards according to the site, and reporting has to be done on a prescribed schedule. In addition, some operations voluntarily apply self-controlled management systems, to prevent pollution and activities or conditions that pose a threat to human health, safety or the environment.

In the past, biological or physio-chemical methods have been used to treat effluents. In a dry country such as Namibia, water is a limited resource and it has become leading practice to adhere to zero discharge, as this allows for maximum water re-use. Waste water treatment facilities need to be developed in accordance to the Code of Practice of the Department of Water Affairs and Forestry.

2.8 PLANNING FOR THE PREVENTION OF ACID MINE DRAINAGE

Several mining activities that expose mined materials, have the potential to alter the quality and quantity of both surface and groundwater. Discharge of Acid Mine Drainage (AMD) is a common impact incurred by mining activity, and may originate during the projects and construction phase, causing instantaneous threats to the quality of both surface and groundwater as well as biota.

Often associated with coal and metal deposits, AMD refers to the acidic water that is generated when sulphide minerals are exposed to air and water. Through oxidation and a subsequent chemical reaction, sulphuric acid is generated, which can mobilise significant amounts of pollutants downstream. Various new compounds may form, depending on the mineralogy of the rocks in the given area. The chemicals that make up the composition of the AMD include, most commonly: iron disulphide (also known as pyrite or "fool's gold") (FeS_2); heavy metals; elemental sulphur; radionuclides (where uranium ore is mined); oxyanions; iron; and manganese.

The resulting waters are usually of low pH and may not be released into an open surface. Treatment of such water involves increasing the pH to 7 by neutralisation with lime. The high concentration of pollutants present in the drainage, forms highly contaminated sludge, which requires proper disposal because it may pose unjustifiable health risks to the public in the surrounding community. Visual pointers of AMD include the following:

- Orange-brown iron oxide precipitates in drainage lines
- Unnaturally clear or red-coloured water
- Dense coatings of green algae filaments on the stream bed
- Poor productivity of vegetated areas
- Deposits of white or coloured salts forming along the bank of drainage channels

FIGURE 4 summarises the different types of drainage that can be formed from the oxidation of sulphide minerals.

The first step in assessing the acid forming potential of a mining site is to carry out an acid-base account on various samples. This involves static laboratory procedures that evaluate the balance between acid generation processes (oxidation of sulphide minerals) and acid neutralising processes (dissolution of alkaline carbonates, displacement of exchangeable bases, and weathering of silicates). The values arising from the acid-base account are referred to as maximum potential acidity (MPA) and acid neutralising capacity (ANC), respectively. The difference between the MPA and ANC values is referred to as the net acid producing potential (NAPP).

[FIGURE 4] Typical range of drainage types produced during the oxidation of sulphide minerals

ACID MINE DRAINAGE

- Acidic pH
- Moderate to elevated metals
- Treated to neutralise the acid, metals and sulfate removal

NEUTRAL MINE DRAINAGE

- Near neutal to alkaline pH
- Low to moderate sulfate content
- Low to moderate metals; may have elevated cadium, zinc, arsenic, manganese, selenium, antimony
- Treatment for metal and removal of sulfate

SALINE DRAINAGE

- Neutral to alkaline pH
- Low metals
- Moderate iron, sulfate, magnesium and calcium
- Treatment for sulfate and sometimes metal removal

Factors such as mineralogy, climate and other environmental factors play a role in the formation of AMD. It is worth noting that AMD can continue to be present after mining operations cease, hence the need for the implementation of precautionary principles to manage the potential occurrence of acid mine drainage. Possible risks of acid mine drainage should be fully evaluated before mining operations commerce, preferably during the projects and construction phase. Prevention or minimisation of AMD requires early planning and active management of sulfuric waste. A proponent should make provision for acid mine drainage solutions that require treatment from neutralisation of acids, flocculation, filtration, softening and demineralisation, if needed. Moreover, it implies significant cost savings in comparison with long-term costs that may be incurred, should retroactive implementation control measures such as collection, mitigation or treatment strategies be considered. TABLE 4 contains some of the activities and procedures implied by the planning process.

Successful long-term management of AMD requires proactive detection and resolution of problems prior to significant environmental impacts. This also involves monitoring, maintenance, repair and contingency plans. When considering AMD management, best environmental practice requires site-specific adaptation of local resources and environment conditions. FIGURE 5 shows the typical visual impacts of acid mine drainage onto a drainage line in Namibia.

[FIGURE 5] Impact of acid mine drainage into a drainage channel

TABLE 4 | Basic activities and procedures for acid mine drainage planning

ACTIVITY/METHOD	PARAMETERS TO BE CONSIDERED FOR PLANNING
Investigation	In order to identify and define the presence of sulphides and determine the most appropriate and practical management strategies, an investigation should include: • Desktop assessment (i.e. geology, bore logs, hydrology) • Sampling • Laboratory analysis • Reporting
Sampling	Sampling should be conducted to quantify the acid-forming capacity of waste material. The parameters to be considered include: • pH • Mineralogy • Electrical-Conductivity • Acid-Base Accounting (ABA) • Multi-element composition
Classification (analysis of results)	Material classification must be performed prior to the proposed excavation. This information is required, to enable the planning of preventative measures, so as to avoid costly long-term mitigation programmes. Mine waste materials classification is as follows: Non-Acid Forming (NAF): ANC/MPA* ratio ≥ 2 Potentially Acid Forming (PAF): ANC/MPA ratio < 2

ACTIVITY/METHOD	PARAMETERS TO BE CONSIDERED FOR PLANNING
Management Plan	There are a variety of strategies available in mitigating the impacts of AMD, and the use of different mechanisms may vary in the effectiveness of outputs. However, the avoidance of a destruction approach is always the best approach. Other strategies include the use of underwater storage, neutralisation, dry covers, collection and treatment. Dry Cover System: • Consider impermeable barriers (i.e. multi-layer barriers) • Minimise the influx of water • Provide an oxygen barrier • Ensure resistance to erosion and support vegetation • For dry cover systems placed on reactive tailings and waste rock, consider oxygen consumption (organic cover materials) and reaction-inhibiting materials (e.g. limestone) Water Cover Systems An alternative for preventing AMD, is to bury the PAF material under water, because in water oxygen is about 25,000 times lower than that in the air (dissolved oxygen concentration in water is 8.6mg/L at 25°C). Organic matter and other reduced compounds can rapidly consume the dissolved oxygen in the water, making it unavailable for sulphide oxidation. Ensure that all PAF material is permanently covered by at least two meters of water. Neutralisation • The degree of contaminants from tailings and waste rock depends on the extent of the buffering capacity of the system • Limestone/Calcium carbonate (crushed $CaCO_3$) and similar alkaline reagents have proven to be effective in increasing the pH and thereby precipitating and immobilising metals

WHAT COULD GO WRONG?

Poor planning and design for AMD at any mine site, may lead to adverse environmental impacts, including the cost of remediation for both the government and the mining company.

2.9 WASTE MANAGEMENT

A variety of waste types and quantities may be generated during the projects and construction phase. In simple terms, a distinction is made between mineral and non-mineral waste and each type must be assessed and managed on its own merits. It is also important to review the waste management measures stipulated in the EMP regularly, as the quantities and disposal options may vary over time.

Mineral waste

When ore bodies are located close to the surface, surface mining is typically used – resulting in an open pit. When the ore body is located deeper down, underground mining methods are generally applied. During the early stage of mine development, mineral waste is stripped and dumped in allocated areas—in accordance with the Life of Mine plan and the EMP. Accordingly, these measures need to be in place during the projects and construction phase and regularly reviewed for continuous improvement. Aspects of mineral waste management are discussed in greater detail in the chapter that focuses on the operational phase.

Hazardous waste

Hazardous waste needs to be handled with great environmental care and must be disposed of at an approved waste site. An onsite facility for storing hazardous waste (including contaminated and non-recyclable waste items) temporarily before disposal offsite is highly recommendable. Aspects of hazardous waste management are discussed in greater detail in the chapter that focuses on the operational phase.

Radioactive waste

The Radiation Protection and Waste Disposal Regulations (No.221 of 2011) of the Atomic Energy and Radiation Protection Act, No. 5 of 2005 demand adequate protection of the environment and of people in current and future generations against the harmful effects of radiation, by controlling and regulating the production, processing, handling, use, storage, transport and disposal of radiation sources and radioactive materials. Any generator of radioactive waste needs to be licensed, and radioactive waste needs to be managed in accordance with Regulation 58 – 74. In consultation with the NRPA radiation safety rules and within a practice or for the use, handling, storage, transportation, or disposal of radiation sources or nuclear material produced or prepared by the licence holder need to be prepared.

Non-Mineral waste

Non-mineral waste items have the potential to cause negative environmental and social impacts when not properly managed. It is assumed that the associated risks during the projects and construction phase are managed according to the EMP. It is also advantageous to maintain existing, and to implement additional, management measures with regard to waste during the projects and construction phase.

Non-mineral waste consists primarily of auxiliary materials that support mining operations. It includes items such as tyres, oils and grease, batteries, empty containers, plastic and wood packaging, scrap metal, paper, building rubble and waste items from processing, maintenance, workshops, laboratories and gardens and other domestic rubbish. Non-mineral waste is produced in much smaller volumes to mineral waste, but is a key indicator for measuring the ecological footprint of an operation.

A number of waste separation and recycling practices can be introduced during the projects and construction phase. Paper and cardboard, wood and plastic from packaging, and scrap metal are some of the waste items that are easily recyclable. Items that are more complicated to recycle include used oil and grease, tyres, batteries, and empty lubricant containers. Items that have little to no potential for recycling include chemicals, building rubble and kitchen remains, contaminated containers and electronic waste.

The early introduction of a waste separation and recycling practice has the potential to increase positive reputation and raise environmental awareness among employees. Furthermore, employees should be encouraged to avoid, reduce and recycle waste, including the compression of bulky waste items.

PART THREE

LEADING STANDARDS FOR THE PROJECTS AND CONSTRUCTION PHASE

BASIC COMPLIANCE REQUIREMENTS

Site preparation involves earthworks such as the construction of access roads, land clearance, stripping and grading, and is typically carried out in preparation for the projects and construction phase. It is good practice to stockpile overburden for use in the reclamation process at a later stage. Additional earthworks are normally required, in order to access and mine the ore body—normally also taking place during the projects and construction phase. To carry out the activities related to site preparation, a company must be in possession of the necessary licence(s) and permit(s). Special considerations should be made with respect to the validity of such licences.

3.1 SITE PREPARATION

When mine sites are in remote areas, the initial step in site preparation is usually land clearing. Typically, there are significant environmental impacts associated with land clearing activities, therefore the activities associated with land clearing should be thoroughly assessed in the EIA and management measures stipulated in the EMP. When planning site preparation, the maintenance, rehabilitation and flora, fauna and heritage surveys must be considered along with cost evaluations (NSW Mineral Council Ltd., 2013).

Legislation and regulatory requirements

All potential environmental impacts that could occur during the projects and construction phase are managed according to the legislative processes implied by Namibia's Environmental Management Act, No. 7 of 2007 and its associated regulations. In the required EMP, mitigation measures are outlined—when applied, these measures can ensure minimal environmental damage during the projects and construction phase.

Vegetation removal as a result of land clearing, is addressed under the Forest Act No. 12 of 2001 prior to conducting such activity. The relevant permits/licences are illustrated in TABLE 5.

TABLE 5 | Required permits/licences for site preparation

ACTIVITY	**Clearing of vegetation**
ACT	The Forestry Act No. 12, 2001 Policy on Exploration and Mining in Protected Areas (2018). Environmental Management Act, No. 7 of 2007
PERMITS/ LICENCES	A forestry licence for harvesting, issued under (section 22, 23, 24, 27 and 33/ regulation 8 and 12) Environmental Clearance Certificate
RELEVANT MINISTRY	Directorate of Forestry, MAWF, MET
LINK	**Form 10 under the forest regulations (page 33 of 62)

Best practice standards

International best practices can be benchmarked to mitigate impacts associated with the various activities carried out for site preparation and set the best standards for Namibia as shown in TABLE 6. The following standards can assist in selecting best practices to work with and achieve set targets whilst optimising EMS.

TABLE 6 | Possible impacts and best practice standards for site preparation

SITE PREPARATION ACTIVITY, POSSIBLE ASSOCIATED IMPACTS, AND BEST PRACTICE STANDARDS

SITE PREPARATION ACTIVITY	POSSIBLE IMPACTS	LEADING PRACTICES
Vegetation clearing	• Water contamination • Loss of native flora • Erosion • Threaten existing protected, endemic, indigenous plant species (i.e. *Acacia erioloba* or *Welwitschia mirabilis*).	• If possible, human labour should be used, however, if not practical, excavators are the recommended machine for exploration earthworks • Removed topsoil and vegetation should be stored in a secure windrow alongside the track • If an additional cut is made, subsoil must be stored in a second separate windrow alongside the track • Do not needlessly remove vegetation from either side of the roadway
Grading	• Grading equipment can cause disturbance to the surrounding environment • Loss of native flora and fauna	Grading should only be done when necessary, otherwise select areas for track and road construction where grading has already been carried out • Ensure as little vegetation is removed as possible • Minimise environmental footprint whenever possible e.g. use existing roads etc.
Generation of mineral waste	Disturbances to ecosystems	Use waste rock for backfilling and construction to minimise volume of waste rock generated.
Stockpiling of topsoil	Soil surface erosion	• All planned erosion and sediment control practices should be in place prior to stripping • Use proper procedures to stockpile topsoil, to be used for backfilling later

WHAT COULD GO WRONG?

If leading environmental best practices are not implemented at the exploration and mine site,
the following can occur:

- Disturbances to ecosystems
- Loss of flora and fauna
- High volumes of waste
- Contamination of water resources
- High rehabilitation costs

Otjikoto mine, B2Gold
Namibia
Otavi
Otjozondjupa
Namibia
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3.2 CONSTRUCTION OF MINE INFRASTRUCTURE

Site preparation is followed by activities to construct the mine infrastructure. Multidisciplinary activities are part of construction and may have significant environmental impacts. To manage these impacts, the measures stipulated in the EMP have to be implemented, which requires close teamwork between the projects and construction team and the operations team.

Legislation and regulatory requirements

Prior to construction, the proponent should have the necessary permits stipulated in the Minerals (Mining and Prospecting) Act, No. 33 of 1992. Additional earthworks and land clearance might be required, and the company has to ensure that all necessary licence(s) and permit(s) are in place and valid. In doing so, the proponent ensures compliance with all relevant legislative and regulatory frameworks.

Leading practice standards

International best practices can be benchmarked to mitigate impacts associated with the construction of the mine infrastructure and to set the best standards for Namibia, as can be seen in TABLE 7. These standards can assist in selecting the best practices to work with during construction activities, and achieve set targets whilst optimising EMS.

TABLE 7 | Leading practice standards for projects and construction

ACTIVITY, POSSIBLE ASSOCIATED IMPACTS, AND LEADING PRACTICE STANDARDS

ACTIVITY	POSSIBLE IMPACTS	LEADING PRACTICES STANDARDS
Construction of on-site facilities	• Excessive dust • Excessive noise • Waste generated	• Arrange dust monitoring stations around the site • Ensure that employee exposure to noise levels remain within limits • Inform communities about the nature and scope of construction activities prior to starting construction • Re-use all suitable material to meet fill requirements
Earthworks	• Erosion and compaction of soils • Transport of sediment and associated contaminants by water and wind • Sedimentation in waterbodies • Loss of vegetation	• Minimise the area of soil exposed by phasing stripping and grading work and/or ensure timely implementation of suitable temporary or permanent stabilisation measures • Implement, inspect and maintain erosion and sediment controls • Ensure traffic travels along pre-defined routes and within the confines of the working areas
Refuelling and servicing of equipment	Hydrocarbon spills.	• Ensure all vehicles have spill kits and workers are trained in using them • Designate areas for refueling located some distance from waterbodies

WHAT COULD GO WRONG?

If leading practices are not implemented, the following can occur:

- If dust emissions are not monitored and mitigated, exposure to dust will have an impact on flora species and human health
- Sedimentation and soil erosion
- Soil contamination due to fuel spills

PART FOUR
REPORTING GUIDELINES

THE NEED FOR REPORTING

Any new project raises interest—among internal as well as external stakeholders. Without any doubt, the project and construction phase will raise interest, and it is vital that information during this phase is shared in a responsible and transparent way, to avoid confusion, misconceptions and, in the worst case, disputes, confrontation and opposition. For this reason, mechanisms of reporting need to be established—not only for the sake of compliance, but also for building relationships and reputations.

Upon the approval of a project the relevant authorities may insist on a detailed EMP, the scope of which should range across all construction activities through to decommissioning. It is the responsibility of the mining company to report regularly to relevant authorities and display how potential impacts are being mitigated. The purpose of reporting is two-fold. It gives the mining company the opportunity to self-evaluate how effective their operation aligns with objectives set out in the EMP, and as such, the government can evaluate compliance. It is also good practice to maintain a photographic record, to be included in reports. Several reports should be compiled, including daily construction reports, survey reports, field and laboratory test reports, and notes from relevant on-site meetings.

It is best practice to include maps in all reports, as it provides details of land use around the selected site. The identification of areas disturbed during construction, and type of disturbance should be clearly identified on these maps.

PART FIVE

CLOSURE PLANNING -DESIGN FOR DECOMMISSIONING

THE NEED FOR REPORTING

During the projects and construction phase, considerations will already have to be made for closure and closure planning needs. Progressive rehabilitation can be initiated during the projects and construction phase as the earthworks, excavations, land clearance and stockpiling of ore and waste can curb eventual rehabilitation liabilities. An early start has many advantages—it is cost-effective, it embeds important corporate values such as responsibility, proactive preparedness and holistic thinking. In addition, it has the ability to mobilise the workforce to be aware of the environmental footprint.

To obtain an Environmental Clearance Certificate and subsequently a ML, proper closure planning should be conducted during the feasibility phase. The mines that were already in operation prior to the declaration of the Minerals (Mining and Prospecting) Act, No. 33 of 1992, were not compelled to develop a closure plan during the feasibility stage.

Closure considerations should be borne in mind throughout the projects and construction phase. Due to the high costs involved, environmental damage should be kept to a minimum, in case all activities have to be ceased during the projects and construction phase. Decisions and planning considerations can have long-term environmental and social consequences, which can impact the mine closure and completion process.

ELEMENTS DURING THE PROJECTS AND CONSTRUCTION PHASE, WHICH AID IN REDUCING CLOSURE COSTS, INCLUDE:

- Proper foundation construction for tailings dams to avoid potential groundwater contamination and seepage
- Construction of a basal layer for mineral waste dumps designed to handle sulphuric waste
- Proper erosion controls during construction, to avoid the increase of sediment loads to water courses during rainy seasons
- Adequate classification of growth media and topsoil
- Adequate handling and storage of lubricants and fuels to reduce possible contamination from spills

In order to mobilise resources for the restoration and rehabilitation of impacted sites and abandoned mines, a rehabilitation fund should be set up.

PART SIX

TRANSITION TO THE NEXT PHASE

THE NEED FOR REPORTING

Once the projects and construction phase is complete, mining operations can commence. Mining operations refer to the process of managing many long- and short-term activities to facilitate the production of a mineral product. As the mine moves into the operational phase and the equipment and processing plant have been commissioned, there are several factors that require consideration.

The operating costs of a mine are typically a function of the equipment used, which is a function of the mining method employed (surface or underground). Risk assessment and management is a critical component during the operations phase, and as such, should receive adequate attention during this phase. When advancing into the operations phase, several types of software can be used to assist in determining the most ideal production schedules at the mine. Selecting the ideal production schedule is key in realising a profit from operations.
Especially two aspects of the projects and construction phase of mine development are closely associated with the setting up of best practice standards for environmental management:

- The storage of waste material on the mine site and the maintenance of these waste storage facilities
- Environmental monitoring (air quality monitoring, noise and vibration monitoring, and water quality monitoring)

Prior to moving into the operational phase, all necessary licences are required as stipulated in the Minerals (Mining and Prospecting) Act, No. 33 of 1992, the Environmental Management Act, No. 7 of 2007, the Water Act No. 54 of 1956, as well as the Water Resources Management Act, No. 11 of 2013. All conditions have to be met as stipulated in the Environmental Clearance Certificate.

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Authors of this publication
Contact details:
+264 81 669 7608
info@eccenvironmental.com
www.eccenvironmental.com