



MICA

Minerals Intelligence Capacity Analysis

FACTSHEET

Mine closure process (overview of different phases and actions)

What happens to mine sites after a mine is closed? An overview of the different phases and actions of the mine closure process.

Scope

What happens to mine sites after a mine is closed?

<http://www.miningfacts.org/environment/what-happens-to-mine-sites-after-a-mine-is-closed/>

Mining is a temporary activity, with the operating life of a mine lasting from a few years to several decades. Mine closure occurs once the mineral resource at a working mine is exhausted, or operations are no longer profitable. These days, **mine closure plans are required by most regulatory agencies worldwide before a mining permit is granted, and must demonstrate that the site will not pose a threat to the health of the environment or society in the future.** Depending on the site, the mine may be repurposed for other human uses or restored to its pre-mining use following closure. Financial assurance is increasingly required by regulators as a guarantee that the funds required for mine closure will be available to complete the closure as planned.

► Mine closure

Mine closure is the process of shutting down mining operations on a temporary or permanent basis. Mines have a limited lifetime which is determined by the size and quality of the mineral being extracted. Mines are closed when the supply of ore runs out or the commodity prices drop, making

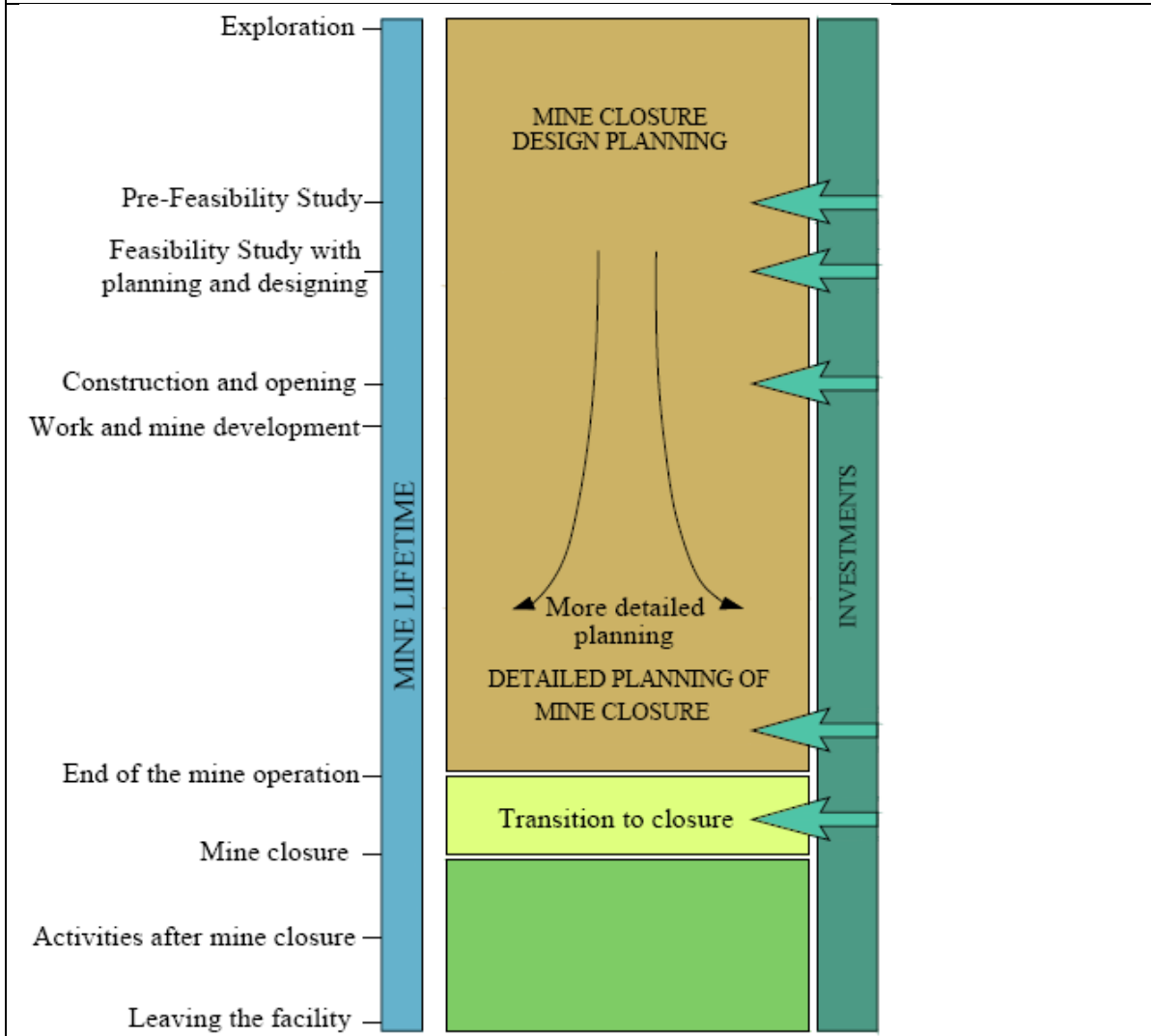
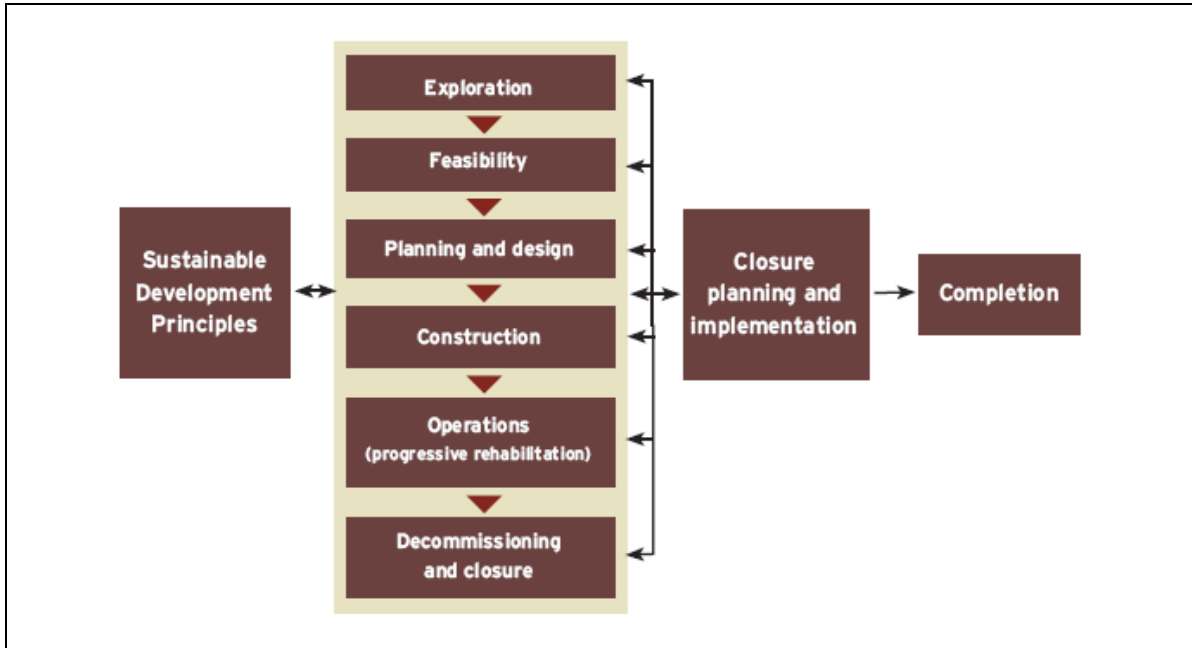
the mine uneconomical to operate. It typically takes two to ten years to shut down a mine, but it can take longer if long term water monitoring or treatment is required.

► Mine closure process

Mine closure activities typically consist of several steps:

- **Shut-down:** Once production stops, the number of workers is reduced, and a small labour force is retained to permanently shut down the mine. In some cases, the mining company may provide re-training or early retirement options to their workers before the mine is closed.
- **Decommissioning:** Small crews or contractors decommission or take apart the mining processing facilities and equipment. Pipelines are drained, equipment and parts are cleaned and may be sold, buildings are repurposed or demolished, warehouse materials are recovered, and waste is disposed of.
- **Remediation/reclamation:** The objective of reclamation is to return the land and watercourses to an acceptable standard of productive use, ensuring that any landforms and structures are stable, and any watercourses are of acceptable water quality. Reclamation typically involves a number of activities such as removing any hazardous materials, reshaping the land, restoring topsoil, and planting native grasses, trees, or ground cover (described in more detail in the mine closure plan section, below).
- **Post-closure:** Monitoring programmes are used to assess the effectiveness of the reclamation measures and to identify any corrective action that may be needed. In addition, mines may require long-term care and maintenance after mine closure such as ongoing treatment of mine discharge water, periodic monitoring and maintenance of tailings containment structures, and monitoring any ongoing remediation technologies used such as constructed wetlands.

Although the mine closure steps are listed above in a linear fashion, **mining operations often begin closure and remediation during active operations.**



*Figure 1. The different phases of a mining project. Above, after the Australian Government (2006); below, after Pavlović and Šubaranović (2012). Planning for mine closure should be undertaken progressively throughout an operation's life cycle. The amount of detail will vary and focus on specific issues through this life cycle. In order for mine closure planning to be successful, the management team needs to ensure it is integrated early into planning rather than being attended to at the end of mine life. The initial ground work, even at the exploration phase, can impact on the effectiveness and success of closure planning. **To ensure optimal results, it is critical that community and other stakeholder engagement occurs throughout the process of planning for mine closure.***

► Mine closure regulations and requirements

Mine closure planning is relatively new to the mining industry and has evolved since it was first developed as understanding and awareness of mining's environmental legacy increased. Over the years more stringent regulations have been introduced, and mining companies have become responsible both technically and financially for reclamation. Prior to the introduction of mine closure requirements and best practices beginning in the 1970s, mines were often abandoned without being adequately decommissioned or reclaimed by today's standards. Abandoned mines have the potential to be safety or environmental hazards where infrastructure is left (buildings, open mine shafts), contamination is not addressed, or acid rock drainage is forming at the site. Over the last forty years, environmental concerns over abandoned mines and the cost to taxpayers for their cleanup have led governments to tighten regulatory controls on mine closure.

Mine land reclamation and closure plans are now required by regulatory agencies around the world, and are often a component of the environmental impact assessment process practiced in over 100 countries. Mine site rehabilitation has been integrated into the early planning process, even preceding the start of mine operations, and is now an ongoing consideration throughout the mine's lifetime both from a technical and a financial standpoint.

► Financial assurance requirements

There are a number of cases where the owner of a contaminated site has been financially unable to complete the cleanup of the site due to unforeseen circumstances such as bankruptcy or corporate dissolution. In order to prevent mine abandonment for such reasons, mining companies are increasingly required to provide financial assurance in the form of a deposit or bond to governments and communities as a guarantee that the resources to meet closure requirements will be available.

The bonds can range from a few thousand to over €75 million for larger mines. Different agencies have different requirements for the amount of financial assurance to be provided for mine closure. For example, many jurisdictions in Australia determine the financial assurance required on a case-by-case basis, and in Texas, the financial assurance required is determined by the mine's permit conditions. India requires a fixed sum per hectare of mine site, and Suriname and Botswana require funding for closure as an ongoing expense. The jurisdictions of Arkansas, New Brunswick, and Ontario require financial assurance covering the complete cost of mine cleanup, while Québec requires funds covering 70%, Nevada 40%, and Ghana 5-10% of the estimated cleanup costs to be provided. Some jurisdictions require a regular review of both the closure plan and its cost (e.g., Ireland), which must be amended if necessary.

Although the adoption of financial assurance programs is relatively new and has yet to be optimized and practiced in all jurisdictions, cost recovery and enforcement of environmental cleanup has been improved by financial assurance requirements. Many of the unrecovered environmental obligations in

the USA are a result of the failure of past rather than current regulations, and government officials surveyed in Canada, South Africa, and the USA report their current financial assurance policies to be generally effective.

► Mine closure plans

Mine closure plans are specific to each mine, and include details on how the mining company will close the mine site, how environmental protection will be achieved, and how the site will be returned to an acceptable state for a pre-arranged land use. The terms reclamation, remediation, rehabilitation, and restoration are all used to describe mine closure activities that attempt to alter the biological and physical state of a site. The terms are sometimes used interchangeably, and are closely linked, but refer to distinct steps in the preparation of the site for another use:

- **Remediation:** The cleanup of the contaminated area to safe levels by removing or isolating contaminants. At mine sites, remediation often consists of isolating contaminated material in pre-existing tailings storage facilities, capping tailings and waste rock piles with clean topsoil, and collecting and treating any contaminated mine water if necessary.
- **Reclamation:** The physical stabilization of the terrain (dams, waste rock piles), landscaping, restoring topsoil, and the return of the land to a useful purpose.
- **Restoration:** The process of rebuilding the ecosystem that existed at the mine site (where applicable) before it was disturbed. The science of mine reclamation has evolved from simple revegetation activities to a discipline which involves using native plants to mimic natural ecosystem development over an extended period of time.
- **Rehabilitation:** The establishment of a stable and self-sustaining ecosystem, but not necessarily the one that existed before mining began. In many cases, complete restoration may be impossible, but successful remediation, reclamation, and rehabilitation can result in the timely establishment of a functional ecosystem.

Technical audits and reviews of mine closure plans and activities are often completed by professional specialists, government agencies, and review committees in order to review the safety, stability, environmental risks, implementability and sustainability of the closure plan at the mine site.

► The concept of social license (after Garcia, 2008)

A **social license** (or Social License to Operate [SLO] – see Prno, 2013) (see also the dedicated FactSheet '**Social License to Operate - SLO and Corporate Social responsibility - CSR**') refers to the acceptance by a community to agree to a mine development in their area. This social license is an intangible, informal approval or acceptance by the community. It is non-permanent. The company must first earn it and then continue to maintain it. As the community lives with the mine forever after closure, it is the community's legitimate right to participate in closure planning.

Within communities there are different local stakeholders that are key contacts in obtaining the social license. The company must demonstrate that it respects, listens to and understands the stakeholders. **During the process of obtaining a social license, the company will be called upon to share its plan for closure and how the closure will ensure that the community will not be harmed by the mine operations, closure, or post-closure conditions.** Post-closure may be a much longer period at many mines compared to the life of mine. Indeed, the social license and costs of closure should be a factor in the mine owner's decision to continue with a project. The closure planning can be a good process to bring disaffected local parties back to the table. Even when a community disagrees with a new operation, or disagrees whether to close a current operation, it can provide constructive input on closure.

► **International guidelines (after Garcia, 2008. Updated)**

There are no regulatory agencies that are international, but financial institutions have emphasized the importance of closure for socially conscious and fiscally safe banking purposes. There are voluntary programs that financial institutions can adopt to manage environmental and social risk in their project finance transactions. These voluntary programs can be especially pertinent for a lender that uses the project revenues both as the source of repayment and as security for the exposure. This type of financing is usually for large, complex and expensive installations, such as mines.

Currently 84 Equator Principles Financial Institutions (EPFIs) in 35 countries have officially adopted the Equator Principles (Eps), which require that the financial institution assess and manage social and environmental risk as part of the project financing (<http://www.equator-principles.com/>). Adherence to the EPs requires that the borrower conduct a social and environmental assessment process to address the relevant social and environmental impacts and to identify risks to the proposed project. The EPs do not cover the technical aspects of due diligence.

The World Bank provides financial and technical assistance to developing countries around the world by offering low-interest loans, interest-free credit and grants to developing countries for education, health, infrastructure, communications and many other purposes. It is composed of two development institutions owned by 185 member countries—the International Bank for Reconstruction and Development (IBRD) and the International Development Association (IDA). The IBRD focuses on middle income and creditworthy poor countries, while IDA focuses on the poorest countries in the world.

The International Finance Corporation (IFC), the private sector arm of the World Bank Group, has a Sustainability Web Portal (<http://www.ifc.org/sustainability>) in response to growing stakeholder interest. IFC uses environmental and social screening criteria to categorize the magnitude of social and environmental impacts. These categories are Category A (projects with potential significant adverse social or environmental impacts that are diverse, irreversible or unprecedented); Category B (projects with potential limited adverse social or environmental impacts that are few in number, generally site-specific, largely reversible and readily addressed through mitigation measures); and Category C (projects with minimal or no social or environmental impacts).

► **Mine closure in Europe (after Garcia, 2008)**

Closure aspects for mining facilities in Europe are closely linked with the conditions of planning permission for the mine. Closure of waste disposal facilities is covered by the European Union (EU) Mining Waste Directive (**EU, Directive 2006/21/EC, 2006**). This includes requirements for the establishment of a closure plan for the waste facilities (Article 12) and allocation of a financial bond to cover the estimated costs of closure and rehabilitation (Article 14). A partnership of international organizations prepared a closure guideline for South-eastern and Eastern Europe, Central Asia and Caucasus as part of its mission to advance and protect peace and the environment (United Nations et al., 2005). The document makes a particular point of the economic development of nations in central and eastern Europe being linked to ongoing and new mining efforts. A primary objective of the document is to provide guidance for either re-opening the mine or redeveloping the site for other economic uses. Historic mines are being revisited in many countries as commodity prices increase and mining technology improves (or in some cases, the political stability of the area allows for private investment).

<p>Example of MINE CLOSURE PLAN (MCP) CHECKLIST (After Government of Western Australia, Department of Mines and Petroleum, Environmental Protection Authority – modified)</p>
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http://www.epa.wa.gov.au/EPADocLib/153549_WEB%20VERSION%20%E2%80%93%20Guidelines%20for%20Preparing%20Mine%20Closure%20Plans.pdf

1 Has the Checklist been endorsed by a senior representative within the tenement holder/operating company? (See bottom of checklist.)

PUBLIC AVAILABILITY

2 Are you aware that from 2015 all MCPs will be made publicly available?

3 Is there any information in this MCP that should not be publicly available?

4 If "Yes" to Q3, has confidential information been submitted in a separate document/ section?

COVER PAGE, TABLE OF CONTENTS

5 Does the MCP cover page include: • Project Title • Company Name • Contact Details (including telephone numbers and email addresses) • Document ID and version number • Date of submission (needs to match the date of this checklist)

SCOPE AND PURPOSE

6 State why the MCP is submitted (e.g. as part of a Mining Proposal, a reviewed MCP or to fulfil other legal requirements)

PROJECT OVERVIEW

7 Does the project summary include: • Land ownership details (include any land management agency responsible for the land / reserve and the purpose for which the land/ reserve [including surrounding land] is being managed) • Location of the project • Comprehensive site plan(s) • Background information on the history and status of the project.

LEGAL OBLIGATIONS AND COMMITMENTS

8 Does the MCP include a consolidated summary or register of closure obligations and commitments?

STAKEHOLDER ENGAGEMENT

9 Have all stakeholders involved in closure been identified?

10 Does the MCP include a summary or register of historic stakeholder engagement with details on who has been consulted and the outcomes?

11 Does the MCP include a stakeholder consultation strategy to be implemented in the future?

POST-MINING LAND USE(S) AND CLOSURE OBJECTIVES

12 Does the MCP include agreed post-mining land use(s), closure objectives and conceptual landform design diagram?

13 Does the MCP identify all potential (or pre-existing) environmental legacies, which may restrict the post mining land use (including contaminated sites)?

14 Has any soil or groundwater contamination that occurred, or is suspected to have occurred, during the operation of the mine, been reported to DER as required under the Contaminated Sites Act 2003?

DEVELOPMENT OF COMPLETION CRITERIA

15 Does the MCP include an appropriate set of specific completion criteria and closure performance indicators?

COLLECTION AND ANALYSIS OF CLOSURE DATA

16 Does the MCP include baseline data (including pre-mining studies and environmental data)?

17 Has materials characterisation been carried out consistent with applicable standards and guidelines (e.g., GARD Guide)?

18 Does the MCP identify applicable closure learnings from benchmarking against other comparable mine sites?

19 Does the MCP identify all key issues impacting mine closure objectives and outcomes (including potential contamination impacts)?

20 Does the MCP include information relevant to mine closure for each domain or feature?

IDENTIFICATION AND MANAGEMENT OF CLOSURE ISSUES

21 Does the MCP include a gap analysis/risk assessment to determine if further information is required in relation to closure of each domain or feature?

22 Does the MCP include the process, methodology, and has the rationale been provided to justify identification and management of the issues?

CLOSURE IMPLEMENTATION

23 Does the MCP include a summary of closure implementation strategies and activities for the proposed operations or for the whole site?

24 Does the MCP include a closure work program for each domain or feature?

25 Does the MCP contain site layout plans to clearly show each type of disturbance as defined in Schedule 1 of the MRF Regulations?

26 Does the MCP contain a schedule of research and trial activities?

27 Does the MCP contain a schedule of progressive rehabilitation activities?

28 Does the MCP include details of how unexpected closure and care and maintenance will be handled?

29 Does the MCP contain a schedule of decommissioning activities?

30 Does the MCP contain a schedule of closure performance monitoring and maintenance activities?

CLOSURE MONITORING AND MAINTENANCE

31 Does the MCP contain a framework, including methodology, quality control and remedial strategy for closure performance monitoring including post-closure monitoring and maintenance?

FINANCIAL PROVISIONING FOR CLOSURE

32 Does the MCP include costing methodology, assumptions and financial provision to resource closure implementation and monitoring?

33 Does the MCP include a process for regular review of the financial provision?

MANAGEMENT OF INFORMATION AND DATA

34 Does the MCP contain a description of management strategies including systems and processes for the retention of mine records?

Contexts of use, application fields

-> contexts (e.g., environmental, economic, social assessment)
 -> which types of stakeholder questions are concerned?
 -> link to published studies that implement the method

▶ Not applicable

Input parameters

-> which parameters are needed to run the method

▶ Not applicable

Type(s) of related input data or knowledge needed and their possible source(s)

-> which types of data are needed to run the method, from which sources could they come...
-> could be qualitative data or quantitative data, and also tacit knowledge, hybrid, etc.

▶ Not applicable

Model used (if any, geological mathematical, heuristic...)

-> e.g., geological model for mapping
-> e.g., mathematical model such as mass balancing, matrix inversion, can be stepwise such as agent -based models, dynamic including time or quasidynamic specifying time series...
-> can also be a scenario

▶ Not applicable

System and/or parameters considered

-> **the system can be described by its boundaries**. These can refer to a geographic location, like a country, or a city, the time period involved, products, materials, processes etc. involved, like flows and stocks of copper, or the cradle-to-grave chain of a cell phone, or the car fleet, or the construction sector, or the whole economy...
-> **parameters** could possibly refer to geographic co-ordinates, scale, commodities considered, genesis of ore deposits and others...

▶ Not applicable

Time / Space / Resolution / Accuracy / Plausibility...

-> to which spatio-temporal domain it applies, with which resolution and/or accuracy (e.g., near future, EU 28, 1 year, country/regional/local level...)
-> for foresight methods can also be plausibility, legitimacy and credibility...

▶ Not applicable

Indicators / Outputs / Units

-> this refers to what the method is actually meant for. Units are an important part but that is most of the time not sufficient to express the meaning. For example, **the indicators used in LCA express the cradle-to-grave environmental impacts of a product or service.** This can be expressed in kg CO₂-equivalent. But also in €. Or in millipoints. Or in m²year land use.
-> for foresight methods the outputs are products or processes

► Not applicable

Treatment of uncertainty, verification, validation

-> evaluation of the uncertainty related to this method, how it can be calculated/estimated

► Not applicable

Main publications / references

-> e.g. , ILCD handbook on LCA, standards (e.g. , ISO)
-> can include reference to websites/pages
-> references to be entered with their DOI

Australian Government (2006). Mine closure and completion.
<http://www.industry.gov.au/resource/Documents/LPSDP/LPSDP-MineClosureCompletionHandbook.pdf> (Last accessed on August 22nd, 2017)

Australian government (2015). Guidelines for Preparing Mine Closure Plans May 2015.
<http://epa.wa.gov.au/policies-guidance/joint-guidelines-preparing-mine-closure-plans>
http://epa.wa.gov.au/sites/default/files/Policies_and_Guidance/DMP-EPA-Guidelines-Mine-Closure-Plans-080515.pdf (Last accessed on August 22nd, 2017)

European Commission (2006). Directive 2006/21/EC of the European Parliament and of the Council of 15 March 2006 on the management of waste from extractive industries and amending Directive 2004/35/EC - Statement by the European Parliament, the Council and the Commission.
http://eur-lex.europa.eu/resource.html?uri=cellar:c370006a-063e-4dc7-9b05-52c37720740c.0005.02/DOC_1&format=PDF
http://eur-lex.europa.eu/resource.html?uri=cellar:c370006a-063e-4dc7-9b05-52c37720740c.0005.02/DOC_2&format=PDF

Garcia D.H. (2008). Overview of international mine closure guidelines. 2008 Meeting of the American Institute of Professional Geologists, Arizona Hydrological Society, and 3rd International Professional

Geology Conference, Flagstaff, Arizona, USA, September 20-24, 2008. Published by American Institute of Professional Geologists.

<http://www.latam.srk.com/files/File/papers/Mine-Closure-Guidelines.pdf> (Last accessed on August 22nd, 2017)

Miningfacts.org: What happens to mine sites after a mine is closed?

<http://www.miningfacts.org/environment/what-happens-to-mine-sites-after-a-mine-is-closed/> (Last accessed on August 22nd, 2017)

Pavlović V. and Šubaranović T. (2012). Mines closure strategy. *Underground Mining Engineering*, 20, 99-106 p.

http://www.rgf.bg.ac.rs/publikacije/PodzemniRadovi/radovi/jun2012/eng/05%20PR%2020_04%20ENG%20definitivno.pdf (Last accessed on August 22nd, 2017)

Prno J. (2013). An analysis of factors leading to the establishment of a social licence to operate in the mining industry. *Resources Policy*, Volume 38, Issue 4, p. 577-590. Available from:

<http://dx.doi.org/10.1016/j.resourpol.2013.09.010>, as of July 29th, 2016.

doi:10.1016/j.resourpol.2013.09.010

United Nations Environment Programme, United Nations Development Programme, Organization for Security and Co-operation in Europe, and North Atlantic Treaty Organization (2005). *Mining for Closure, Policies and Guidelines for Sustainable Mining Practice and Closure of Mines*. 97 pp.

ISBN: 82-7701-037-0

https://www.researchgate.net/publication/262259186_Mining_for_Closure_Policies_and_Guidelines_for_Sustainable_Mining_Practice_and_Closure_of_Mines (Last accessed on August 22nd, 2017)

Related methods

-> List of comparable methods, their particularities...
-> link to one or several other existing fact sheet(s)

FactSheet '**Social License to Operate - SLO and Corporate Social responsibility - CSR**'

(or SLO & CSR (Social license to operate, corporate social responsibility) – check the final title)

DocSheet '**Mine project life cycle**'

Some examples of operational tools (CAUTION, this list is not exhaustive)

-> e.g., software... Only give a listing and a reference (publication, website/page...)
-> **should be provided only if ALL main actors are properly cited**

► Not applicable

Key relevant contacts

-> list of relevant **types** of organisations that could provide further expertise and help with the methods described above.

GSI (<http://www.gsi.ie/>)

Glossary of acronyms /abbreviations

-> Definition

EPFIs	Equator Principles Financial Institutions
EPs	Equator Principles
SLO	Social License to Operate
CSR	Corporate Social responsibility
IBRD	International Bank for Reconstruction and Development
IDA	International Development Association
IFC	International Finance Corporation
MCP	Mine Closure Plan