

CONCEPT NOTE

LARGE VOLUME WASTE

Background

Large-scale mining operations, in particular open-pit, inevitably produce large volumes of waste. The classes of wastes considered in this project consist of waste rock and overburden, tailings and spent ore from heap leach operations. One of the most important environmental consideration at any mine is how to manage these large volumes of waste so as to minimise the long term impacts and maximise any long term benefits. These considerations should be taken into account in the decision-making process for the mining and processing methods, location and operation of facilities.

Mining waste facilities are rarely designed for beneficial end uses. The wastes are generally disposed of and the most common way of doing this is on land. However, waste is also discharged into river systems and the sea. The selection of disposal method is site-specific and typically controlled by technical and economic feasibility evaluations. Climate, land availability and predicted environmental and social impacts at the time of mine development are important considerations.

The physical footprints of waste disposal facilities are often significant. Apart from the land area involved, other impacts can result from waste disposal sites. Sulphide bearing wastes can generate acid and the resulting drainage may contain high concentrations of metals and salts. Even non-acid generating wastes may release metals and other constituents through leaching. In addition, mine waste sediments that end up in natural water systems can result in changes to aquatic and marine environments and may release metals if there are changes in conditions (temperature, pH etc). One of the most important aspects of these impacts is their potential long term nature. These can have lasting environmental and socio-economic consequences and be extremely difficult and costly to address through remedial measures.

Alternative ways of waste disposal are being developed to minimise their potential impact and to facilitate successful rehabilitation and final mine closure. One of these is the co-disposal of tailings and waste-rock which can help prevent acid generation and reduce the land use area. Another alternative is to thicken the tailings slurry prior to disposal. Tailings can also be disposed of as a paste, either in an impoundment or used as backfill.

Heap leaching produces a different type of waste made up of spent ore with some remaining lixiviant used in the process (i.e. cyanide for gold and silver heap leaching and sulphuric acid for copper heap leaching) and metals associated with the ore. Even after rinsing, these substances and other constituents may leach from the spent ore.

Wastes associated with these types of operations therefore have particular environmental concerns.

The sustainable benefits that may be created by the development of a mining project can be important. However, there is no doubt that the negative environmental, social and economic impacts and issues associated with the generation of large volumes of waste are of particular concern. In light of the site-specific technical and economical factors which dictate the types of disposal methods that are feasible, the following (amongst many) questions may be raised for each mining site:

- What are the exploitation, processing and location alternatives?
- What are the potential waste disposal options?
- How can the waste disposal sites be integrated into overall land use and land development plans?
- How much environmental degradation is acceptable in exchange for social and economic development? That is, how do you balance the environmental, community and economic aspects, taking into consideration long-term impacts and the benefits of development?
- Are there any economic or beneficial uses that could be derived from the mining wastes?
- Who should be participating in making these decisions and what criteria should be applied?
- How reliable are the tools used for short, medium and long term predictions?

Objectives

The objective of the proposed study is to work out a holistic approach to dealing with large volume wastes. Recommendations will be developed based on evaluation of existing information, workshops and stakeholder dialogue on the different large volume waste topics.

There is no one best way to dispose of large volume mining wastes because each site, its environment and the local community, will have specific characteristics with different concerns. This project will attempt to develop an approach to deal with large volume wastes based on a description of the issues and the different stakeholder perspectives (communities, industry, government, NGOs). This will involve taking into account the following questions:

- What disposal options are available considering site-specific physical and environmental constraints, local economy and community elements?
- Which aspects must be considered, such as long-term impacts of mining wastes, when deciding on how to deal with large volume wastes? How should these be balanced with possible sustainable economic and community development?
- Who should be involved in the decision-making process and what criteria should they take into consideration?

The different large volume waste topics proposed for evaluation are land disposal (including the physical stability of these structures, thickened tailings, paste, backfill and co-disposal of wastes), riverine disposal, marine disposal and the chemical stability of the waste.

Project Design

The research element of the project will consist of a summary of existing information on large volume wastes. Environmental, economic, community and governance issues will be described as they relate to different stakeholders (e.g. communities, governments, industry). A review panel comprised of experts representing the broad topics under consideration will work with the project manager and research fellows in giving guidance to the information review, report preparation and the final presentation. A workshop will be convened in July 2001 to review the draft reports, provide input on the specific drivers for large volume waste and develop the recommendations for dealing with large volume wastes. This will be done in preparation of the final document for inclusion in the MMSD project report. The workshop will also provide a forum for stakeholder dialogue on the range of topics considered in this project.

Land Disposal

Land disposal of mining wastes is the most common method of managing wastes and a large body of information on the subject exists. The data search will concentrate on assembling important information relating to land disposal including:

- Summaries of different types of land disposal; sub-aerial and sub-aqueous tailings storage facilities, thickened tailings, paste, backfill, waste rock facilities, co-disposal of tailings and waste rock and heap leach spent ore facilities.
- A summary of issues related to the land disposal of waste including long term integrity, stability and liability especially in areas of high rainfall and seismic action.
- A review and comparison of requirements and issues related to Pollutant Release Inventories from different regions.
- A compilation of a database on recent tailings storage facility failures in different regions and the reasons for these failures (based on existing databases). Information sources describing the detailed analyses of the failures will be listed.
- A review of existing dam safety guidelines, as they apply to tailings storage facilities, from different organisations/regions.
- A section on stewardship issues for waste storage facilities including an analysis of possible environmental, social, economic impacts.

The main objective of compiling this information is to highlight the issues related to the design and operation of waste storage facilities (stability, leachate, land access) and to recommend guidelines for establishing best practise for new mines. Observed long-term impacts will be included in order to better understand the implications of land disposal with respect to other types of disposal.

Riverine Disposal

Riverine disposal of mining wastes is practised in a few locations where site-specific decisions were made about its implementation. It is a practice that has been widely contested by the environmental community. Review on this topic will involve the compilation of case histories of riverine disposal indicating why it was selected as a disposal option, as well what the immediate and long-term impacts are and who is affected.

Specifically, the work will consist of:

- Case studies of active projects (Ok Tedi, Grasberg, and Porgera) and past projects (eg: Clark Fork River in Butte, Montana and Chañaral in Chile etc). These case studies will attempt to bring to the forefront technical issues as well as perspectives of the different stakeholders.
- These case studies will form the basis for a dialogue to evaluate when and where this kind of disposal may be a possible alternative considering economic, community, environmental and governance factors. The dialogue will consider what are the (possible) long-term impacts of a mine with riverine disposal and how can sustainable economic and community development balance with environmental impacts?

Marine Disposal

Shallow and deep sea marine disposal of tailings¹ is practised at a number of different sites around the world. It represents an alternative to land disposal that avoids associated potential acid mine production or stability problems. A summary of the technical and environmental issues associated with this type of disposal will be included, with references to a number of different cases. The risks involved, the potential long-term impacts and the necessary conditions to justify this kind of disposal remain contested. Public opinion is divided and available information is often considered biased, the dialogue on marine disposal is therefore ongoing.

The evaluation of the information will focus on the following points:

- Establishing a comprehensive summary of the risks and opportunities offered by marine disposal including criteria for deep sea tailings disposal (physical conditions such as depth of receiving waters, biodiversity of marine environments and potential for upwelling, toxicity of the effluent, etc.).
- Identifying what information is necessary to make informed decisions including site-specific investigations, and who should be involved in the decision making process?

There are ongoing discussions between industry and environmental NGO's on marine disposal of mining wastes. The progress of these discussions will be followed and the Workshop planned in July will provide another forum for these discussions.

Chemical Stability

Leachate and, in particular, acid drainage is a major concern at many mining operations. A great deal of work has been done to improve the understanding of this

¹ Submarine tailings disposal (STD) or deep sea tailings placement (DSTP)

issue, including work on acid generation prediction and modelling, prevention and mitigation. The main objective of the work on chemical stability is to summarise ongoing work on acid drainage and leachate prediction, prevention and control. This will involve:

- Providing a list of information sources and ongoing activities.
- Identifying the immediate and long-term impacts, both chronic and acute.
- Look at the possible provisions to manage acid drainage or leachate production.
- Identifying key outstanding issues and proposing a path forward.

This work will take into consideration the impacts of leachate and acid drainage on the natural water quality but will not provide an extensive exploration of water quality issues associated with mining.

Expected Results

Among the results expected from this project are:

- Summaries of the information on the various topics providing insight for the development of practices with respect to large volume waste that contribute to sustainable development.
- From stakeholder dialogue, the identification of consensus (or lack of consensus) on different types of large volume waste disposal methods and the issues associated with them.
- Recommendations or guidance on an approach to deal with large volume wastes that considers how mining can better contribute to sustainable development.
- Identification of research needs related to large volume waste disposal.