The Global Acid Rock Drainage Guide (GARD Guide) – Best Management Practices for Acid Prevention

Rens Verburg[1], Terrence Chatwin[2]

[1]*Golder Associates Inc., 18300 NE Union Hill Road, Redmond, WA 98052, USA, rverburg@golder.com*
[2]*International Network for Acid Prevention, 2105 Oneida Street, Salt Lake City, UT 84109, USA, terrence.chatwin@inap.com.au*

Abstract The International Network for Acid Prevention (INAP), a consortium of mining companies dedicated to addressing the challenge of acid rock drainage (ARD) and metal leaching (ML), has consolidated relevant information and produced a Global ARD Guide (GARD Guide) that summarizes best management practices to prevent ARD and ML. The Guide assists industry to provide high levels of environmental protection, supports regulators with assessing mining practices, and enables the public to gain a higher degree of understanding of ARD/ML-related issues. This public-domain document, which is available online, provides a structured system to identify proven techniques for prevention and management of ARD/ML.

Key Words INAP, acid rock drainage, ARD, metal leaching, ML, GARD Guide, management, prevention

Introduction

Research on ARD formation, associated ML, and methods to minimize their impact has been ongoing for more than 50 years. Progress has accelerated over the last 20 years as interest in the topic has grown. Hence, there is considerable scientific and technical information available on ARD/ML. For brevity, in the remainder of this paper, the terms ARD or ARD/ML are used to represent all discharges generated from sulfide oxidation, including neutral and saline drainage.

Much of this work was performed through organizations such as the Mine Environment Neutral Drainage (MEND), the International Mine Water Association (IMWA), the Acid Drainage Technology Initiative (ADTI), the Australian Sustainable Mining Institute – Knowledge Transfer (SMIKT) (formerly known as the Australian Centre for Minerals Extension and Research – ACMER), the South African Water Research Commission (WRC), the Partnership for Acid Drainage Remediation in Europe (PADRE), and more recently the South American Network for Acid Prevention (SANAP), the Chinese Network for Acid Mine Drainage (CNAMD), and the Indonesian Network for Acid Drainage (INAD).

Many examples and case studies of ARD prediction and mitigation have been completed that strengthen the more fundamental scientific research. Knowledge gained from both positive and negative field results contributes greatly to current and future ARD management plans. Application of ongoing science and engineering research supports continual improvement in ARD management. However, this research is generally only available through disparate references and is not easily accessible.

The Global Acid Rock Drainage Guide

In response to the need for a single, global reference for acid prevention, INAP created the Global Acid Rock Drainage Guide (INAP 2009). This online document (www.gardguide.com) aims to consolidate the best technical and management practices into a guide with high industry and external stakeholder credibility. It assists the industry in providing high levels of environmental protection, assists governments in the assessment and regulation of mining, and enables the public to better understand acid prevention plans and practices. The guide provides a structured system to identify proven techniques for characterization, prediction, monitoring, treatment, prevention and management of ARD. The web-based format was selected for ease of information dissemination and to allow for continual updates and improvement of the document.

The GARD Guide has been prepared as a road map through the process of evaluating, planning, designing, and managing ARD over the life cycle of mining. It provides a broad, but not highly detailed, understanding of ARD technologies and management. However, a comprehensive ARD Management Plan, which is considered the cornerstone of ARD prevention, can be developed using the concepts and guidance in the GARD Guide supplemented by more specific references and technical and site-specific knowledge. The GARD Guide also provides numerous references to identify more detailed information on ARD technologies and management options.

The following are specific objectives of the GARD Guide:

1. Describe issues associated with sulfide mineral oxidation
2. Expand best global ARD management practice
3. Promote a risk-based reduction and control of ARD at the source
4. Leverage the world's ARD expertise by sharing with developing countries
5. Achieve 'global best practice' in future mining projects

The GARD Guide deals with the management of drainage produced from sulfide mineral oxidation. The document also addresses metal leaching caused by sulfide mineral oxidation. While focused on mining, the technology described is relevant to encounters and exposure of sulfide minerals due to other activities (e.g., rock cuts, excavations, tunnels). Some of the approaches in the GARD Guide are also relevant to issues arising from reactive non-sulfide minerals.

Development of the GARD Guide started in 2006 with the development of the GARD Guide planning document prepared by the GARD Guide Steering Committee under the direction of Mr. Keith Ferguson. Following this outline, INAP selected a technical team led by Golder Associates to prepare multiple drafts of the Guide. Under the leadership of INAP, the GARD Guide Steering Committee, and Golder Associates, the first public version was made available online in summer 2009. INAP received input from many contributors, peer reviewers, workshop participants, and interested stakeholders. INAP gratefully acknowledges all of this assistance.

The ARD management approach promoted in the GARD guide proceeds from site characterization to preparation, and ultimately implementation of an ARD Management Plan, as depicted in Figure 1. The recommended methodology includes a loop for verification and calibration of

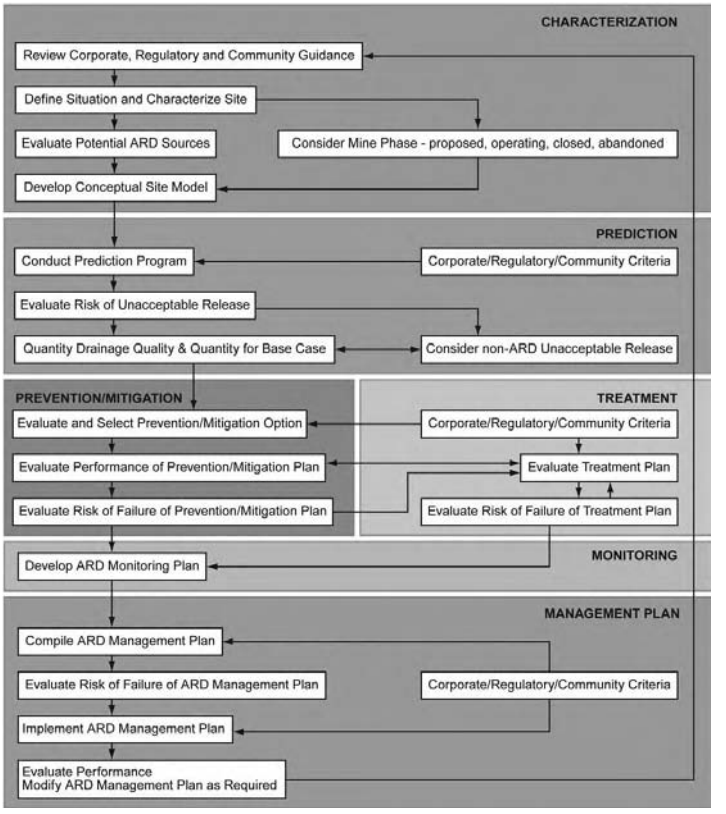

Figure 1 *Overall ARD management flowchart*

predictions and assessments as part of evaluating the performance of the ARD Management Plan. This approach also provides the framework for the various technical chapters in the GARD Guide.

The ARD Management Plan is based on technical understanding and knowledge, but is defined within corporate policies, government regulations, and community expectations. The Plan is founded on site characterization and ARD prediction science and incorporates engineering measures aimed at ARD prevention and control.

Implementation of an ARD Management Plan requires the use of management systems and communication between stakeholders. The Plan's performance is monitored through a range of mine operating and environmental metrics, including the evaluation of mine water quality. The overall performance of ARD management is evaluated against site-specific environmental requirements and the criteria established by corporate policies, government standards, and community expectations. Accordingly, the ARD management process is a continuous loop.

The level of assessment and planning for each phase of mining varies based on the information available, the extent of rock excavation, and the potential environmental impact. Site characterization, including ore and waste characterization and ARD/ML prediction, must begin at the start of mineral exploration.

With its potentially wide-ranging and multi-generational consequences, ARD/ML is an important "sustainable development" or "sustainability" issue. Environmental impacts of ARD/ML can be serious and enduring. Depending on where a mine operates, ARD/ML can also impact the well-being of people surrounding the mine, now and in the future. Poor management of ARD not only can harm the environment, but also the mining industry's reputation and communities' acceptance of individual mining operations. Applying the concept of sustainable development, on the other hand, offers an opportunity to involve multiple stakeholders in ARD management, improve risk management, and optimize the economic and social benefits of a mining operation.

In practice, sustainable development requires an integrated, balanced, and responsible approach that accounts for short-term and long-term environmental, social, economic, and governance considerations. These considerations are used as guiding principles throughout the Guide.

GARD Guide Content

The GARD Guide currently has eleven chapters. The chapters are presented in an organized fashion, addressing all aspects related to ARD management while building on each other. The chapters are as follows:

1. Introduction
2. ARD Process
3. Corporate, Regulatory and Community Aspects
4. Characterization
5. Prediction
6. Prevention and Mitigation
7. Treatment
8. Monitoring
9. Management and Performance Assessment
10. Communication and Consultation
11. ARD Management in the Future

Considerations related to sustainable development are woven throughout the guide. Technical elements are linked, leading to the development of the ARD Management Plan. Successful integration and implementation of ARD management within an overall mine development plan is the principal objective of the GARD Guide.

Path Forward

The path forward for ARD/ML prevention relies on and includes a number of participants. The primary drivers for the prevention of ARD/ML are the mining companies. They need to do the planning, make the commitments, and earn their social license to operate through demonstration of responsible mining and operational excellence. Next are other stakeholders such as government agencies, communities affected by mining, non-governmental organizations (NGOs), and the public at large.

They, to a significant degree, are the beneficiaries of the mining industry's good performance. In turn, these various stakeholders can enhance and expand this performance. As a consequence, the most important element of the path forward is all of you, the users of the GARD Guide.

You, the people of the mining industry and its stakeholders who use the GARD Guide, will ultimately determine its success – not only by effective application of its technical and management tools, but in how you articulate your commitment to the successful prevention and management of ARD/ML to your neighbors and the public. Your contributions to the GARD Guide itself will increase its value and raise best practices for ARD management around the world.

We invite you to join us in this effort. Comments on the GARD Guide can be submitted online at www.gardguide.com. It is anticipated that updating, the GARD Guide, taking into account the comments received, will begin during the 4th quarter 2010 and the new version will be issued in summer 2011.

Acknowledgements

The authors want to express their deep appreciation to Keith Ferguson (Sustainability Engineering, Vancouver, BC) for his tireless dedication to the development of the GARD Guide.

Reference

International Network for Acid Prevention (2009) Global Acid Rock Drainage Guide (GARD Guide). http://www.gardguide.com