



INAP – Global ARD Guide

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MEND Manitoba Workshop
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Gilles Tremblay, GARD Guide Secretariat

Special thanks to:
Terrence Chatwin & Keith Ferguson

Summary

- Guide Sponsored by INAP
with the Support of the Global Alliance
- Guide's Scope & Objectives
- Guide's Progress/Path Forward
- Guide's Table of Contents
- Project Team
- How You can be Involved



Sponsored by INAP

An organization of international mining companies dedicated to reducing liabilities associated with acid formation from mining





Supported by the
Global Alliance

Acid Drainage Technology Initiative



MEND

Water Research Commission



GARD Guide

An international guide for facilitating world-wide best practice in prediction, control, and mitigation of acid-rock drainage.

The guide will become a reference document for all stakeholders involved in ARD and waste management issues

The GARD Guide Meets Stakeholder's Needs

- To:
 - Articulate the issues
 - Reference best practice
 - Promote consistency in approach
 - Improve understanding of practices
- To create a comprehensive compilation of World 'Best Practice'
 - Current guides focus on regional issues or focussed aspects of ARD management
- To leverage the World's ARD Expertise
 - Share expertise with developing countries
- To facilitate the 'Equator Principles' by achieving 'global best practice' in future projects

GARD Guide Characteristics

- Flexible to accommodate site-specific issues
- Avoid duplication and build on existing guidelines and compendia
- Be consistent and promote a systematic approach
- Founded on a risk-based approach
- Endorse a pro-active approach and encourage reduction and control at the source
- Be a “how to” guide and not a regulatory tool or a design manual
- Be based on proven, field tested technologies
- Cater to the life cycle of a mine (cradle to cradle)

Scope of GARD Guide

- Acid rock drainage (ARD), neutral mine drainage (NMD) and saline drainage (SD) where contaminants are released from solid to liquid phase by sulphide oxidation
- Includes: tailings, waste rock, underground mine and pit walls, pit lakes, spent ore heaps and low-grade stockpiles
- Applies to all commodities, including base metals, precious metals, coal, diamonds, iron ore and uranium

Target Audience

- Companies, governments, consultants, researchers, educators, communities, bankers and NGO's
- Primary target audience is a scientist or engineer with a reasonable background in chemistry and the basics of civil engineering, but not necessarily specifically related to acidic drainage

GARD Guide Progress



- **First Phase (Web-based Document – Beta Version)**
 - Golder selected as contractor for Beta version
 - Project and review teams assembled
 - Table of contents prepared
 - Guidance provided to chapter authors (champions)
 - Wiki structure developed for Guide
 - Literature review proceeding
 - Scheduled to deliver a Beta version in June 2008
- **Second Phase**
 - Publish and rollout by June 2009
- **Third Phase (Web-based Document)**
 - updates and continuous Improvements

Project Team - Structure

- Project Management
 - overall execution and review of project
- Chapter Champions
 - technical leadership and responsible for chapter content
- Regional Champions
 - identification and compilation of regional input
- Web Author
- Technical Editor

Project Team – Non-Technical

- Project Management
 - Dr. Rens Verburg – Project Director (Redmond)
 - Mr. Nico Bezuidenhout – Project Manager (Johannesburg)
 - Mrs. Shareen Khamisa – Project Administrator (Johannesburg)
- Web Authors
 - Dr. Tom Kleine and Mr. Conrad Muller (Redmond)
- Technical Editor
 - Mrs. Karen Clarke-Whistler (Mississauga)

Project Team

– TOC and Chapter Champions



Chapter	Champion
1. GARD Guide	INAP
"1.5" Sustainability (focused)	Mrs. Beth Beloff
2. ARD Process	Dr. Rens Verburg
3. Corporate, Regulatory and Community Framework	Mr. John Wates
4. Characterization	Dr. Devin Castendyk
5. Prediction	Dr. Kirk Nordstrom + Dr. Rens Verburg
6. Prevention/Mitigation	Dr. Ward Wilson
7. Treatment	Dr. Andre van Niekerk
8. Monitoring	Mrs. Cheryl Ross + Dr. Peter Chapman
9. Management and Performance Assessment	Dr. Andy Robertson (+ Dr. Dirk Van Zyl) + Mrs. Karen Clarke-Whistler
10. Communication and Consultation	Mrs. Tisha Greyling
11. Summary and "Vision"	INAP



Project Team

– Regional Champions

Region	Champion
Africa	Mr. Nico Bezuidenhout (Johannesburg)
Australasia	Dr. Greg Maddocks (Brisbane)
Canada	Mr. Ken DeVos (Mississauga)
Europe	Dr. Bernadette Azzie (Naas)
South America	Dr. Flavio Vasconcelos (Belo Horizonte)
United States	Dr. Rens Verburg (Redmond)



Steering Committee and Secretariate

- Dr. Clive Bell – retired University of Queensland/ACMER (Australia)
- Dr. Terry Chatwin (INAP) - INAP Technical Manager
- Mr. Charles Bucknam – Newmont (USA)
- Mr. Keith Ferguson (SE) - GARD Guide Project Champion
- Dr. Adam Jarvis – University of Newcastle (UK)
- Mr. Dave Salmon – Anglo American (South Africa)
- Mr. Gilles Tremblay and Mrs. Charlene Hogan (NRCAN/MEND) - GARD Guide Secretariate
- Mrs. Amber Turner (INAP) - INAP Administrator

Advisory Committee



- Rich Borden - Kennecott (USA)
- Rodolfo Camacho - Freeport McMoRan (Chile)
- Dave Chambers - Center for Science in Public Participation (USA)
- Meiring du Plessis - Water Research Commission (SA)
- Linda Figueroa - Colorado School of Mines/ADTI (USA)
- Craig Ford - Inmet Mining (Canada)
- Ross Gallinger - IAMGOLD/INAP (Canada)
- Elizabeth Gardiner - Mining Association of Canada/MEND (Canada)
- Zhenqi Hu - China University of Mining and Technology (China)
- David Jones - Australia Department of Environment and Health (Australia)
- Lars-Ake Lindahl - Swedish Mining Association (Sweden)
- Glenn Miller - University of Nevada/Earthworks (USA)
- Peter Moore - Export Development Canada (Canada)
- Gavin Murray - ANZ Bank (Australia)
- Stephen Parsons - Export-Import Bank of the United States (USA)
- Bill Price - Natural Resources Canada/MEND (Canada)
- Jos Schaeckers - Consultant (SA)
- Harvey Van Veldhuizen - World Bank - MIGA (USA)
- Dirk van Zyl - University of Nevada (USA)
- David Williams - US Bureau of Land Management/ADTI (USA)
- Christian Wolkersdorfer - PADRE/IMWA/TU Bergakademie Freiberg (Germany)
- Jae Yang - Kangwon National University (Korea)
- Paul Younger - Newcastle University (UK)
- Paul Ziemkiewicz - University of West Virginia/ADTI (USA)

What will it look like??

- Web Based
- “Wiki” Structure with active links
- Secure editing provisions, unlike Wikipedia
- Follow the links...

Main Page



Main Page - GARDGuide - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://www480.pair.com/sturner/gardwiki/index.php/Main_Page

Best of the Web Channel Guide Customize Links Free Hotmail Google Internet Explorer News Internet Start RealPlayer Windows Media Windows VeloNews The Journa...

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Main Page

INAP: The International Network for Acid Prevention

An organization of international mining companies dedicated to reducing liabilities associated with sulphide mine materials.

The International Network for Acid Prevention (INAP) is an industry group created to help meet the challenge of acid drainage. INAP exists to fill the need for an international body which mobilizes acid drainage information and experience. The network was founded in 1998. Since then INAP has become a proactive, global leader in this field.

What is the Global Acid Rock Drainage Guide (GARD Guide)?

The International Network for Acid Prevention is pleased to announce that our dream of creating a 'Global Acid Rock Drainage Guide' is finally well under way. The GARD Guide aims to be a world-wide reference for acid prevention and to identify Best Practice in the field of ARD. Consolidating the vast global knowledge on ARD management into a single document is not going to be an easy undertaking. In order to create a truly global guide, experts from several countries are contributing their knowledge to the development of the Guide.

Funding and sponsorship is of course also crucial to ensure successful completion of the project. INAP is committing a significant amount of its own funds to the project and is actively seeking other sponsors.

A tremendous 'thank you' goes out to all of those who assisted in Phase I of the project, and especially to Keith Ferguson for his willingness to take on such a daunting job. We also look forward to continued support for current and future phases through completion of the project.

Project updates will be readily available in our newsletters and on the GARD Guide webpage of the INAP website. If you have questions concerning the project, please contact the INAP Administrator or the INAP Technical Manager.

Addressing a Global Need

Acid drainage is one of the most serious and potentially enduring environmental problems for the mining industry. Left unchecked, it can result in such long-term water quality impacts that it could well be this industry's most harmful legacy. Effectively dealing with acid drainage is a formidable challenge for which no global solutions currently exist.

navigation

- Main Page
- Guide Purpose
- Guide Process
- Guide Progress
- Committees & Staff
- Recent Changes
- Help
- Sand Box

gard guide chapters

- Table of Contents
- Preface
- Executive Summary
- Acknowledgments
- 1. The Gard Guide
- 2. The ARD Process
- 3. Corporate, Regulatory and Community Framework
- 4. Defining the Problem
- 5. Prediction
- 6. Prevention and Mitigation
- 7. Drainage Treatment
- 8. Monitoring
- 9. Management And Performance Assessment
- 10. ARD Communication And Consultation
- 11. ARD Management & Sustainability Framework
- 12. References
- Tables
- Figures
- Appendices

Links to INAP member companies:

- Anglo American
- Barrick
- BHP Billiton
- Freeport McMoRan
- Newmont
- Rio Tinto
- Vale INCO
- Xstrata

start

David R. Willia... Main Page - G... Mozilla Firefox... Kinetic Testwo... Microsoft Pow... Document1 - ... Handy Guide F... Main Page - G... 9:00 AM

Follow Links for "Prediction"



A screenshot of a Mozilla Firefox browser window. The title bar reads "Chapter 5 - GARDGuide - Mozilla Firefox". The address bar shows the URL "http://www480.pair.com/aturner/gardwiki/index.php/Chapter_5". The browser's toolbar includes navigation buttons (back, forward, home, stop, refresh) and a search engine dropdown set to "Google". Below the toolbar is a bookmarks bar with several entries like "Best of the Web", "Channel Guide", "Customize Links", "Free Hotmail", "Google", "Internet Explorer News", "Internet Start", "RealPlayer", "Windows Media", "Windows", and "VeloNews The Journa...". A "Log in / create account" link is visible in the top right of the page content area. The main content area displays the INAP logo on the left and a table of contents for "Chapter 5: Prediction (Kirk Nordstrom)". The table of contents lists sections from 5.1 Introduction to 5.16 References, with sub-sections under 5.9 and 5.12. A left-hand navigation menu contains links for "Main Page", "Guide Purpose", "Guide Process", "Guide Progress", "Committees & Staff", "Recent Changes", "Help", and "Sand Box". Below this is a "gard guide chapters" menu listing sections 1 through 12, plus "Tables", "Figures", and "Appendices". A search box is located at the bottom left of the page content. The browser's status bar at the bottom shows the "start" button, the current page title "David R. Willia...", and the system clock "9:02 AM".

Chapter 5

5.0 Chapter 5: Prediction (Kirk Nordstrom)

- 5.1 Introduction
- 5.2 Objectives of Prediction Program
- 5.3 The ARD Prediction Approach
- 5.4 Relevance of ARD Source
- 5.5 Consideration of ARD Factors
- 5.6 Climatic Factors
- 5.7 ARD , Metal Leaching and Sulphate Production
- 5.8 Data Needs for Prediction
- 5.9 Prediction Tools
 - 5.9.1 Geology and Lithological Considerations
 - 5.9.2 Mineralogical Investigations
 - 5.9.3 Field Measurements and Assessments
 - 5.9.4 Geophysical Investigations
 - 5.9.5 Hydrogeological/Hydrological Investigations
 - 5.9.6 Overview of Testing Methods
 - 5.9.6.1 Static Methods
 - 5.9.6.2 Kinetic Methods
- 5.10 Geochemical Modeling of ARD for Characterization and Remediation
- 5.11 Relation to ARD Mitigation Methods
- 5.12 Evaluation Approaches
 - 5.12.1 NMD and Saline Drainage Considerations
 - 5.12.2 Scale-up Considerations
 - 5.12.3 "Yes/no" Prediction
 - 5.12.4 Quantitative ARD Prediction
- 5.13 Certainty of Prediction
- 5.14 Usefulness and Limitations of Geochemical Modeling
- 5.15 ARD Prediction FAQ's
- 5.16 References

Continue with links...

A screenshot of a Mozilla Firefox browser window. The address bar shows the URL: http://www480.pair.com/aturner/gardwik/index.php/Guide5.9.6. The page title is "Guide5.9.6". The main content area is titled "5.9.6 Overview of Testing Methods". The page includes a navigation sidebar on the left with sections for "navigation" and "gard guide chapters". The main text describes the purpose of the section and lists various testing methods and procedures.

Guide5.9.6

5.9.6 Overview of Testing Methods

This section will describe how results from static and kinetic testing methods can be used for prediction of mine water quality. It will liaise closely with Chapter 4 – Characterization. The section will be a high-level overview of available test methods rather than a detailed description of individual procedure. The overview will provide brief discussion of advantages and limitations of each method, but generally focus on the interpretive and predictive value resulting from these tests. Include decision tree on ARD characterization and prediction methods.

- 5.9.6.1 Static Methods
 - 5.9.6.1.1 Physical Characterization
 - Particle size analysis
 - Evaluation of mineral reaction rates
 - Evaluation of movement and transport of air and water
 - 5.9.6.1.2 ABA
 - Evaluation of acid generation potential through independent determination of acid generating and total neutralizing content
 - Identification of samples requiring kinetic testing
 - Provides operational screening criteria for mine waste classification and management
 - Many methods to determine components of ABA (i.e. sulphur species, neutralization potential)
 - Sobek;
 - Modified Sobek;
 - Lapakko;
 - BC Research Initial;
 - BC Research Confirmation;
 - Net Carbonate Value;
 - Siderite Correction;
 - Total Inorganic Carbon;
 - Chromium Reducible Sulphur;
 - Total Actual Acidity;
 - Paste pH/Paste Conductivity (pH1:2/EC1:2).\
 - 5.9.6.1.3 NAG
 - Evaluation of net acid-base balance through simultaneous determination of acid generating and total neutralizing content;
 - Identification of samples requiring kinetic testing;
 - Provides operational screening criteria for mine waste classification and management (particularly in SE Asia and Australia);
 - Methods;
 - Single addition NAG;
 - Kinetic NAG;
 - Sequential NAG
 - 5.9.6.1.4 Metal Content and Surrogates
 - Whole rock analysis (WRA) and trace metal content;
 - Surrogate for ABA parameters (e.g., Ca for NP; total S for AGP);

After the Beta Version



- Review by Steering and Advisory Committee and INAP OpCom
- Specific input
 - External peer reviews
 - Requests for additional text
 - First and last chapter
 - Bibliography and glossary
- Broader input/buy-in
 - External contributors
 - ICMM
 - UNEP
 - World Bank/IFC
 - Governments
 - NGO's
- Make it “User Friendly”
- Publishing, translation and maintenance

How You Can Contribute

- Provide best practices and key references – *“how to”*
- Contribute to the GARD Guide Beta reviews
- Make others aware of the GARD Guide



Questions/Comments?