SELECTING TECHNOLOGIES TO ADDRESS MINE WASTE ISSUES- A WEB BASED GUIDANCE[1]

Paul Eger[2], Cherri Baysinger and Steve Hill

Abstract: Historic mining practices and the lack of mineland reclamation have led to sites with significant environmental and human health issues. Typical remedial solutions are often lengthy and expensive, and are unacceptable to the mining community, the regulatory community, and to the public. Innovative approaches and technologies need to be developed and implemented that solve environmental issues and remove existing regulatory barriers. The Interstate Technology and Regulatory Council (ITRC) mine waste team has helped to address these issues by producing web-based guidance to help select technologies that address a wide variety of mine waste issues.

The ITRC is a state-led, national coalition helping regulatory agencies, site owners, and technology developers and vendors achieve better environmental protection through the use of innovative technologies. Through open communication among its partners, ITRC is streamlining and standardizing the regulatory approval process for better, more cost-effective, environmental technologies. ITRC receives funding from the U.S. Departments of Defense and Energy, as well as the U.S. Environmental Protection Agency.

---

[1] Paper was presented at the 2010 National Meeting of the American Society of Mining and Reclamation, Pittsburgh, PA ***Bridging Reclamation, Science and the Community*** June 5 - 11, 2010. R.I. Barnhisel (Ed.) Published by ASMR, 3134 Montavesta Rd., Lexington, KY 40502.

[2] Paul Eger is a Principal Engineer, Minnesota Dept. of Natural Resources, St. Paul, MN 55155. Cherri Baysinger is Chief, Bureau of Epidemiology, Missouri Dept. of Health and Senior Services, Jefferson City, MO 65102. Steve Hill, President of RegTech Inc., 6750 Southside Blvd, Nampa, ID 83686.

Proceedings America Society of Mining and Reclamation, 2010 pp 265-275
DOI: 10.21000/JASMR10010265

http://dx.doi.org/10.21000/JASMR10010265

Introduction

Mining is essential to the economy of the United States. However, historical mining practices and the absence of routine mineland reclamation, remediation, and restoration have led to legacy sites with significant environmental and human health impacts. Typical remedial solutions are often lengthy and expensive, and are unacceptable to the regulated and regulatory community, and to the public. Gaining acceptance of new and more cost effective remedial methods is often difficult and requires lengthy review.

Although standard approaches exist to solve many water and solid waste problems associated with mining, the high cost and long-term maintenance are often prohibitive. At Superfund sites where no legacy owner is available, EPA provides 90% of the funding for remedial activities. The states must provide 10% of the cleanup costs and 100% of the funding for operations and maintenance after the remedy is completed. These cost and resource issues for long-term O&M are major concerns for the states, particularly since legacy sites can contain multiple sites and range up to hundreds of square miles. In 1993, the Mineral Policy Center estimated it would take from $33-$72 billion to address mine waste issues in the 32 western states (Lyons et al., 1993). Problems related to mine-influenced water can last for tens to hundreds of years, with long-term costs in the millions of dollars.

Innovative approaches are needed to solve environmental problems related to mining, but how can they be thoroughly evaluated in a reasonable time? For example, if you are a regulator, how do you tell if a new technology is legitimate or just ‘snake oil’? Will it really perform as described and will it meet regulatory standards? If you are a technology vendor or a site owner, how can you get regulatory acceptance of your new approach within a reasonable amount of time? Innovative technologies are generally not well understood, and considerable effort is required to gain acceptance.

Once an innovative approach is developed to treat a specific problem, it can often be applied at many sites. In the past, new technologies were not readily transferred since each state had specific regulatory requirements and varying interpretations of common statutes. Each application would often have to replicate testing previously conducted because the state was not familiar with the new technology. The Interstate Technology and Regulatory Council (ITRC) was formed in 1995 to help address these issues.

Background

In 1995, ten states came together to start the ITRC. Today, all 50 states are members. Each year, new projects are started based on state priorities. Projects are managed and completed by technical teams with the proper blend of perspectives from the various ITRC partners. The ITRC teams bring multiple state, federal agencies, site owners, consultants (practitioners), and community stakeholders together to evaluate the performance and application of new technologies. The team prepares a guidance document specific to the technology and application, with the goal of increasing acceptance and shortening review time. The technical teams are always led by state regulatory personnel and must include at least five separate states as team members. Anyone with an interest in a specific team can join by agreeing to commit 10% of their time to the team.

Since its inception in 1995, ITRC has published about 91 documents in 30 topic areas, including 43 technical/ regulatory guidance documents on 22 topics. ITRC has trained over 62,000 participants in over 450 classes on 49 topics in the classroom and over the Internet through guidance documents development and training, ITRC has been able to facilitate the acceptance of new approaches, reduce permitting time, and reduce the overall cost of remediation projects.

In 2007, a team was formed to address issues related to mine waste problems. The team gathered information on technologies and case studies on emerging and innovative technologies. The goal was to address the large volume and types of wastes and other releases, associated with mining and process operations, including physical hazards and off-site environmental and ecological impacts. Team members include states from all over the country, universities, industry, federal agencies, and public stakeholders (Eger et al., 2008).

The two general problems faced by most of the states were mine-influenced water and solid mine waste. The team decided to produce guidance that would help select technologies based on how quickly a response was needed and the type of waste. The team decided that a web-based approach would be better than a standard printed document.

Advantages of the web-based approached included:

Interactive

The site can easily be navigated to identify appropriate technologies.

Better images/photos

Color images, photos, animations, and videos can be used to better illustrate technologies

Flexibility

Site can be updated as new information or technologies become available.

Updating a web site is much easier than revising a printed document.

Results

The web-based guidance contains

- Overview
- A series of decision trees
- Matrix tables that help differentiate between technologies
- Technology overviews
- Case studies
- Regulatory issues
- Stakeholders concerns

The home page of the site is shown in Fig. 1. The objective of the guidance is to help select an applicable technology, or suite of technologies, to remediate mine waste contaminated sites. From the home page, the decision trees provide assistance in selecting a group of potential technologies for a given situation (Fig. 2 and 3). After the technologies are selected, a matrix table helps distinguish between the technologies (Table 1). There is a matrix table for each group of technologies identified in the decision trees.

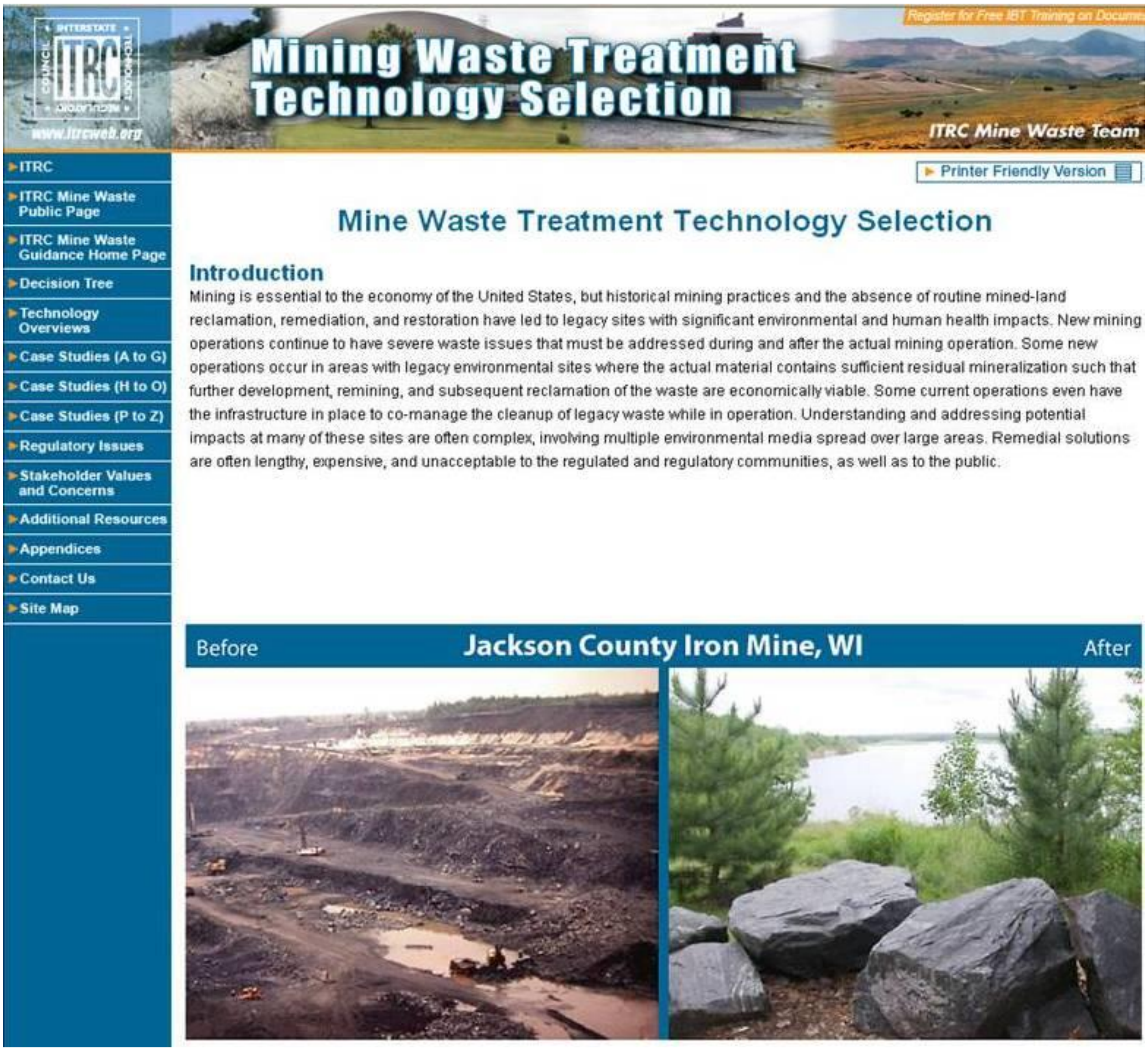

Figure 1. Mine waste treatment technology selection home page

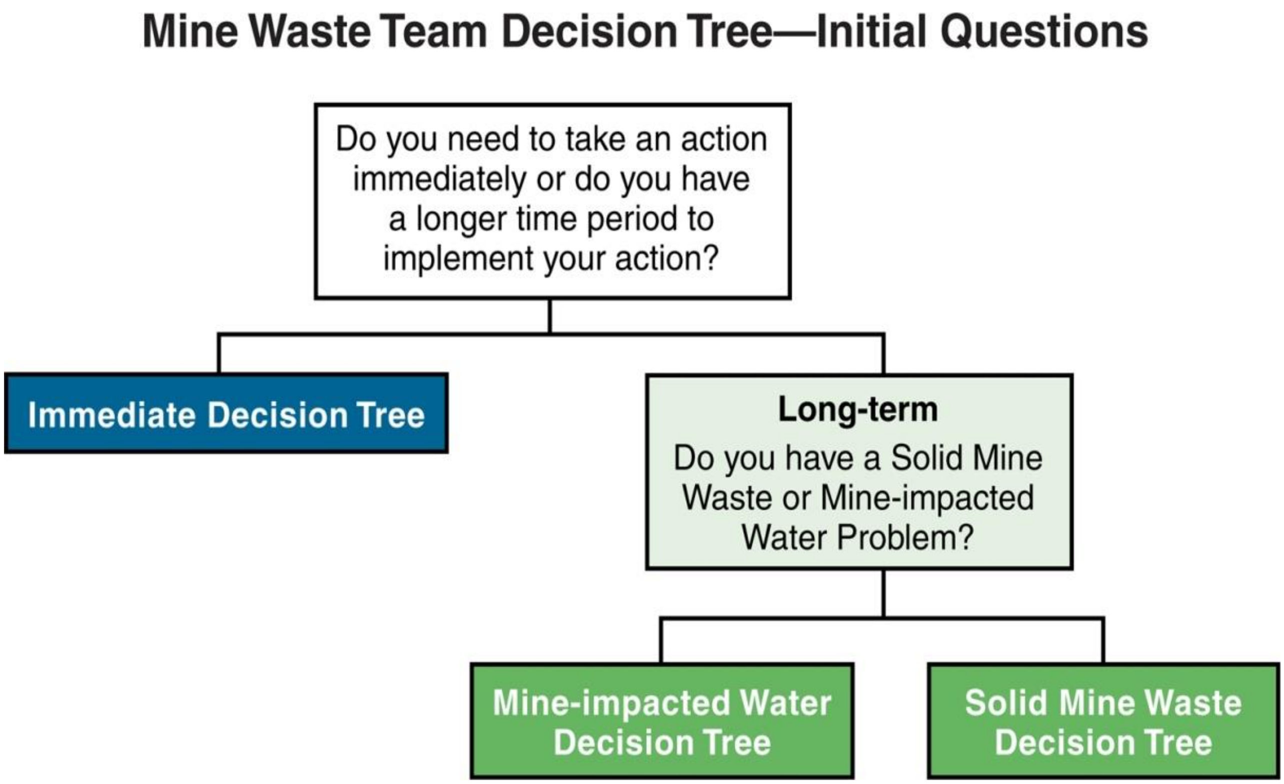

Figure 2. Initial decision tree

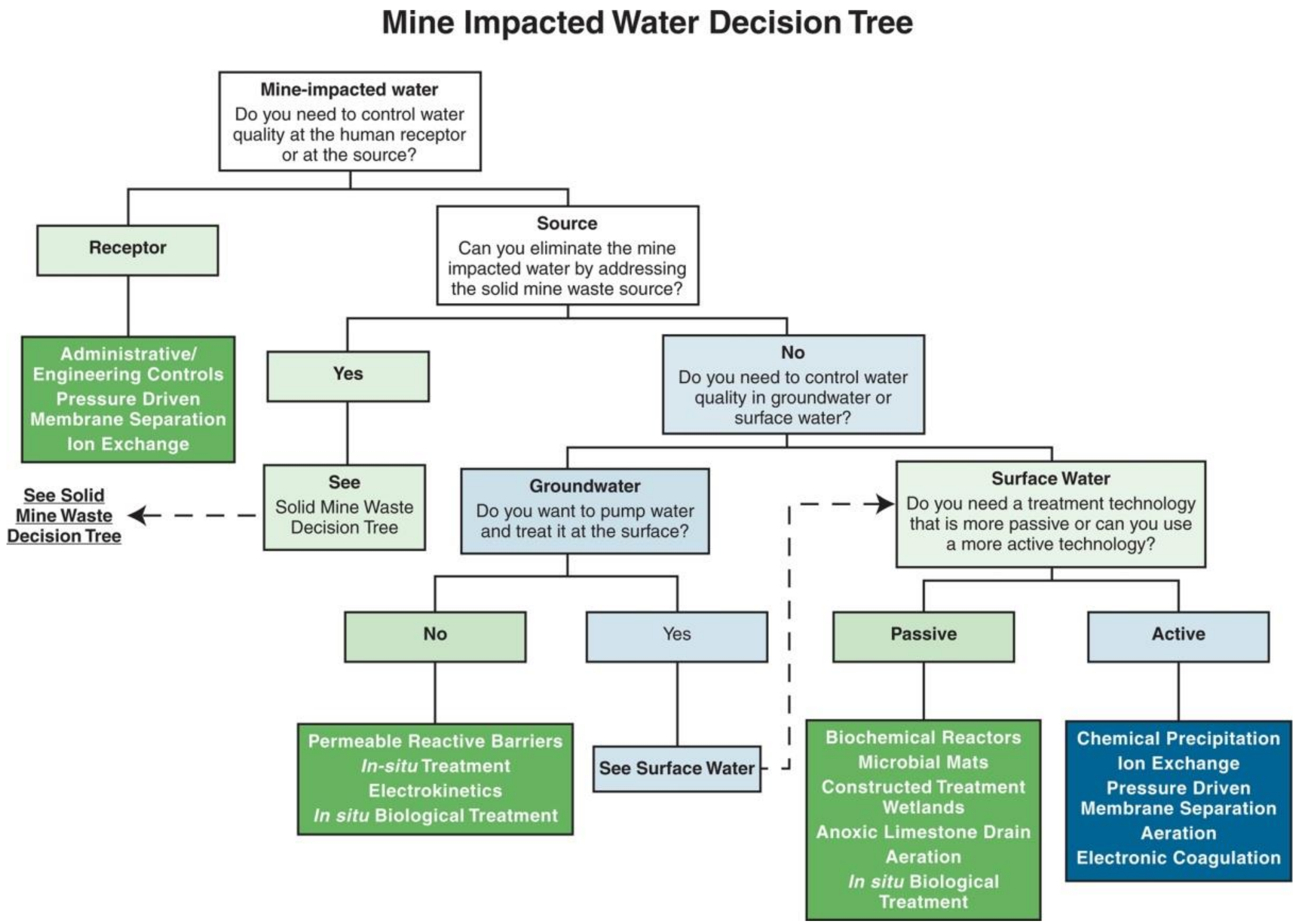

Figure 3. Mine-influenced water decision tree

Table 1. Technology characteristics

LONG TERM – MINE-IMPACTED WATER TREATED WITH ACTIVE TECHNOLOGIES					
TECHNOLOGY CHARACTERISTICS	**Chemical Precipitation**	**Ion Exchange**	**Pressure Driven Membrane Separation**	**Aeration**	**Electronic Coagulation**
Applicable for water while still below ground (groundwater, perched water)				Y	Y
Applicable to any hydrogeology/soil characteristics?	Y		Y	Y	Y
Applicable to any depth?			Y	Y	Y
Requires limited long term Maintenance and Operation?		Y	Y	Y	Y

The technology overviews are in a standard format that includes

Introduction/Overview

Applicability

Advantages

Limitations

Performance (Results)

Cost Considerations

Regulatory Considerations

Stakeholder Considerations / Public Acceptance

Lessons Learned

Case Studies

References

There are 22 technology overviews supported by 58 case studies (Table 2). Attempts were made to collect as much information on newer technologies (for example biochemical reactors) as well as new approaches in conventional technologies like chemical precipitation. These technology overviews are not meant to be technical design manuals and the level of detail varies among overviews. The team coordinated with ADTI and INAP to avoid duplication. More technical and design information has recently been produced by both of these groups (GARD, 2009). Each technology overview includes links to case studies where the technology has been implemented and provides site contacts and references on the technology and its application.

Table 2. Technologies included in mine waste treatment selection

Administrative and Engineering Controls
Aeration
Anoxic Limestone Drains
Backfilling, Subaqueous Disposal
Biochemical Reactors
Capping, Covers and Grading
Chemical Stabilization
Constructed Treatment Wetlands
Diversionary Structures
Electrokinetics
Electrocoagulation
Excavation and Disposal
In situ Biological Treatment
In situ Treatment
Ion Exchange
Microbial Mats
Passivation
Permeable Reactive Barriers
Phosphate Treatment –Chemical Stabilization
Phytotechnologies
Pressure Driven Membrane Separation
Reuse and Reprocess

<u>Using the Web site - Decision Trees</u>

The site is set up for easy navigation so that a user can go directly to a technology overview or case study, but the core framework for selecting technologies is the decision trees. The first question which must be answered in the decision tree is if a technology is needed which can be implemented immediately. Immediately, in this case, means within a year or two. The implementation time criterion is loosely based on a superfund removal project. Those situations where a technology must be implemented immediately are generally needed to mitigate an existing human health or ecological exposure. In some cases, the technology implemented may be a permanent solution to the problem. In other cases, the technology may be an intermediate step, taken to protect public health or the environment, as part of a longer-term process.

The next question presented in the decision tree is whether a technology is needed to address solid mining waste or mine-influenced water. Solid mining waste may present a risk from direct contact with human or ecological receptors and is generally the source of mine-influenced water problems. Although it is usually preferable to control the problem at the source, this is not always possible, and the only approach is to treat the water. The decision trees include this interaction by asking "Can you eliminate the mine-influenced water by addressing the solid mine waste source?" If yes, the user goes to the solid mine waste decision tree; if no, the user continues on the water decision tree (Fig. 3).

The guidance differentiates between 'active' and 'passive' treatment, understanding that there is a large gray area between these two approaches and that some technologies may be more passive than others. Any definition is wrought with subjectivity, but the team chose to use the GARD Guide definitions:

> "Passive treatment refers to processes that do not require regular human intervention, operations, or maintenances. It should typically employ natural construction material, (e.g. soils, clays, and broken rock), natural materials (e.g., plant residues such as straw, wood chips, manure, and compost) and promote growth of natural vegetation. Passive treatment systems use gravity flow for water movement. In some arid climates, it might also include use of evaporation or infiltration (e.g., soil amelioration and neutralization) of small volumes of ARD (acid rock drainage)".

> "Active treatment refers to technologies requiring ongoing human operations, maintenance, and monitoring based on external sources of energy (electrical power) using infrastructure and engineered systems."

At the end of the decision tree, there are a group of technologies that might be appropriate for the site under consideration. Clicking on this box takes the user to a table that helps differentiate between this group of technologies (Table 1). The user can then select the technology that appears to be the most appropriate for the site and go directly to the technology overview. Each technology is supported by case studies.

Conclusions

The ITRC Mine Waste Treatment Technology Selection web-based guidance was designed to help select appropriate technologies to remediate contaminated mine sites. Because of the size, complexity, and number of media affected at any given mine waste site, it may be necessary to go through the decision trees several times to select appropriate technologies to address all the sites issues. This guidance provides technology overviews, not specific design information, and assumes that the site is well characterized and that the problems are well defined and understood. As in any project, unique site characteristics and costs must be carefully considered. For more information about ITRC, please go to www.itrcweb.org.

References

Eger, P., Baysinger, C. Hill, S. 2008. ITRC – Improving Regulatory Acceptance for New Approaches to Mine Waste Issues. Proceedings America Society of Mining and Reclamation, 2008 pp 351-357 http://dx.doi.org/10.21000/JASMR08010351

General Accounting Office, National Security and International Affairs Division 1985. Washington, DC.

Lyon, J.S., Hilliard, T. J., and Bethell, T. N. 1993. Burden of Gilt: The legacy of environmental damage from abandoned mines, and what America should do about it, Mineral Policy Center, Washington, DC. 68p

www.itrcweb.org, Interstate Technology and Regulatory Council home page