# FINANCIAL ASSURANCE REVIEW AND EVALUATION FOR THE NORTHMET MINING PROJECT

## PHASE I – TASK 1D REPORT

## Case Studies

Prepared for the Minnesota Department of Natural Resources

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Photo of NorthMet Mining facility, Hoyt Lakes, MN.

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## CAUTIONARY NOTE

The assumptions and analyses in this report were independently generated by Emmons and Olivier Resources Inc. (EOR), Spectrum Engineering and Environmental LLC (Spectrum) and Jardine Lloyd Thompson (JLT) for use by the State of Minnesota in its review of potential financial assurance mechanisms and requirements for the proposed NorthMet project. This report was created solely for government regulatory purposes related to the State of Minnesota's implementation of the financial-assurance requirements of the Minnesota Mineland Reclamation Act, Minn. Stat. § 93.44-93.51, and the Nonferrous Metallic Mineral Mining Rules, Minn. R. ch. 6132. None of the statements or analyses reported herein are made by or on behalf of PolyMet Mining Corp.

This report and the analyses contained herein were not generated by EOR, Spectrum, JLT, the State of Minnesota, or PolyMet Mining Corp. in order to generate mineral resource or mineral reserve estimates under any applicable securities laws.

This independent report is not a National Instrument 43-101 technical report. PolyMet Mining Corp.'s NI 43-101 technical report, last updated on January 14, 2013, is publicly available at: https://www.sec.gov/Archives/edgar/data/866028/000106299313001723/exhibit99-1.htm.

## EXECUTIVE SUMMARY

Financial assurances are a source of funds to be used by the Minnesota Department of Natural Resources (DNR) Commissioner if the mining company permittee fails to perform:

A. Reclamation activities including closure and post-closure maintenance needed if operations cease; and
B. Corrective action as required by the Commissioner if noncompliance with design and operating criteria in the permit to mine occurs.

The purpose of this report is to provide:

1) Case studies of non-ferrous mines with inadequate financial assurance, including an analysis of why they were underfunded, common problems with the financial assurance, and lessons learned;
2) Case studies of non-ferrous mines with financial assurance and factors for long-term compliance, and
3) A summary of federal regulations and other guidelines developed in part in response to past successes and failures in non-ferrous mining.

The major recurring deficiency in the underfunded financial assurances that occurred in the 1990's and early 2000's was not properly accounting for the risks associated with the oxidation of sulfides in the ore, the waste rock, the unmined pit and stope walls, and the mill processing tailings. Many of the original mine permits and financial assurances did not fully recognize the water treatment costs because the causes of the potential contamination were not fully evaluated or were assumed negligible, or because toxic trace metals such as selenium or thallium were overlooked during the permitting and site characterization, only becoming apparent to the regulators after the mine closed. In some instances, the mining companies were aware of the problems, but hid them from the regulators.

Historically, mining exploration sampling and modeling evaluation focused only on the orebody with little or no sampling or modeling of the mining or processing waste. In many cases, existing historic underground mine workings added to the acid rock drainage (ARD) issues, but the potential ARD contribution from these sources was not adequately recognized.

When sulfides are present, there is risk that the long-term ARD issues will be underestimated, eventually leaving the government to choose between paying the financial shortfall or allowing the ARD and other contamination to be released unabated or partially abated. In general, the cost estimates to reclaim and revegetate the land to the standards specified in the regulations and permit were reasonably accurate if the long-term ARD mitigation costs were ignored. When additional costs to prevent and/or capture ARD from waste dumps, mine openings, and tailings facilities were considered, the financial assurances were inadequate.

Some of the bond defaults and bankruptcies occurred due to a combination of low commodity prices occurring during the time frame when ARD or cyanide releases were discovered and the mine permits were being reviewed for future mine expansion. The combination of increased “environmental” liabilities, low commodity prices, and other bad corporate investments resulted in bankruptcies. This problem occurred at Landusky Mine, Zortman Mine, and Gilt Edge Mine.

The cases studied involve financial assurance failures during the late 1990’s and early 2000’s at large surface mines that were permitted and bonded without fully investigating or understanding the geochemistry and long-term water pollution potential. Most of the bankruptcies occurred due to a combination of low metal prices and an increasing awareness of the water pollution liabilities.

Numerous other mines with similar underestimated long-term water quality issues but with financially stable owners eventually adjusted their financial assurances to account for the long-term costs. These operations continue to responsibly maintain the O&M of the closed mines or, in some cases, mines continue to operate but with revised financial assurances that reflect the updated geochemistry knowledge.

The authors could not find any examples of mining companies that went bankrupt or walked away from their responsibilities that were permitted and bonded since the early 2000’s. More recently, financial assurances comprehensively addressed the long-term geochemical issues and costs since more stringent standards for financial assurances and geochemistry evaluation have been initiated. Mines have closed, but the mining companies are responsibly performing their obligations.

# INTRODUCTION

The Minnesota Department of Natural Resources (DNR) is responsible for reviewing the Permit to Mine application for the Poly Met Mining Inc. (PolyMet) NorthMet project, including assessing the project's ability to meet all Permit to Mine requirements. The purpose of the Permit to Mine is to mitigate the possible adverse environmental effects of mining by ensuring orderly construction and development of a mine, sound operational practices, progressive reclamation of mined areas, and long-term protection of the environment. Financial assurance is required to provide adequate funding that the DNR could access in the event that a company abandons a project, fails to properly maintain or reclaim the site, or fails to correct noncompliance.

The purpose of this report is to provide: 1) case studies of non-ferrous mines with inadequate financial assurances, including an analysis of why they were underfunded, common problems with the financial assurance, and lessons learned; 2) factors for long-term compliance and case studies of non-ferrous mines in compliance with financial assurances; and 3) a summary of federal regulations and other guidance developed in part in response to past successes and failures in non-ferrous mining.

The first section describes what financial assurances are and why they are needed for mining permits. The second section describes five case studies with inadequate financial assurance, and identifies the reasons some mining reclamation financial assurances were underfunded or did not perform as anticipated and provides suggestions to avoid these problems with new projects. The third section describes non-ferrous mines currently in compliance and identifies some details of their operation that can be compared and contrasted to other operations. And the fourth section summarizes other regulations and guidelines which have been developed in part in response to past successes and failures in non-ferrous mining.

Much of the information comes from Spectrum Engineering's experience with the Zortman and Landusky gold mines in Montana, where the firm has been managing reclamation and water treatment for Montana DEQ since June 1999, and with the Mike Horse mine cleanup project also in Montana. Spectrum has also been running the water treatment plant at the bankrupt Gilt Edge gold mine in South Dakota for the Environmental Protection Agency (EPA)/Corps of Engineers since 2015 and assumed responsibility for operating the underfunded Kendall gold mine (Montana) water treatment system.

The DNR and PolyMet are aware of the reasons that financial assurances were inadequate for many mines that were permitted before the 2000's. For the NorthMet project the geochemical and geotechnical risks that were often underestimated or overlooked in past projects elsewhere are being thoroughly investigated and addressed. The DNR and EOR will be thoroughly assessing PolyMet's proposed plans and financial assurances. The DNR and EOR will also be evaluating different types of financial assurance vehicles to ensure that there is minimal risk to the State.

# 1. WHAT ARE FINANCIAL ASSURANCES?

Financial assurances are a source of funds to be used by the Minnesota Department of Natural Resources (DNR) Commissioner if the mining company permittee fails to perform:

C. Reclamation activities including closure and post-closure maintenance needed if operations cease; and
D. Corrective action as required by the Commissioner if noncompliance with design and operating criteria in the permit to mine occurs.

Before a mining permit can be granted, Minnesota Administrative Rule 6132.1200, financial assurance, requires the mining company to determine the cost to reclaim the mine and perform post-closure maintenance if operations cease for any reason during the first calendar year of operations. The cost estimate to reclaim the mine following a cease in operations must be updated annually (as required by rule) by the mining company and submitted to the State. Therefore, DNR must look many years ahead to anticipate the value of the financial assurance package needed to perform the required reclamation activities or corrective actions during the entire course of mining production. The mining company must provide satisfactory financial assurances to perform the necessary reclamation activities and corrective actions that must meet the following criteria listed in Minnesota Rule 6132.1200, subpart 5:

A. assurance of funds sufficient to cover the [reclamation and corrective action] costs estimated under [Minnesota Rule 6132.1200] subparts 2 and 3;
B. assurance that the funds will be available and made payable to the commissioner when needed;
C. assurance that the funds will be fully valid, binding, and enforceable under state and federal law;
D. assurance that the funds will not be dischargeable through bankruptcy; and
E. all terms and conditions of the financial assurance must be approved by the DNR Commissioner.

After mining begins, Minnesota Administrative Rules 6132.1200 and 6132.1300 require the mining company to provide an annual report, including a contingency reclamation plan. The contingency reclamation plan must include long-term operation and maintenance to be implemented if operations cease during the upcoming year, and it must provide financial assurance to ensure that there is a source of funds to perform the work if the State assumes the responsibility and must contract a third party to perform the work.

These rules require that the financial assurance plans and costs be revised annually to reflect the liability that will be incurred during the following year. However, the State recognizes that some reclamation activities will require long-term operation and maintenance, so the financial assurances plans and costs must recognize that the liabilities created in the following year will also have costs that extend far into the future.

It is important to note that EPA has indicated they intend to promulgate financial assurance rules for hard rock mining. This may affect financial assurance for this project in the future.

## 2. NON-FERROUS MINES WITH INADEQUATE FINANCIAL ASSURANCE

Five case studies are described in this section to illustrate common past problems and lessons learned for adequately funding financial assurance for non-ferrous mining operations:

1. Zortman & Landusky Mines in Montana
2. Summitville Mine in Colorado
3. Beal Mountain Mine in Montana
4. Gilt Edge Mine in South Dakota
5. CR Kendall Mine in Montana

It should be noted that these case studies involve financial assurance failures during the late 1990's and early 2000's at large surface mines that were permitted and bonded without fully investigating or understanding the geochemistry and long-term water pollution potential. Most of the bankruptcies occurred due to a combination of low metal prices and an increasing awareness of the water pollution liabilities. The authors could not find any examples of bankruptcy in mines that were permitted and bonded since the early 2000's where the financial assurances comprehensively addressed the long-term geochemical issues and costs.

### 2.1. Zortman & Landusky, Montana

**Lessons Learned:**

- Need to better understand both ore and waste rock geochemistry before permitting the mine.
- Need to understand the geochemistry and water balance of historic underground mining.
- Standard engineering contingencies that involve more predictable costs are inadequate to account for the large uncertainty of post-closure treatment costs.
- Surety bonds need to include provision for inflation.
- Surety bonds need to cover all costs plus a contingency. Do not constrain payments to line item estimates.
- Government needs to be first in line for assets if there is a bankruptcy. If the mining equipment that is on site can be used for reclamation, the costs will be lower.
- When default occurs, government needs immediate access to funds.
- Financial losses in related companies can cause even profitable mines to declare bankruptcy.

From 1979 until it filed for bankruptcy in early 1998, Pegasus Gold Corporation, through its subsidiary ZMI, operated two open-pit cyanide heap leach gold mines in the Little Rocky Mountains immediately south of the Fort Belknap Reservation in north-central Montana. The Zortman mine permit includes approximately 406 acres (122 acres Bureau of Land Management, BLM; 284 acres private mining claims), and the Landusky mine permit includes approximately 783 acres (472 acres BLM; 311 acres private mining claims). Extensive underground mining had occurred at both sites prior to the development of the surface mines and has been responsible for significant acid mine drainage.

The Zortman mine is located about 1½ miles east of the much larger Landusky mine. Both mines are located on a mountain divide that separates the Missouri River drainage to the south from the Milk River drainage to the north. The Fort Belknap Reservation boundary is approximately 3 miles north of the Zortman mine and is approximately ¼ mile north of the nearest disturbance at the Landusky mine.

The mines were granted a series of permit amendments that expanded the size of the operations until Pegasus applied for a major permit expansion in 1992, which was eventually not implemented. Discovery of significant acid rock drainage problems at both mines resulted in a need for a major revision of the existing mine reclamation plans and a review of existing bond amounts. It was determined that the proposed 1992 mine expansion would require a detailed analysis through the preparation of an environmental impact statement (EIS).

Between 1993 and 1995, litigation under the federal Clean Water Act was initiated in state and federal courts alleging unpermitted mine discharges to state waters. Settlement discussions resulted in the signing of a Consent Decree between Pegasus, the Montana Department of Environmental Quality (DEQ), the Environmental Protection Agency (EPA), a citizen's group, and the Fort Belknap Tribes, effective in September 1996. The Consent Decree obligated Pegasus to construct water collection systems and water treatment plants, bond for the immediate operation of the water treatment plants, and establish a trust reserve for their long-term operation and maintenance. It also provided for a penalty and required the company to perform ground water, aquatic, and health studies, implement monitoring programs, and provide improvements to drinking water systems on the reservation.

The Consent Decree established temporary water quality standards and obligated the company to obtain Montana Pollution Discharge Elimination System (MPDES) permits for each discharge to state waters based on more stringent water quality standards once the water treatment plants and water discharge capture systems were in place and operational. The Consent Decree did not address surface reclamation of the mines because the decree was a settlement of alleged violations of the Clean Water Act, which did not include jurisdiction over surface reclamation requirements.

The BLM and the DEQ completed an EIS for the proposed mine expansion, which included a revised land reclamation plan, and the agencies issued a Record of Decision approving the expansion in October 1996. The BLM's decision to expand the mine was appealed to the federal Interior Board of Land Appeals (IBLA) by citizen groups and the Fort Belknap Tribes in late 1996. The state's decision to approve the mine expansion was challenged in state court by citizen groups and the Fort Belknap Tribes in early 1997. The IBLA issued an order in June 1997 to stay the mine expansion approval pending further administrative review of the BLM decision. In January 1998, Pegasus and ZMI filed for bankruptcy protection before the IBLA issued a ruling, and in March 1998, the companies announced their decision to not proceed with the mine expansion but to close and reclaim the mines instead. In this case, the bankruptcy could have been primarily motivated by financial losses associated with a project in Australia.

The agencies voided the now-moot 1996 mine expansion decision in June 1998, issued a new Record of Decision, and attempted to increase the surface reclamation bond based on the revised reclamation plan reviewed in the 1996 EIS, acknowledging at that time that the existing bonds were an estimated $8.5 million less than what was needed to implement the agencies' preferred reclamation alternative. Pegasus objected to the BLM's June 1998 selection of reclamation alternatives, which would have increased the bond amount and appealed the decision to the IBLA. The additional bonds were not provided as the bankruptcy actions moved forward. The bonding calculation assumed that the heap leach pads would be detoxified after two pore rinses, which would allow the liners to be punctured to restore normal groundwater drainage, and that reclamation would be limited to grading, top dressing with soil, and revegetation. However, Pegasus had inactive heap leach pads dating back to 1979 and had not punctured the liners on any of these facilities.

In November 1998, the DEQ signed a settlement agreement with Pegasus' sureties, National Union Fire Insurance Company and the United States Fidelity and Guarantee Company, which made available to the state the balance of the unspent reclamation bonds and water treatment bonds required under the previously approved reclamation plan and the Consent Decree. The bond funds available to the DEQ for the Zortman and Landusky mines are as follows:

- $10,024,000 – Zortman reclamation bond.
- $19,600,000 – Landusky reclamation bond.
- $2,040,970 – Construction assurance for water capture and treatment plants (bond was $10,100,000 but Pegasus had built much of the infrastructure).
- $13,895,101 – Water treatment bond for 20-year operation and maintenance (bond was $14,626,422 but Pegasus had paid for 1 of the 20 years prior to settlement). The sureties were required to make 19 equal yearly payments of this amount at a zero interest rate.
- $389,000 – Exploration permit reclamation bond.
- $295,485 – Open-cut mine reclamation bond for an offsite clay pit.

Additionally, the DEQ received $1,050,000 from the bankruptcy court in partial settlement of state claims filed against the assets based on an identified need for additional reclamation. The court directed that $450,000 be designated for reclamation at the Zortman site, with the balance to be used for interim site operations and maintenance at both sites until a reclamation contractor could be retained by DEQ.

In November 1998, the IBLA issued a decision on Fort Belknap's 1996 appeal of the BLM mine expansion decision, and it ordered the BLM to work with the Tribes on the selection of a reclamation alternative for the mines that were considered to have potential impacts on tribal water resources. This action essentially vacated the decisions made under the 1996 EIS, which were based on the company's now-abandoned expansion plans. The BLM was also directed to develop additional information about ground water conditions at the mines.

Since then, the BLM and the DEQ, in consultation with the Fort Belknap Tribes, the EPA, and others, produced a final Supplemental Environmental Impact Statement (SEIS), which was completed in December 2001. In May 2002, the agencies issued a new joint Record of Decision that selected reclamation alternatives for the Zortman and Landusky mines. Because the selected alternatives were dependent on the receipt of an additional $22.5 million in reclamation funds beyond what was available from the mine reclamation bonds, the record of decision also selected a set of less expensive alternatives. The DEQ and the BLM determined that all four alternatives would reclaim the mines in compliance with state and federal reclamation requirements while protecting human health, the environment, and tribal trust resources. Under either choice, the trust fund provided by Pegasus for the long-term maintenance and operation of the water treatment facilities at the mines would be nearly equally inadequate.

Following the May 2002 Record of Decision, the DEQ began reclaiming the two mine sites with reclamation bond settlement funds by performing tasks that were common to the Zortman and

Landusky alternatives. Because mine development was still in progress when the mining terminated, the reclamation plans in the existing mine permit did not reflect conditions as they existed at the sites. Therefore, the reclamation designs that had been the basis of the bonds were discarded and revised plans that were based on input from DEQ regulators, BLM administrators, and other stakeholders were implemented. The reclamation plans that were implemented recognized the limitations of available funding.

Nonetheless, between June and July of 2002, the Fort Belknap Tribes, and three citizen groups filed suits challenging the Record of Decision's authorization to implement the selected less expensive alternative if necessary. Through various cost-saving measures and the procurement of additional reclamation funds, the DEQ has been able to implement most of the components of the preferred reclamation alternatives.

Unfortunately, the implemented reclamation requires long-term capture and treatment to control acid mine drainage from the underground mine openings, waste rock dumps, and leach pads. In addition, site management is required to monitor the stability of waste dumps, leach dump containment structures, and the seepage capture systems.

The treatment plants, land application facility, and capture systems that ZMI passed onto DEQ and BLM when it abandoned the Zortman and Landusky sites have been augmented with:

- A Biological Treatment Plant with reactors to remove selenium, cyanide, and nitrate;
- Four Process Water Ponds and a Clarifier to pre-treat pad water prior to entering the Biological Treatment Plant;
- A Passive Treatment Facility in King Creek;
- A Swift Gulch Water Treatment Plant;
- A Montana Gulch Capture and Pumping System replacing ineffective ZMI systems; and
- A New pump station for Mill Gulch replacing outdated equipment.

The investment in additional infrastructure has been funded by the Bureau of Land Management, American Recovery Act, and grants from the Montana Department of Natural Resources.

The bankrupt Zortman-Landusky Mines in Montana is a particularly useful case study because the bond structure and causes of cost overruns are well documented. Following the operator's bankruptcy in 1998, the state and the BLM took on water treatment using surety funds, but the project became an example of underfunding caused by inadequate initial assumptions in the 1990s and earlier. The funds covering water treatment have failed to cover actual costs in every year since 1999. After year 2017, a $34 million trust fund for perpetual treatment (funded in part by the State's Metalliferous Mines License Tax) will become available. Part of the underfunding problem has been an agreement that allows the surety to make yearly equal payments from the water treatment trusts without inflation or interest adjustments. Key suggestions made by the Montana Bureau Chief Warren McCullough for improved surety funding include:

1. Collect bond amounts as lump sums for placement in interest-bearing accounts, with immediate access by regulatory agencies;
2. Assume cost variability and avoid line-item cost limitations, which can underfund treatment in high-flow years;

3. Anticipate protracted negotiations or litigation and include funds for managing the same; and,
4. Calculate net-present value of perpetual treatment on 100-years of operation.

Besides allowing the sureties to dictate the terms of the bond payments, the bond was inadequate for a number of other reasons, described below:

**Waste Rock Dumps** - In waste rock, water quality degradation arises when atmospheric oxygen encounters sulfide minerals that are wet enough to support oxidation, and the oxidation products, primarily sulfuric acid and soluble metals, leach to surface or groundwater by runoff or percolating pore-water. There is some acid-generating rock that causes water quality problems below the toes of several dumps. ZMI recognized the problematic dumps and constructed capture and pumping systems below the toes of each of these dumps. It is now apparent that long-term water capture and treatment will be required. One of the original capture systems has been replaced with an upgraded system. In addition, water infiltration has caused decomposition of the rock in one of the dumps and a failure of the dump toe (150,000 cubic yards washed away in a 100-year event).

**Lined Heap-Leach Facilities** - Alkaline cyanide leachates used for gold recovery often contains dissolved anions (e.g. arsenic, selenium, molybdenum, antimony, and cyanide) and cyano-metallic complexes (copper, mercury, cadmium, and zinc). Water rinsing to remove contaminants generally fails in cyanide heaps because redox and pH shifts re-solubilize metals and because contaminants slowly diffuse out of fragments.

Because the cyanide ion tends to breakdown at pH below 11, ZMI mixed lime into the ore heaps. While the leach dumps remained in production, the neutralization potential of the lime was gradually consumed. But the leach heaps remained basic until DEQ and BLM took over operation of the site. Due to the residual sulfides that remain in the heaps, many of the Zortman and Landusky heaps have now begun to produce acidic effluent. In order to prevent this effluent from over-topping and escaping the pad liner as additional meteoric water enters the heap, removal and treatment of trapped pad water is required. The frequency of removal depends on the amount of meteoric water that is allowed to infiltrate the heaps. At Zortman and Landusky, soil water balance covers were used. If adequate reclamation funds had been available, heap leach closure would have focused on minimizing water infiltration by the installation of impermeable geosynthetic liner systems. It should also be noted that two of the pad liners have developed leaks, which are being controlled by keeping the containment volume at a minimum. This might indicate that there has been some movement of the material in the heap requiring additional monitoring of the containment dike.

**Water Treatment and Management Costs** - Cost estimates for perpetual post-closure mine water treatment have large degrees of uncertainty. Some of the physical factors affecting actual post-closure costs include geographic scope and nature of the ultimate disturbance, reclamation effectiveness, the concentrations and volume of the effluent, climate variability, climate change, and the nature of effected resources. Reliance on model predictions greatly increases uncertainty, particularly in fracture-flow environments. More generally, future costs are uncertain. Technological innovations could reduce future costs, while external costs (e.g.

changes in energy costs or regulations) could increase future costs. Thus standard engineering contingencies used to estimate mine reclamation costs, which typically involve more predictable costs such as earth moving, are inadequate for accommodating the large uncertainty in estimates of post-closure treatment costs that use predictive models. Given the long-time treatment period, it is also generally appropriate to assume government contracting costs are higher than if mining companies undertake the construction themselves. These uncertainties can be addressed by adding conservative contingency costs to scope, design, and construction estimates. However, a diverse alliance of stakeholders has cause to resist the large financial assurance that adequately covers the large uncertainty in perpetual treatment. For operators, the additional expense complicates project financing; for politicians, operating mines bring jobs and tax revenues; and for insurers, litigation may be less expensive than funding treatment under conditions that were unforeseen when the original policies were created. A partial solution is commitment to periodic refinement of surety bonds using experience gained as the project proceeds (e.g. the State of Montana requires that closure bond estimates be updated annually and reviewed comprehensively every 5 years).

At Zortman and Landusky, the requirements for long-term treatment and management were poorly understood:

- Research into the mechanisms that control seeps and ground water levels at the sites is continuing.
- Using the mine's existing cost experience proved to under value on-going costs. Because ZMI was by far the largest commercial power user, its power usage had a dramatic effect on the base load and local power rates. The loss of ZMI as a customer forced the power company to increase rates to cover its fixed costs, which in turn increased long-term treatment and pumping costs.
- During the bankruptcy, assets were sold at auction. This included patented mining claims inside the mine permit area. Although the site treatment facilities are situated on BLM land, islands of private land inside the site make access control difficult and complicate planning and execution.
- Equipment that could have been used for reclamation was transferred to an operating mine that was allowed to continue to operate.
- Selenium treatment was never anticipated in the two 100 acres leach pads containing selenium and the biological treatment added a $1 million per year cost to the operation and closure cost.
- One drainage system went acid after bankruptcy and a new water treatment plant had to be built post-reclamation.

The yearly amount the water treatment costs exceeded the yearly bond amount of $731,321 for Zortman-Landusky ranged from $307,687 to $2,083,771 between 2004 and 2015. This includes only engineering costs and does not include Montana DEQ costs for overseeing the project. The amount the water treatment costs exceed the yearly bond amount varies significantly from year to year, primarily due to the amount of rainfall. Yearly averages are around 18 inches precipitation per year but, in years like 2011 when the water treatment cost exceeded the yearly bond amount by $2M, the site received over 38 inches of precipitation.

## 2.2. Summitville Mine, Colorado

> **Lessons Learned:**
> - Financial assurance only addressed earthwork and not water or acid rock drainage potential.
> - Need to better understand both ore and waste rock geochemistry before permitting the mine.
> - Need to understand water balance and geochemistry relationships.
> - Need to better understand and account for cost of long-term processing waste geochemistry (leach pad).
> - Water treatment costs exceed earthwork costs.
> - Don't place mine waste on seeps and springs.

The Summitville mine is located in the San Juan Mountain range in Colorado, at an average elevation of 11,500 feet. The mine is situated on 1,440 acres at the headwaters of the Alamosa River. However, only 550 acres were actually disturbed. Most of this area is covered by patented mining claims surrounded by the Rio Grande National Forest. The area was first mined in the 1870's when placer miners were attracted to deposits in Cropsy Creek and Wightman Fork. Underground mining of the gold bearing quartz veins dominated the area from 1873 through 1940, so some of the problems associated with the modern mining were exacerbated due to historic mining and milling and a drain tunnel driven under the orebody.

Following an aggressive drilling program, Galactic Resources Limited (GRL), a Canadian Corporation, set about acquiring mining rights in Colorado's historic Summitville mining district by leasing land from the Forest Service and private property owners. In 1984, GRL completed additional drilling, formed a local subsidiary, Summitville Consolidated Mining Company Inc. (SCMCI), and obtained a permit for a "limited impact" test pit and heap leach. The test project, which was limited to less than 70,000 tons of total excavation, was completed in the summer and fall of 1984.

Thereafter, GRL obtained a mine permit for the full scale open pit and heap leach operation in October 1984, which required posting a $4.7 million reclamation bond. Colorado's Mined Land Reclamation Board (MLRB) reviewed the permit submission and approved the mine permit 56 days after the submittal of the application. Approval was granted prior to the expiration of the 20-day public comment period.

Construction of the full-scale mine commenced in 1985 and was completed during the summer of 1986. During the winter construction period, the heap leach liner system was damaged by avalanches. Mining and leaching operations began on June 5, 1986, before the leach pad liner was fully constructed. Six days after commencing operations, the mining company reported that the leak detection system between the upper and lower liners had detected a small amount of cyanide solution. However, the presence of the solution was explained as the result of overspray to the leach pad and could be controlled through the use of better spraying practices. Later in June after the pad had been fully loaded with ore, an official from the Division of Minerals and Geology (DMG) inspected the site and determined that the cyanide detected below the liner was actually the result of leaks in the liner pad.

As a result of this inspection, GRL installed a sump pump system to trap the leaking solution and pump it back into the heap. However, this measure proved inadequate as nine cyanide spills were reported during the summer of 1987. Over 85,000 gallons of contaminated fluids flowed into Cropsy Creek. Following this discharge, GRL was required to apply for a discharge permit from the

Colorado Water Quality Control Division (CWQCD). The permit requirements included implementation of the Best Available Technology to meet strict water quality standards. Although GRL installed a treatment system, the system was unable to meet the high standards imposed by the permit. Hence, waste fluids could not be discharged, requiring storage in the leach pad until another solution could be implemented.

GRL then attempted to dispose of the pad water by land application. It obtained approval from MLRB for a 17-acre land application site. However, the soils at the site were not adequately studied and landowner permission could not be obtained for the entire area. The actual application area was reduced to less than 6 acres with clayey soils lying just below the surface. When GRL began spraying, the pad water began running off the land into Wightman Fork, which earned GRL a second violation for unpermitted discharge.

In 1991, MLRB and CWQCD issued notices of violation to GRL/SCMCI for discharges, acid drainage from the waste rock dump, and the leach pad liner leaks. Fines totaling $100,000 were assessed. In July 1992, the parties agreed to increase the reclamation bond by $5 million.

On December 1, 1992 GRL/SCMCI notified the State of its intention to file for Chapter VII bankruptcy because it lacked the financial ability to continue operations at the Summitville Mine after December 15, 1992. On the previous day, the mine operator had delivered an application to revise their reclamation plan to MLRB and DMG. The revision included cost estimates ranging from $20.6 and $38.6 million for amended reclamation plans. GRL/SCMCI filed its petition with the federal bankruptcy court in Denver on the afternoon of December 3, 1992. GRL/SCMCI's bond for the mine stood at $4,718,310 at the time the company filed bankruptcy.

Even though the Summitville mine had produced a reported 249,000 troy ounces of gold with a market value of only about $81 million, the company's December 4, 1992 U.S. bankruptcy petition reported a net operating loss of approximately $85 million. Complemented by equally unprofitable involvements in the Ridgeway (South Carolina) and Ivanhoe (Nevada) gold mines, Galactic Resources Limited of Vancouver, Canada, SCMCI's parent, reported a combined net operating loss of $297 million in its January 21, 1993 Canadian bankruptcy petition.

On December 4, of 1992, the State of Colorado requested the aid of the Environmental Protection Agency. After immediately addressing leach pad overflow issues, the U.S. Environmental Protection Agency (EPA) began evaluating the site. A two part plan was developed to control AMD from the most significant sources. The first part was initiated immediately to control AMD being released from the Site. This part focused on improving the efficiency of the water treatment facilities and controlling the AMD discharges from the mine drainage adits by plugging the Reynolds and Chandler adits.

The second part of the plan focused on reducing the AMD generated from mine waste piles and areas disturbed by mining. A lined and capped repository was located in the mine pits for AMD generating waste rock. Revegetation was determined to be the preferred alternative to address these sources of contamination.

The EPA's clean-up action consisted of three phases:

- Phase I, which was completed during the 1993 construction season, involved lining the mine pit with pH neutralizing material and moving 1 million cubic yards of waste into the pit.
- Phase II, which was completed during the 1994 construction season, involved moving another 3.5 million cubic yards of waste into the mine pit and contouring the pits so they are free draining.
- Phase III, which was completed during the 1995 construction season, involved placing a vegetative cap on the mine pits and revegetation of the former Cropsy Waste Pile, Beaver Mud Dump, and Cleveland Cliffs Tailings Pond.

Seven years after the Summitville mine was permitted in 1985, the heap leach system overflowed, destroying all biological life in a 17-mile stretch of the Alamosa River. Almost 300 million gallons of contaminated water were captured for treatment in 2005. However, according to a 2005 EPA Summitville update, the mine continues to discharge contaminated water due to limited storage and treatment capacity. An estimated 65 million gallons of untreated water were released into the Wrightman Fork in 2005, and flows of contaminated water to the Alamosa River caused violations of water standards on a regular basis. According to the EPA, about $210 million in public funds have been spent so far.

The original permit required a reclamation bond of $1,304,509, to cover costs for surface grading and shaping, clay caps on waste rock and heap residue, and revegetation. Reclamation law at the time did not establish bonding authority for water treatment or heap detoxification. In 1989, an additional surety bond of $913,801 was required by the MLRB, which included costs for a one-time detoxification rinse. The bond still excluded cost for water treatment. As problems mounted, the Board became suspicious that significant modifications would be required in the reclamation plan and requested an additional $5,000,000 bond. Upon the completion of site grading and commenced operation of a Portable Interim Treatment System in November 1992, SCMCI gained release of $2,500,000 of the bond. However, at that time, the financial warranty consisted of little more than a written promise by the mine operator to take responsibility for limited reclamation costs along with proof of financial responsibility.

According to EPA Denver, in addition to the cyanide gold leach pad leaking and sulfides being placed in the leach pad, there was no attention paid to the characterization of the sulfides in the waste rock or the water balance/water management or historic mine workings. The potential for acid rock drainage (ARD) was initially dismissed because the orebody was supposedly already oxidized, and thus it was claimed that there was no ARD generating potential. This was wrong, as both the ore and waste were acid generating. Waste rock was placed haphazardly around the site including on top of a spring. The mine assumed net evaporation from the site, but the wrong climate data was apparently used, thus hugely underestimating the amount of water needed to be treated.

The open pit funneled water that previously ran off, down into and through the fractured orebody into a drain tunnel a few hundred feet below the pit bottom. This significantly increased the oxidation within the unmined orebody below, increasing the flow and metal concentration from the historic Reynolds drain adit. If a thorough investigation of the geochemistry, historic mining activities, and climate had been completed prior to the permitting, it is unlikely that the project would have been considered economically feasible or that the regulators would have approved the permit. In addition to the lack of proper study before opening the mine, the new heap leach pad immediately leaked. Even though it was leaking, the mine claimed it wasn't and so continued to pile ore onto the top. The initial bonding only included earthwork and didn't include the water tretment costs nor the taskes required to mitigate the ARD. Due to the extreme elevation and weather, the project apparently lost money.

## 2.3. Beal Mountain Mine, Montana

The Beal Mountain Mine was developed in 1989 and operated for nine years before the owner, Pegasus Gold Corporation of Canada, filed for bankruptcy in 1998. The gold ore was mined from an open pit and processed by heap-leach using a cyanide-based solution to dissolve the gold out of the ore. Pegasus had extracted 14 tons of gold in nine years of operation. Ore mining had stopped prior to the bankruptcy, but Pegasus was still recovering and processing pregnant solution from the heap when it went into bankruptcy and abandoned the site.

Although selenium began showing up in German Gulch surface water by 1993, the regulators underestimated the potential for water contamination and financial assurance requirements. A $6.3 million surety bond had been posted to cover reclamation liabilities.

**Lessons Learned:**

- Financial assurance only addressed earthwork and not water or acid rock drainage.
- Mine bankruptcy may be the result of Corporation's financial losses somewhere els.
- Need to understand both ore and waste rock geochemistry (selenium) before permit is issued.
- Need to understand water balance and geochemistry relationships. Consider need to cap waste rock and processing waste piles.
- Need to better understand and account for cost of long-term processing waste geochemistry.
- Water treatment costs exceed earthwork costs.
- Don't place mine waste on seeps and springs.
- Need to understand mine stability. Pit high walls are failing and may damage other waste facilities.

Because the U.S. Forest Service owned most of the mine-impacted land, it took over the site and assumed control of the cleanup. As the primary responsible party, the USFS declared its intention to address the site under CERCLA provisions. Among other things, this action essentially voided the need for MPDES water quality discharge permits under the Clean Water Act and provided the agency with some flexibility regarding how, when, and, in some cases, to what extent the agencies must comply with state and federal water quality standards. The mine operating permits were also canceled.

The unfunded financial assurances issues are described in the March 2010 EIS:

> T*he USDA-FS goal for the site is to close the mine and allow the area to return to its multiple use state. Although portions of the mine property were reclaimed, there are several on-going operational, maintenance, and reclamation requirements that need to be met for specific facilities before final closures are complete. There are also several significant and outstanding issues that potentially impact the environment that need to be addressed. These issues include:*

1. *The long-term geochemical reactivity of mine wastes (including both acidity and the release of selenium to the environment from several potential mine sources.*
2. *Geotechnical stability of the pit high-wall and leach pad containment dike.*
3. *Public safety issues related to the pit high-wall.*
4. *Infiltration of precipitation and groundwater into the leach pad and waste rock dump.*
5. *Treatment and disposal of heap leach solution.*
6. *Mitigation of impacts to surface water in German Gulch and other nearby drainages.*
7. *Impacts to seeps and springs in the vicinity of the Beal Mountain Mine area.*

> *Mine wastes present at the Beal Mountain Mine site are associated with certain mine facilities including: two reclaimed open pits; reclaimed ore crushing and processing facilities; a partially reclaimed waste rock dump; waste rock used in the construction of roads and leach pad containment dikes; a reclaimed heap leach pad; and, areas that have been impacted by Land Application Disposal (LAD) of mine solutions.*

There have been major reclamation cost overruns due to the presence of a previously unsuspected treatment-resistant cyanide compound (thiocyanate) in 155 million gallons of solution still contained within the heap at mine closure. So far, the Forest Service and the State of Montana have spent between $14 million and $15 million for reclamation on Beal Mountain. The overrun is mostly associated with long-term water treatment. Although site water quality shows signs of recovering, German Gulch Creek remains unsuitable for aquatic life and for drinking water. The agency estimates it could take another $39 million to fully restore the land for public use.

The heap was capped in an attempt to restrict, or at least limit, the infiltration of precipitation. The cyanide leaching solution in the heap was emptied, treated, and land applied, with some resulting unanticipated impacts on ground and surface water. Unfortunately, the lined heap continued to take in as much as 32 million gallons of water per year. Water that continues to infiltrate into the leach pad is pumped out and filtered at a reverse osmosis treatment plant. The "reject" material is being put back into the pad. Fixes to the liner are expected to eventually reduce water intake.

Water quality monitoring continues to be conducted at 21 surface water and spring stations, six groundwater locations and two leach pad sumps. Long-term treatment of selenium in water from contact with waste material and natural bedrock may be a problem. Work at the site also includes restoration of lands disturbed by old mining activities.

The Pegasus Gold Corporation bankruptcy was primarily motivated by huge financial losses associated with a project in Australia. Because cash flow at Beal Mountain was in the process of turning negative as gold production was coming to an end, there was no incentive to do anything except shut this operation down. A reclamation bond that had been approved by Montana DEQ was in place as surety bond. The surety released these funds as proofs of actual expenditures were submitted. The bond proved inadequate because the leach pad chemistry did not behave as predicted, requiring long-term treatment, and because the waste rock leached selenium. Contingencies designed to cover these real-life uncertainties had not been required.

## 2.4. Gilt Edge Mine, South Dakota

**Lessons Learned:**

- Need to better understand both ore and waste rock geochemistry before permitting the mine.
- Only the earthwork was bonded. Water treatment not bonded but exceeds earthwork cost.
- Self-bonding is not sufficient, because corporate financials can rapidly change.
- SD DNR recommends adding at least 25% to cost estimate for unforeseen contingencies. This can be reduced later based on actual experience.
- Bonding must include some form of tangible money. Use the operating cash flow to reduce the bond.
- Include government administration, engineering, supervision, profit and contingency in financial assurance.
- Include allowance for cost inflation.

The 360-acre Gilt Edge Mine site is located about 6.5 miles east of Lead, South Dakota. Mining and mineral processing at the site began in 1876 when the Gilt Edge and Dakota Maid mining claims were located. Sporadic underground mining by numerous operators took place at the site until the early 1920s. Early gold miners developed extensive underground workings that wind through the central portion of the site and also engaged in some surface mining as well. From 1935 to 1941, the mines at the site were in steady production and the underground workings were expanded. Beginning in 1976, an extensive mine development program investigated potential open pit heap leaching of gold or other minerals. In 1986, Brohm Mining Company (BMC) commenced development of a large-scale open pit, cyanide heap leach gold mine operation. BMC abandoned the site in July 1999, leaving about 150 million gallons of acidic heavy-metal-laden water in three open pits, as well as millions of cubic yards of acid-generating waste rock.

Mike Sepak with the South Dakota DNR (605-773-5418) summarized the deficiencies and lessons learned as:

1. There were insufficient geochemical investigations of the ore and waste, so the acid rock drainage (ARD) issues were not recognized and not part of the original financial assurance. Similar to the representations made at Summitville, Brohm assumed that, because the ore was oxidized, there would be no ARD. Not conducting geochemical investigations was a big mistake.
2. The initial bonding was too small because it only addressed earthwork, and did not include any water chemistry or water treatment issues, or any additional earthwork or capping to deal with ARD issues.
3. By the time the ARD problems were recognized, the mining company did not have sufficient cash flow to qualify for third party financial assurances. Concurrently, the mine was applying to expand the permit to open the new Anchor Hill Pit. The first phase would be on private land, but the second phase would involve USFS land. The economics were favorable, so the South Dakota DNR approved Phase 1 allowing the mining company to generate the cash flow to build a water treatment plant and to begin to regrade the waste rock dump. This was self-bonded, with the bond increasing from $1.2 to $6 Million. The USFS denied the phase 2 expansion, forcing Brohm into bankruptcy. If the USFS had granted Brohm the phase 2 permit, it is likely that additional cash would have been generated to perform additional mitigation, but it would probably not have been sufficient to cover all the costs.

The U.S. Environmental Protection Agency (EPA) assumed the responsibility for the site. This added considerably to the cost, since the EPA's procedures are so rigorous. Presently, the EPA subcontracts the U.S. Army Corps of Engineers (USACE), who manages the site contractor with South Dakota DNR oversight, adding a considerable amount of overhead to the direct costs.

## 2.5. CR Kendall Mine, Montana

**Lessons Learned:**

- The thallium problem was not discovered until after active mining ceased.
- Water contamination problems were detected by post-mine operations monitoring.
- Attempting to increase reclamation bonds after or near the end of ore production can be problematic and could cause the mine operator to consider other alternatives.
- Mine operators may not have the resources to provide long-term treatment.
- If the bond fails to include an adequate contingency fund, the State will become the fallback surety of the project by default.

The 1,040-acre CR Kendall Mine is located in the North Moccasin Mountains north of Lewistown, Montana. This hardrock gold mine began in about 1880 and continued until 1942. Modern mining processes were initiated by Triad Investments in 1981 under a small miner permit and later an operating permit in 1984. The mine used open-pit mining methods and cyanide heap-leaching to extract gold from the ore, and was fully active until 1995. Although most of the mine has now been reclaimed and is currently in closure status, contaminated water containing elevated levels of arsenic, antimony, selenium, thallium, nitrate and cyanide is still being captured and treated by the mine operator. Zeolite adsorption is used to remove thallium. Antimony, selenium and nitrate are diluted with fresh water to below state standards.

Due to concerns about water quality impacts and long-term water treatment, Montana DEQ recently decided to institute additional reclamation requirements that would require the site trustee to install a system that would pre-treat contaminated water draining from the process pads before it is mixed with other mine drainage waters. The mixed water would be pumped back through the thallium treatment system. Pre-treatment would remove arsenic. The selection of this final closure plan was supported by an April 2016 EIS, which was the final step in a process that started in July 2012 when ATNA Resources, the mining company, submitted an amended plan for final water management and treatment.

Unfortunately, the selection of this final closure alternation has come too late. On Nov. 18, 2015 Atna Resources filed for bankruptcy, claiming to have only $200,000 cash on hand. Atna cited several reasons for the company's troubles, including low gold prices in 2015, the continued indifference in the market for gold company equities, a lack of capital in the mining sector, a lack of development capital and operating issues resulting in a significant shortfall in third-quarter gold production at the Pinson mine, and a depressed market for the sale of idled mining equipment. Atna recently informed DEQ that it will be forced to abandon all operations at the CR Kendall mine and turn over water treatment responsibilities to the State sometime in the fall of 2016.

The original CR Kendall mine permit was issued to Triad Investments on September 14, 1984 and only covered a 119 acre permit area. Following a bankruptcy, the mine and the permit were acquired by Canyon Resources. Canyon merged with Atna in 2008. On July 25, 2012, CR Kendall submitted permit amendment application proposing the following:

1. Amended closure plan for the final design of water management and treatment,
2. Final capping and reseeding of the former process pads, and
3. Long-term reclamation monitoring and maintenance.

On March 16, 2015, DEQ issued a draft permit amendment and succeeded in increasing the surety bond covering water treatment and reclamation to $2.4 million.

DEQ issued a Draft EIS on September 10, 2015, that analyzed:

- The effects of mine closure on surface water and groundwater quantity and quality; and
- The effects of mine closure on soils and reclamation including excessive infiltration through the cover systems and salt accumulation on leach pads due to the application of reverse osmosis (RO) brine.

The specific changes to the existing treatment systems were described in the FEIS as follows. A separate piping system would collect the drainage water from process pads 3 and 4 for pretreatment prior to blending the drainage water with other mine waters. Arsenic is one of the contaminants in the process pad drainage water, and is exceeding groundwater standards even after the drainage water and captured groundwater are combined. The pre-treatment system will remove arsenic and other contaminants, if necessary to comply with discharge criteria. The likely pre-treatment system would involve the oxidation and adsorption of arsenic onto an adsorbent compound (ferric chloride, iron filings, or other). The pre-treatment process would most likely be developed specifically for the CR Kendall process pad drainage water to effectively remove arsenic. After pre-treatment, the water would be combined with the other captured groundwater for thallium removal through the current method of zeolite adsorption. Treated water would be discharged to groundwater through the Kendall Pit. New water treatment equipment would be required to pre-treat the process pad drainage water. The annual average flow rate after installing the current process pads caps (2009 to 2014) ranged from 11.3 gallons per minute (gpm) to 20.5 gpm, with an average rate of 13.7 gpm. Possible disposal options for the contaminated media could include: (1) shipping it back to the manufacturer when exhausted; (2) shipping it offsite for disposal; or (3) burying it onsite if confirmed as non-hazardous.

The spent zeolites are currently stored in super sacks and will be ultimately disposed of in Pond 7. Testing has revealed that virtually none of the thallium goes back into solution once sequestered onto the zeolite medium.

## 2.6. Common Problems & Lessons Learned

This section attempts to identify the reasons some mining reclamation financial assurances were underfunded or did not perform as anticipated, and provides lessons learned. These reasons can be grouped into nine common problems, which are described in the following section:

1. Underestimating the administrative costs
2. Overlooking a major cost component
3. Financial strength and self-bonding
4. Underestimating the required level of effort
5. Underestimating the long-term chemistry or water quantity
6. Achieving water discharge standards
7. Achieving performance criteria
8. Surety company maneuvering
9. Bankruptcy

### 2.6.1. Underestimating the Administrative Costs

The cost to perform the project management, reclamation and long-term water collection and treatment will be greater if a government agency or agencies must take over the responsibility, hire consultants, and manage contractors to perform the work. In addition, a new federal or state EIS might need to be conducted. In general, if government must assume responsibility for the costs and operation, the costs will increase due to additional oversight, inefficiency, smaller reclamation equipment, mark-ups, and third party profit.

This inefficiency is exacerbated if multiple agencies or sub-agencies become involved in the management and oversight of the work. Spectrum is presently working on the Mike Horse Mine cleanup and operation and maintenance for the Montana Department of Environmental Quality and has observed the conflicts and inefficiencies that can occur when three government entities have the authority and responsibility to perform different components of the work. Spectrum is also working for the Montana DEQ on the Zortman & Landusky project, which is more efficiently managed by a single entity.

**Lesson Learned:** Mining projects should have a contingency plan that defines how the project will be efficiently managed if the mining company defaults. The responsibilities include managing the finance, accounting, engineering, environmental monitoring, construction, and long-term operation and maintenance.

### 2.6.2. Overlooking a Major Cost Component

In the 1990's, it was assumed that cyanide heap leach pads in gold mines could be reclaimed to a walk-away condition by oxidizing the cyanide and then rinsing the pad with a couple of pore volumes of clean water. This was a mistake. It was also wrongly assumed by the mining companies and the regulators that oxidized ore bodies would not generate acid rock drainage (ARD), because the sulfides were already oxidized. Nobody during the gold rush in the 1980's bothered to verify this assumption, which is the dominant cause of many of the infamous financial assurance debacles that involve gold mines.

In the case of the Landusky leach pads, it was assumed that, after two pore rinses, the liners could be punctured with no water quality issues. In hind sight, that was an error resulting in more than $1,000,000 per year in unanticipated water treatment costs. In addition to the ARD issues, the leach pads were subsequently found to contain high concentrations of selenium and nitrate that violated water chemistry standards. Other mines have been found to be producing other toxic trace metals such as thallium and arsenic that were not recognized until after the mining ended.

A typical underfunding has occurred when the initial reclamation budget only involved re-sloping and revegetating dumps and stockpiles, but did not consider long-term water management or the possibility of ARD. At Questa and Zortman, the ARD in the rock converted boulders into sand and clay, resulting in slope stability issues. At Zortman, a portion of the dump failed, destroying the ARD capture system. Another contributing factor was building cross slope drainages that also failed.

**Lesson learned:** The entire mineral makeup of the ore and waste rock should be understood, and to ensure that any type of stipulated special material segregation and handling is properly performed and verified.

### 2.6.3. Financial Strength and Self Bonding

Many of the bankruptcies involved small or junior mining companies without "deep pockets". So, when the commodity price slumped or additional financial assurances were demanded, the company could not maintain cash flow, and could not secure outside financial assurances after the fact. In most cases, neither party understood the true future environmental damage potential nor the cost to mitigate the problem because the regulators did not insist on geochemical sampling and evaluations. The magnitude of the problems was not recognized by the regulators until after the damage was done, and by then it was too late. If the actual cost of the reclamation and water treatment were recognized and factored into the mine economics, some of these projects may never have been started.

Given the bankruptcies of major mining companies in the 1990s and early 2000s due to market volume and price fluctuations, and given how fast fortunes can change, most states now prohibit self-bonding and require cash, letters of credit or some type of surety. Pegasus was forced into bankruptcy due to a bad investment in Australia. Many of the individual mines remained economically viable, but the parent corporation declared bankruptcy due to an inability to make debt payments on bad investments elsewhere.

**Lesson learned:** Self-bonding can be risky because the financial strength of a mining company is influenced not only by the financial strength of the local mining project, but all of the projects of the mining company.

### 2.6.4. Underestimating the Required Level of Effort

If the plan was originally to move X tons of material Y feet, but due to changes in the plans or timing, 2X tons must be moved 2Y feet, cost will change. As the value of commodities change, the mine plan may change. This can change both the quantities and the distances, and affect the timing and the cost.

**Lesson learned:** Reclamation costs should be recomputed annually to account for changes in the plans or timing of operation.

### 2.6.5. Underestimating the Long-Term Chemistry or Water Quantity

Many mines have experienced acid rock drainage chemistry changing faster and more than predicted by geochemical theory. This has a material effect on the cost of water treatment and is not easy to predict.

#### Not recognizing issues that develop later

Unrecognized issues that develop later may have been unknown by the regulators, such as the placement of sulfides in non-sulfide stockpiles or waste dumps, or relying on Acid/Base accounting logic that does not always work as hoped. For example, at the Mike Horse Mine (Montana), the host rock is a calcareous mudstone. The natural background water is about 8.4 pH. The acid/base accounting is basic, yet at a micro scale, the pyrite oxidizes, drops the pH, and dissolves lead, zinc, copper, cadmium, iron, aluminum, and arsenic. On a macro scale, the acidic water is buffered back to neutral or basic, yet contains high levels of sulfates and metals. Average sulfide concentrations in a stockpile cannot be used to predict acid rock drainage (ARD) potential. If veinlets or blebs of sulfides exist in the waste rock, then there is a high likelihood that ARD will become an issue, even if the host rock is basic or the average sulfide concentration is very low.

#### Underestimating the water quantity

Fluctuations in the annual or long-term precipitation may affect the water quantity and chemistry. Local precipitation variances due to climate change could increase or decrease the precipitation and change the water balance. The potential variation in water quantity that must be captured and treated needs to be considered. Miscalculating the water balance was one of the big problems at Summitville. At Landusky, the recent precipitation is double the long-term average, with four 100-year events in a single decade. In hind sight, impermeable liners on the dumps and leach pads would have been more effective than water balance covers.

The change in the water quantity may change the water chemistry if more water passes through a cover then envisioned in the design. In some instances, the metal concentrations increase when the amount of water increases and flushes out the salts, but sometimes the reverse is true due to dilution. The amount of water leaking from a bentonite-lined tailings pond might change depending on the efficacy of the bentonite seal and the effect the water chemistry has on the ability of bentonite to create a seal. Vegetation/root penetration may also change the efficacy of the seal, especially if the post reclamation water elevation fluctuates.

**Lesson learned:** The project geochemistry should be thoroughly understood, and how those materials react at different scales and under different water conditions.

### 2.6.6. Achieving Water Discharge Standards

The water collection and treatment system must be designed with certain capacities, and input chemistry assumptions and output standards in mind. Averages are not recommended, since at least half the time the system will underperform. At Zortman & Landusky, the average amount of water collected and treated each year has doubled since the water treatment plants were designed. As a result, during certain peak events, contaminated water must be released because there is no funding available to increase the treatment or storage capacity. The issue of what discharge chemistry standards should be applied to peak water years or events that exceed the design capacity of the system is critical. If water collection and treatment will be needed for a long time, an underestimation can rapidly consume the financial assurance unless it is acceptable to periodically, seasonally, or potentially perpetually discharge contaminated water because the system is under designed and underfunded.

**Lesson learned:** The effectiveness of treatment systems designs should be considered for peak events and events that exceed the design capacity of the system, not just average events.

### 2.6.7. Achieving Performance Criteria

Water and air quality performance criteria need to be well defined. Due to dilution and mixing, the measuring point locations can have a material influence on the concentrations measured. The cost of water treatment can be very sensitive to the required water chemistry at the discharge point before any mixing takes place. Depending on the treatment technology used, the incremental cost to remove the last 10% or 20% of the contaminant can be higher than the cost to remove the initial 80%. The practicality of achieving different discharge concentrations should be addressed as part of the permit and the financial assurance computation logic.

Since it typically takes several years for water chemistry from the tailings, waste piles, etc. to stabilize, the water treatment system may need to constantly change to address the new concentrations or quantities that develop after closure. At Zortman & Landusky, it took several years after mining stopped for the acid rock drainage to reach peak concentrations. In addition to the pH and metal concentration issues, Zortman & Landusky experienced four 100-year rainfall events in one decade, thus increasing the total volume of water captured at peak flows and as annual averages. Climate change is confusing the ability to estimate water balances. If a closure requires inundation based on an assumed water balance, then the financial assurance must address the consequences of a wetter or drier climate, and fund the most expensive case.

**Lesson learned:** Water and air quality performance criteria should be well defined, and the cost to achieve the required discharge concentrations should be based on expected concentrations at the discharge point before any mixing takes place.

### 2.6.8. Surety Company Maneuvering

At Zortman & Landusky, the bonding computations assumed a constant annual operation and maintenance cost into perpetuity for some of the cost components. The unwritten assumption was that the fund would accrue interest and grow to cover inflation. However, rather than giving the total bonded amount to the Montana DEQ where the money could be placed in an investment account, the surety is only doling out the annual constant uninflated payment to the DEQ. There is no allowance for inflation, so the amount of work achievable with the funding is shrinking every year.

Other than the issues related to the sulfides in the leach pads, the grand total estimated amount of the reclamation and O&M cost for Zortman & Landusky that was bonded was reasonable, but the amount of each individual cost element was not accurate. Some elements were overestimated and some underestimated. The estimating errors tended to offset each other in aggregate. However, rather than paying the total estimated annual cost, the surety is allowed to pay only the initially estimated amount for the cost elements that were underestimated, but only pay the bonded cost for the cost elements that were overestimated. This is a problem.

In cases where acid rock drainage and other long-term reclamation costs are identified before mining and processing begins, there are engineering/cost tradeoffs that need to be addressed. The tradeoff generally involves operating and designing the system to avoid or minimize future long-term costs but paying more up front, or minimizing the short-term costs by deferring the mitigation costs into the future, even if it might cost more in the future. Net present value theory teaches that deferring the costs is more economical unless the cost of the deferment (financial assurance) is placed in some type of fund before the cash flow from operations is realized.

In some cases, if the company must book the negative cash flow for reclamation and other mitigation up front, a marginal project will become uneconomical. This cost can be reduced if a reputable third party is willing to guarantee the financial assurance via some type of letter of credit or surety. Then the mining company can use cash flow from operations to build a cash (or cash equivalent) account to reduce the third party assurance. At some predetermined time, well before the predicted end of the permit life, the cash account should be fully funded, and revised up or down as needed to reflect actual experience. The management of this account needs to be determined. It may only be between the surety and the mining company, so if there is a default, then the surety has the option of doing the work or passing the funding to the State. The mechanism for reimbursing the state needs to be established up front. It is best if all the money is immediately given to the state, but most sureties will want to keep the money and distribute it annually.

Items that might fall into this type of consideration include whether wet tailings storage should be used versus drying and compacting the tailings or whether liners and water capture systems should be installed before mine or mill tailings waste is placed on the ground.

**Lesson learned:** Financial assurance should include inflation adjustments and also ensure that that the individual cost components cannot be micromanaged and manipulated to avoid liability.

### 2.6.9. Bankruptcy

When Pegasus declared bankruptcy, the State of Montana did not have any title to the water treatment plants, roads, or land, and had to purchase the property from the bankruptcy trustee.

**Lesson learned:** Some legal provision or lien must be placed mining company's assets, facilities, mining equipment, and land so that the title to everything required for reclamation and long-term operation and maintenance can be transferred to the State or a Trust if there is a bankruptcy. These assets can then be retained and used by the State until all the reclamation liabilities have been resolved to the State's satisfaction.

# 3. NON-FERROUS MINES WITH FINANCIAL ASSURANCE

While there are some mines that were permitted and bonded prior to the 2000s with inadequate financial assurances, there are examples of currently compliant non-ferrous mines. The Flambeau and Ridgeway Mines were described in detail in the March 2013 report *Successful Non-ferrous Mine Sites – Flambeau and Ridgeway* prepared by Foth Infrastructure & Environment, LLC for Poly Met Mining, Inc. The case studies include:

- Flambeau Mine from the Wisconsin DNR (WI DNR),
- Ridgeway Mine from South Carolina Department of Health & Environmental Control (SCDHEC),
- Conda Mine from the Idaho Department of Environmental Quality (IDEQ), and
- Round Mountain Gold Mine from the Bureau of Regulation and Reclamation.

The discussion below includes: facility's status, compliance's status, financial assurance mechanism used, and anticipated long-term water treatment needs. None of these entities has become bankrupt. All continue to be maintained by large responsible parent companies.

## 3.1. Flambeau Mine, Wisconsin

The Flambeau Mining Company was issued a Mining Permit to extract metallic sulfide from a site along the Flambeau River just south of the City of Ladysmith. The Flambeau Mine was in operation from 1993 until 1997 and produced 181,000 tons of copper, 3.3 million ounces of silver, and 334,000 ounces of gold from a 181 acre site. Beginning in 1997, the mine pit was backfilled with waste rock, 30,000 tons of limestone (to neutralize potential acid production), and contoured with a vegetated soil cover.

At no time during their operation or after closure has the Flambeau Mine been cited by WI DNR as being in violation of the conditions of their Mining Permit. The Flambeau Mine was issued a Wisconsin Pollution Discharge Elimination System (WPDES) permit with their Mining Permit limiting their surface discharge and establishing effluent limits. The permit was allowed to expire in 1998 after the wastewater treatment plant was disassembled. At no time did Flambeau exceed their permitted effluent limits for any parameter. However, there has been some legal dispute over traces of copper found in stormwater runoff from a portion of the mine site after mining activity had ceased. The district court ruled that copper was discharged from the site, but imposed only a modest penalty due to the small amount of copper discharged. Since the March 2013 Foth Report, the district court ruling was reversed by the US Court of Appeals for the Seventh Circuit.

During their operation, Flambeau posted a performance bond in the amount of 11 million dollars to cover the State's cost of reclamation should the corporation declare bankruptcy. They also maintained a 1 million dollar letter of credit for their long-term care responsibilities. After issuance of the Certificate of Completion, the reclamation bond was reduced to 20% of the initial reclamation bond (again submitted as a performance bond) and the long-term care was also resubmitted as a performance bond in the amount of 3.1 million dollars. The WI DNR currently holds both bonds, payable to the WI DNR.

At this point, long-term water treatment is not anticipated at Flambeau as it has been demonstrated that the backfilled pit should not cause any measurable adverse impacts to the Flambeau River. The Flambeau River is ~150 feet from the mine but separated by two curtain walls. Groundwater monitoring and modeling will be performed long-term to confirm compliance.

### 3.2. Ridgeway Mine, South Carolina

The Kennecott Mining Company (KRMC) Ridgeway Gold Mine ended production operations in November 1999. The reserve has been extracted and the site permanently closed. Currently KRMC is in year nine of the "Interim Reclamation" period. Interim Reclamation is defined by KRMC and recognized by South Carolina Department of Health & Environmental Control (SCDHEC) as the period during which site vegetation develops, water quality and groundwater recharge are monitored, and the two pit lakes develop to a surface elevation leading to discharge into an unnamed tributary of Bear Creek. In conjunction with development of two pit lakes, KRMC operates and maintains six storm water collection ponds and a network of water management channels and constructed wetlands. The overall water management system connects the ponds via gravity flow to the two open pit lakes. The surface water management system is designed to capture and direct all KRMC site surface water runoff to one or both of the open pit lakes until both lakes are filled to capacity. The SCDHEC holds a surety bond to ensure monitoring through the post-closure period.

All surface water is currently regulated by an existing NPDES Permit, Number SC0041374. The SCDHEC is currently unaware of any non-compliance issues with either surface water or groundwater quality. In addition, the Ridgeway Kennecott Mine won the 2005 Hardrock Mineral Environmental Award from the Bureau of Land Management for successfully meeting or exceeding state reclamation requirements with minimal oversight.

At this point, Long-term treatment is not anticipated for the Ridgeway Mine. By directing all water to the pit lakes, no off-site discharge has taken place since closure. Assuming the site receives normal annual rainfall, the expected discharge date is in the 2018 to 2020 timeframe. The post-closure care period will officially begin when both pit lakes are full and discharge begins through to Bear Creek. Pit water quality is very good. There is some pyritic rock exposed in a high wall in North Pit that will be submerged below the oxygenated level once the water level reaches the design pool. Therefore, the pit water at North Pit requires occasional treatment in the short-term.

### 3.3. Conda Mine, Idaho

The Idaho Department of Environmental Quality (IDEQ) oversees the clean-up mining site at the former Conda/Woodall Mountain Phosphate Mine[1] near Soda Springs in eastern Idaho. The primary risk driver is selenium. The Conda/Woodall Mountain Phosphate Mine produced phosphate ore under various operators from 1906 to 1984 and under Federal Phosphate lease issued in 1954, and issued in 1965. Mining initially occurred underground, transitioning into open pit mining in the early 1950's. J.R. Simplot Company (Simplot) became the mine operator in 1960. During open pit mining, surface soils and overburden were excavated from the mining pits to expose the phosphate

[1] http://www.deq.idaho.gov/conda-woodall-mountain-mine-site

ore. Overburden was either backfilled into the pits or placed in external overburden areas. Portions of these overburden rock units contain naturally elevated levels of selenium and other trace metals. Handling and disposal of overburden accelerated both physical and chemical weathering processes, resulting in releases of selenium and other metals to the environment. Once these contaminants of potential concern ("COPC") are released through this oxidation and dissolution process, the COPCs may be transported by groundwater, surface water, sediments, or by direct plant uptake. Selenium has the widest distribution and greatest exceedances of risk-based benchmark concentrations and is, therefore, the contaminant with the highest potential for impact.

The mine is currently being addressed under Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). The site wide Remedial Investigation/Feasibility Study and selection of remedy (RI/FS) is on-going. In addition, IDEQ accelerated cleanup of the Pedro Creek Waste Rock Dump via a Non Time-Critical Removal Action (NTCRA). Any NTCRA is designed to reduce concentrations in surface water and groundwater, but not to fully clean up to standards. Doing so will be part of a final remedial action for the Conda Mine, and is several years away. Thus cleanup will be achieved in a phased approach – first IDEQ will see what happens with source control and will address residual contamination through a final action.

An October 2012 Settlement Agreement/Administrative Order on Consent (SA/CO) has been completed and has a section on Financial Assurance to account for potential permanent treatment needs. This SA/CO is entered into voluntarily by the IDEQ, the US Environmental Protection Agency (USEPA), the US Department of Interior (USDOI), the Bureau of Land Management (BLM), and Simplot. This Settlement Agreement provides for the full performance of a removal action by Simplot and the reimbursement of certain response costs incurred by the US and IDEQ at or in connection with the Pedro Creek Overburden Disposal Area within the Conda/Woodall Mountain Phosphate Mine Site.

At this point it is unknown if long-term water treatment will be needed, but IDEQ would guess a passive barrier technology for toe seeps will receive consideration as part of the agreement. Land ownership for the entire mine is 80 percent private, 20 percent US BLM.

## 3.4. Round Mountain Gold Mine, Nevada

Round Mountain Gold Corporation (RMGC) operates a joint venture between Kinross Gold Corporation (Kinross) and Barrick Goldstrike, with Kinross as the operating partner. RMGC operates two mines: Smoky Valley Common Operation (SVCO) and the neighboring Gold Hill Mine (GHM) located approximately 250 miles south east of Reno in Nye County. A smaller satellite operation (Manhattan), located about 20 miles south of the RMGC-SVCO has been closed since the mid-1990s and portions of the reclamation bond have been released. RMGC practices concurrent reclamation at the SVCO. SVCO has been in operation since the early 1980s and GHM came on line in 2011. Both facilities are on leased public land (U.S. Bureau of Land Management, BLM, and the U.S. Forest Service, USFS) and private land. The mines and waste rock dumps are for the most part on public lands where as the process plant, heap leach pad, and tailings facilities are on private land. This is typical for operations throughout Nevada.

The RMGC facilities are inspected quarterly and continue to operate in compliance with their Permit. Other than a few minor spills and minor housekeeping issues (typical for all facilities), the Bureau of Mining Regulation and Reclamation (Bureau) never formally issued any kind of compliance order. When problems develop, the Bureau's goal is to work with the facility first to resolve the issues. Compliance orders are a last resort. As the mines continue to expand and deepen, more sulfide material is being encountered; consequently acid generation from waste rock is a big issue. The Bureau requires periodic updates to SVCO and GHM waste rock management plans, which by industry standards are very thorough and detailed. Background water quality in the RMGC area is characterized by elevated fluoride, arsenic, iron and sometimes antimony. Because of the intense geological fracturing typical of the area, several comprehensive hydrological studies have been undertaken and these too are updated periodically as more data is generated.

Both the SVCO and GHP are expected to form pit lakes upon completion of mining. The current plan is to backfill the pits with benign waste rock to approximately 15 feet above the pre-mining water table. There currently are no plans for long-term water treatment.

## 3.5. Factors for Long-term Compliance

One common factor for all of these mines that are currently compliant with adequate financial assurance is that none have yet identified any serious ARD or other geochemistry issues that would require expensive long-term water treatment. This could be because the underlying geology is benign, or because the potential geochemistry issues have yet to appear, such as after the pit lakes are filled.  In all the examples listed above, the common theme is they are all owned by large responsible parent companies, and none of them have become bankrupt.

Therefore, it is difficult to determine at this point whether these mines will continue to be compliant with adequate financial assurance funding in the long run because of appropriate financial assurances set on a thorough understanding of site geochemistry and required treatment, or because the required treatment is simpler and easier to fund.

The case studies in Section 2 involved mines where the geochemistry was not properly addressed and the potential for long-term water chemistry and quantity problems were underestimated or not recognized.  This deficiency only became a problem for the government when the mining company encountered financial difficulties and either became bankrupt or elected to walk away from the site.

Numerous other mines with similar underestimated long-term water quality issues but with financially stable owners eventually adjusted their financial assurances to account for the long-term costs.  These operations continue to responsibly maintain the O&M of the closed mines or, in some cases, mines continue to operate but with revised financial assurances that reflect the updated geochemistry knowledge.

From a regulatory risk point of view, the major mining companies with a large portfolio of operations are more likely to have the desire and financial wherewithal to properly reclaim the site and perform the long-term water treatment and O&M than a company whose entire future is based on a single operation, and has no other source of income.

Most States and Federal agencies learned about the risks from the historic mines and mining districts that have become superfund sites, as well as late $20^{th}$ century mines that were subject to state and federal permitting and water quality rules, but underestimated the risks and failed leaving the government to manage the site.

These States and Federal agencies, including Minnesota, now require a very thorough and professional analysis of the site water and geochemistry to identify and predict potential problems so they can be addressed in mine permitting and financial assurance computations. The authors were not able to find any examples of mining companies that went bankrupt or walked away from their responsibilities since more stringent standards for financial assurances and geochemistry evaluation have been initiated. Mines have closed, but the mining companies are responsibly performing their obligations.

One important consideration for mines that were developed under less stringent standards but are currently compliant, is that they may have not yet identified serious ARD or other geochemistry issues that would require expensive long-term water treatment. This could be because the underlying geology is benign, or because the potential geochemistry issues have yet to appear, such as after the pit lakes are filled.

# 4. OTHER REGULATIONS AND GUIDELINES

In addition to examples of non-ferrous mines with adequate and inadequate financial assurance, there are other regulations and guidelines which have been developed in part in response to past successes and failures in non-ferrous mining. These include the federal regulations and World Bank Group guidelines described below.

The driving forces behind these regulations and guidelines are, fundamentally, financial and environmental. On one hand, the need to reduce the amount of public money that federal and state agencies spend to clean up hardrock mines and processing sites. On the other hand, the necessity to minimize and quickly respond to hardrock mines' environmental threats in the most responsible manner.

Common goals of these regulations and guidelines are to fully understand future geochemistry issues and long-term water treatment needs upfront during project feasibility, and to incorporate both reclamation and long-term water treatment costs into the initial financial assurance estimate and overall project financial feasibility.

## 4.1. Federal Regulations

The U.S. Environmental Protection Agency (EPA) reports that through 2011, the agency spent ±$4.6 billion to clean up hardrock mines and processing sites[2]. This does not include amounts spent by the Office of Surface Mining Reclamation and Enforcement (OSMRE), the states, the Bureau of Land Management (BLM) or the U.S. Forest Service (USFS).

Some states such as Montana began requiring reclamation financial assurance for these mines in the late 1970's but the costs to perform the reclamation and long-term water treatment were in many instances underestimated. When some of the mining companies declared bankruptcy and defaulted on their obligations, the state and federal governments were forced to take over and fund the work with taxpayer money. Subsequently, regulators and the mining community have worked to better understand how water contaminated by mining is generated and how it can be controlled.

Mine permitting regulations have been strengthened to require the mining companies to address the water quality issues, to prevent any contaminants from escaping the mine site during and after mining, to address the long-term stability of waste and tailings disposal facilities, and to provide financial assurance that the land will be reclaimed and all water contaminated by the mine will be collected and treated until it meets water quality discharge standards.

A different financial assurance strategy is required by the federal government. The Bureau of Land Management is requiring that the mining reclamation cost estimate (RCE) reflect the maximum cost rather than the cost incurred during the following year (BLM Handbook H-3809-1 Surface Management, 09/17/2012, Chapter 6, from 43 CFR 3809). This is more conservative than previous approaches because it removes politics from the calculation, and assures that the amount of total

[2] CERCLA 108(b) Financial Responsibility Power Point Small Business Advocacy Review Panel Outreach, August 23, 2016. https://www.epa.gov/superfund/superfund-financial-responsibility

financial assurance is more likely to be sufficient. However, it accelerates the financial burden on the mining company, and effectively reduces the NPV or IRR[3].

The EPA has initiated CERCLA Section 108(b) rulemaking intended to assure the availability of funds for hazardous substance response should a mining or mineral processing company declare bankruptcy or be otherwise unable to conduct necessary response activities. This may also apply to old mining areas located on, or adjacent to, active mining sites.

It is also important to note that EPA has indicated they intend to promulgate financial assurance rules for hardrock mining. This may affect financial assurance for the NorthMet project in the future.

## 4.2. World Bank Guidelines

The World Bank is an organization that provides low-interest loans, zero to low-interest credits, and grants to developing countries to support investments in education, health, public administration, infrastructure, financial and private sector development, agricultural, and environmental and natural resource management. All projects financed by the World Bank Mining Department have to adhere to strict social and environmental guidelines which help ensure that mining operations are undertaken in a responsible manner.

For mining projects, the World Bank Group developed the report "Financial Surety: Guidelines for the Implementation of Financial Surety for Mine Closure[4]". This report provide governments with the information needed to make informed decisions regarding mine closure plans and help in the development of their own financial assurance requirements. The report is based on a review of existing financial surety systems requirements in a number of countries and mining regulatory agencies.

All of the World Bank mining financial assurance guidelines don't necessarily apply to non-ferrous mine projects, but some pertinent excerpts from the report may provide some perspective regarding the NortMet project:

> ***Financial Feasibility***
>
> *The costs associated with mine closure and post-closure activities, including post-closure care, should be included in business feasibility analyses during the planning and design stages. Minimum considerations should include the availability of all necessary funds, by appropriate financial instruments, to cover the cost of closure at any stage in the mine life, including provision for early, or temporary closure. Funding should be by either a cash accrual system or a financial guarantee.*
>
> *The two acceptable cash accrual systems are fully funded escrow accounts (including government managed arrangements) or sinking funds. An acceptable form of financial guarantee must be*

[3] NPV is net present value. IRR is the internal rate of return. These are measures of the financial risk to the investor.

[4] "Sassoon, Meredith. 2009. Financial Surety: Guidelines for the Implementation of Financial Surety for Mine Closure. Extractive industries and development series;no. 7. World Bank, Washington, DC. © World Bank. https://openknowledge.worldbank.org/handle/10986/18386 License: CC BY 3.0 IGO."

*provided by a reputable financial institution. Mine closure requirements should be reviewed on an annual basis and the closure funding arrangements adjusted to reflect any changes.*

***Financial Surety Standards***

***Closure costs:*** *Financial assurances must cover the operator's cost of reclamation and closure as well as redress any impacts that a mining operation causes to wildlife, soil, and water quality. The bond should also cover the cost of a post-closure monitoring period. To accurately compute the level of financial assurance, reclamation and mitigation activities should be clearly spelled out in the operation plan. In addition, the bond should cover the costs of addressing impacts that stem from the operator's failure to complete reclamation, such as the need for long-term treatment of surface and groundwater, environmental monitoring and site maintenance. During mining, assurance levels should be subject to periodic reviews, in order to allow regulators to adjust operators' assurance amounts upward or downward as clean-up needs, environmental risks, or economic factors dictate.*

***Liquidity:*** *All forms of financial assurance should be reasonably liquid. Cash is the most liquid asset, but high-grade securities, surety bonds and irrevocable letters of credit can serve as acceptable forms of assurance. However, assets that are less liquid, particularly the mine operator's own property or equipment should not be considered adequate assurance, since these items may quickly become valueless in the event of an operator default or bankruptcy.*

***Accessible:*** *Financial assurances should be readily accessible, dedicated and only released with the specific assent of the regulatory authority, so that regulators can promptly obtain funding to initiate reclamation and remediation in case of operator default. Forms of financial assurance should be payable to regulators, under their control or in trust for their benefit, and earmarked for reclamation and closure. Further, such financial assurances must be discreet legal instruments or sums of money releasable only with the regulatory authority's specific consent.*

*For their part, regulators must obtain financial assurance up front before a mine project is approved. While regulators, as determined by their periodic reviews, must have the authority to secure financial assurance during the course of mining, waiting until late in the mining process to obtain substantial assurance is unwise, since reduced cash flows at this stage may make it difficult for operators to secure bonding from a surety, bank, or other guarantor.*

***Healthy guarantors:*** *To assure that guarantors have the financial capacity to assume an operator's risk of not performing its reclamation obligations, regulators must carefully screen guarantors' financial health before accepting any form of assurance. Any risk sharing pools should also be operated on an actuarially sound basis. Regulators should require periodic certification of these criteria by independent, third parties.*

***Public involvement:*** *Since the public runs the risk of bearing the environmental costs not covered by an inadequate or prematurely released bond, the public must be accorded an essential role in advising authorities on setting and releasing of bonds. Therefore, regulators must give the public notice and an opportunity to comment both before the setting of a bond amount and before any decision on whether to release a bond.*

***No substitute:*** *Any financial assurance should not be regarded as a surrogate for a company's legal liability for clean-up, or for the regulators' applying the strictest scrutiny and standards to proposed mining plans and operations. Rather, a financial assurance is only intended to provide the public with a buffer against having to shoulders costs for which the operator is liable.*

## 5. REFERENCES


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