

Response to Selenium Contamination at Phosphate Mines in Southeastern Idaho

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Abstract

Selenium contaminated vegetation and surface water related to phosphate overburden disposal was discovered in southeast Idaho in 1997. Shortly afterward, phosphate mining companies and regulatory agencies joined in response to the potentially widespread problem throughout the phosphate mining area. Mining companies with a vested interest in Southeastern Idaho phosphate reserves organized as a committee under the Idaho Mining Association. Under this arrangement, they commissioned a regional environmental sampling program to characterize the problem in voluntary collaboration with Federal and State regulatory agencies. In 2000, the agencies in cooperation with tribal authorities agreed to coordinate their regulatory responses under a Memorandum of Understanding (MOU) that identified statutory and regulatory authorities and responsibilities; established priorities, and clarified processes for undertaking area-wide and site-specific investigations. Within the agreement, participating agencies and the Shoshone-Bannock Tribes set out frameworks for response actions and regulatory cost recovery. This group of agencies and the Tribes entered into an enforceable Area-wide Administrative Order of Consent (AOC) with the mining companies to conduct area-wide site investigations and risk assessments intended to lead to the development of remedial action objectives, remediation goals, and risk-based cleanup levels for selenium and other contaminants of concern. The U.S. Forest Service and Idaho Department of Environmental Quality, with support from other State, Federal and tribal authorities are cooperating to plan localized site investigations and engineering evaluations/cost analyses at individual mines. Data collected during the course of site-specific and area-wide efforts will eventually result in appropriate remediation of the selenium impacts at all developed phosphate mines in southeast Idaho. The authors describe the inter-agency and industry cooperative efforts in response to the selenium issue, highlighting the complications, successes, and stumbling points encountered along the way.

Background

Phosphorous, an economically and strategically important element used in the agricultural and chemical industries worldwide is consumed faster than its produced in the United States. The United States contains approximately 4.2 billion tons of phosphate ore, about 14 percent of the world's known reserves (USGS, 2000). In 1975, the western phosphate field in Southeastern Idaho was estimated to contain approximately one billion tons, about a quarter of the U.S. reserves (USGS, 1977). Approximately, eighty percent of the nation's phosphate reserves are

located on public lands throughout Southeastern Idaho. Fifty percent of those reserves lie on land administered by the United States Forest Service, Caribou-Targhee National Forest, with smaller amounts on State or Tribal leases and private land (Figure 1). Under their delegated authority and the 1920 Mineral Leasing Act, the Bureau of Land Management administers 84 Federal phosphate mineral leases on about 46,000 acres of land and cooperates with the Forest Service, Idaho Department of Environmental Quality and other Federal and State agencies in evaluating and mitigating the environmental consequences of the mining.

Phosphate mining began in Idaho about 1907 with major production commencing in the 1940's. There are three active Idaho phosphate mining operations that, in a normal market, produce an aggregate of about six million tons of ore annually. Ore is shipped from the mines by rail, truck, and/or slurry pipeline to fertilizer or phosphorous manufacturing plants located in the Soda Springs or Pocatello areas. The region contains 12 major inactive phosphate mines along with numerous, small historic orphan sites. Various types and amounts of reclamation have been completed at the major inactive mines, depending on the applicable regulations and policies in existence at the time the mining was conducted. The historic, orphaned mines have generally not been reclaimed.

Phosphate ore in Southeastern Idaho occurs within the upper and lower parts of the Meade Peak member of the Phosphoria Formation. A typical phosphate mine in the area is developed on dipping ore beds that parallel topographic ridges. Ore is removed by open pit mining methods down-dip to the economic stripping ratio and then along the strike of the outcrop to the margin of the available ore. This results in long, relatively narrow open pits, similar to many eastern coal strip mines. Because of the sequential extension of the open pits along strike, much of the overburden from active mine pits is used to back fill previous pits. In some cases, the initial mine panel developments have involved placing initial overburden outside of pit backfills in external overburden disposal fills.

Overburden for the upper ore zone is typically sandy siltstone and limestone from the Triassic Dinwoody formation, chert from the Rex Chert member of the Phosphoria formation, and shale and mudstone from the upper Meade Peak Member (Figure 2). Overburden produced between the upper and lower ore zones is shale and mudstone from the "Middle Waste Shale" portion of the Meade Peak Member. Overburden is moved with trucks from the open pits to the overburden disposal sites and enddumped from various heights in lifts. Historically, this material was placed in a run-of-mine condition with little or no segregation of the different rock lithologies. Shale and siltstone overburden weathers variably into rocky soil-like material that was utilized in the past to support reclamation vegetation in lieu of using topsoil. Until the early 1990's topsoil was not typically salvaged or replaced during reclamation. Many overburden fills constructed prior to about 1990 were reclaimed by regrading to 3h:1v (horizontal: vertical) maximum slopes and drilling or hydro-seeding a mix of grasses and forbs directly onto the regraded overburden surface. The relatively moist mountain climate of Southeastern Idaho is conducive to establishment of vegetation cover on most reclaimed mined land in the region. Reclamation vegetation cover has been established on overburden surfaces, regardless if the vegetation is growing directly in weathered overburden or topsoil. In recent years, topsoil salvage and reuse in reclamation has become the norm for the modern mining operations.

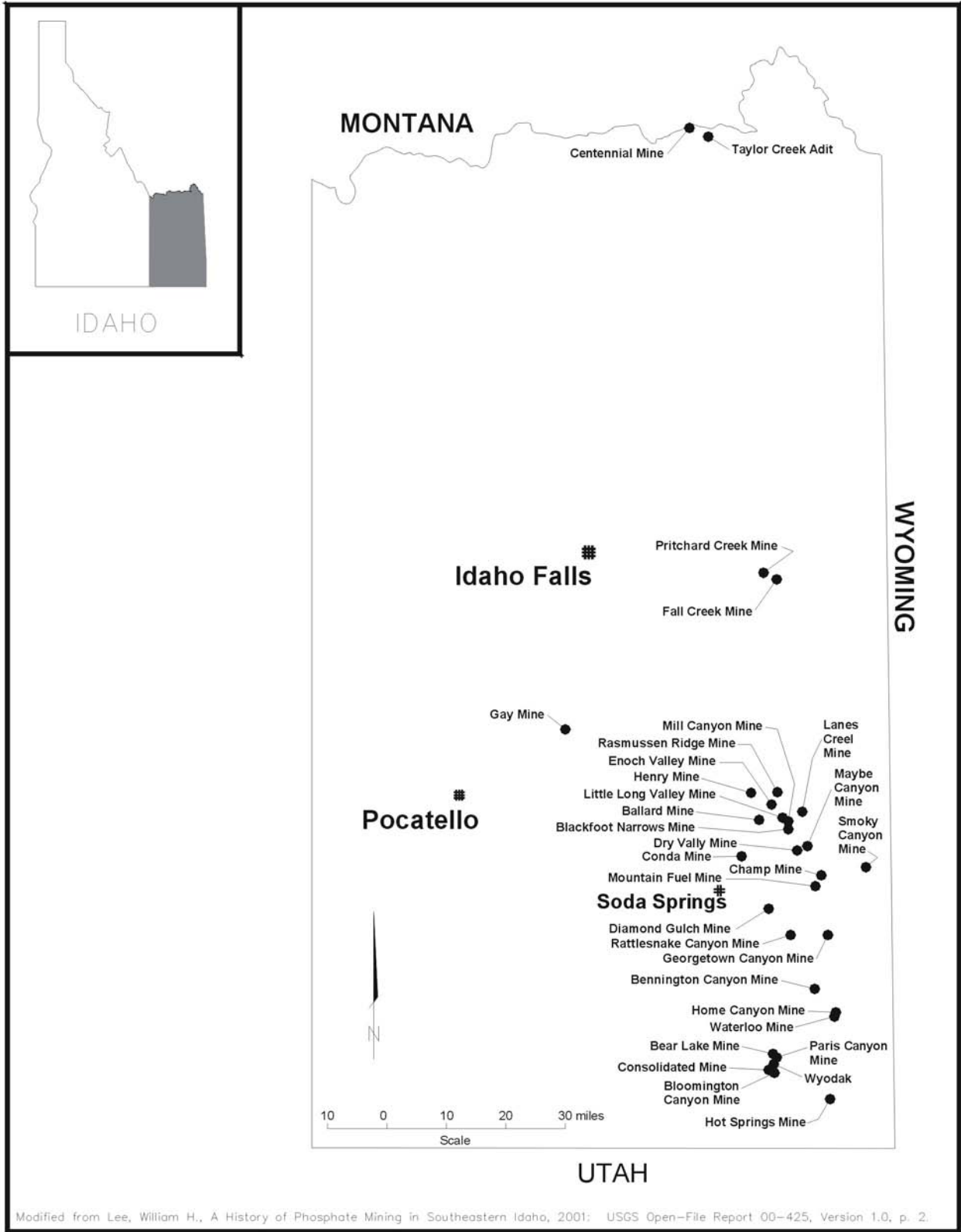


Figure 1. Generalized location map showing phosphate mines in southeastern Idaho

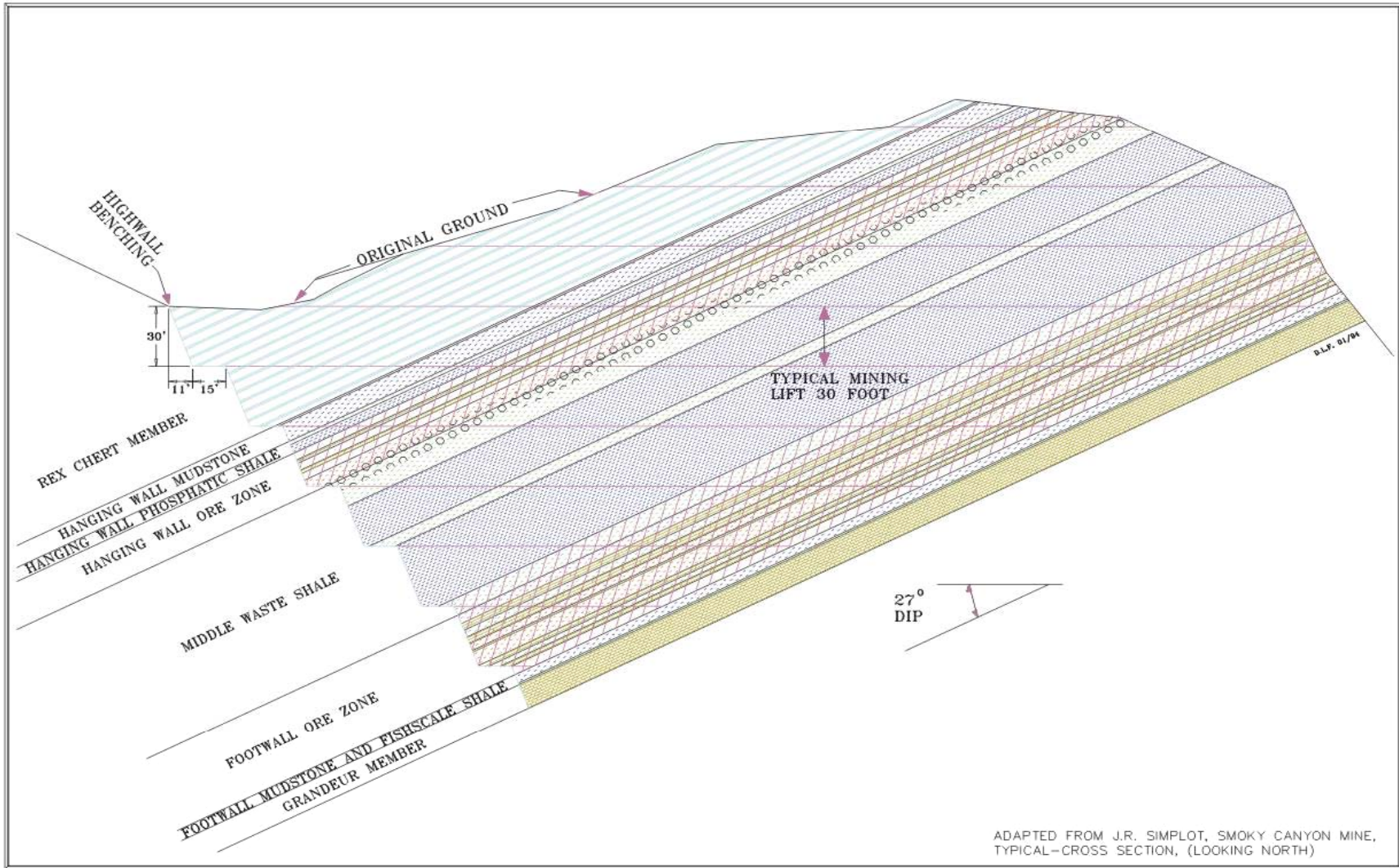


Figure 2. Typical Cross Section of the Phosphoria Formation, Simplot Smoky Canyon Mine Panels B&C

Mountainous topography in the area has led to construction of overburden disposal sites on hillsides, some of which are close to stream channels. In some cases, overburden was placed in head-of-hollow or cross-hollow fills with rock drains in the underlying stream channels to carry infiltrating meteoric water and stream flow under the overburden fills. Construction of overburden fills in valleys was a preferred overburden handling technique for a number of years because of convenience, unobtrusive visual profiles, and reduced surface areas of external overburden fills when compared to placement of overburden on steep mountain slopes. For the environmental reasons described in this paper, this is no longer an approved design for overburden disposal fills in the area.

Runoff from mine-disturbed areas is typically controlled with runoff diversion, collection, and settling features common to all types of mining. Runoff from storm events and snowmelt is routed to settling ponds or silt traps to remove eroded sediment before discharge to local streams. On older overburden fills with no topsoil cover, precipitation can come in direct contact with weathered overburden. Past environmental impact analyses for the area documented the potential for impacts to surface streams. Impacts were most often attributed to suspended sediment along with lesser amounts of dissolved parameters such as nitrate, metals, and other contaminants (USGS, 1977).

Discovery of Selenium Problem

Selenium in trace quantities is an important nutrient for human health (ATSDR, 1996). Small quantities of selenium are present in many human and livestock food supplements but selenium can also be toxic to humans and animals at higher doses. A number of environmental studies have been conducted in the United States where selenium concentrations in surface waters were elevated above background, most often by irrigation drainage (Seiler et al. 1999, Luoma and Presser, 2000). Mobile forms of selenium bioaccumulate in some plants and animals chronically exposed to the contaminant (Herring et al, 1999). A particularly problematic pathway of selenium exposure can be present where livestock or wildlife feed exclusively on bioaccumulating vegetation growing in seleniferous growth medium or irrigated with contaminated water. Animals fed moderate doses of selenium for a prolonged period can accumulate and biomagnify toxic concentrations of the contaminant and display symptoms of chronic selenium poisoning (selenosis).

Selenium has been known to be present in elevated concentrations in Meade Peak Member phosphate rock and mudstone for some time. In 1977, a programmatic EIS developed to analyze impacts of phosphate mining in Southeastern Idaho reported that phosphate rock had average selenium concentrations of 30 mg/kg (ppm), with maximum concentrations of 800 mg/kg, while mudstones were documented with average concentrations of 14 mg/kg and maximum concentrations of 1,500 mg/kg (USGS, 1977). Selenium was significantly elevated when compared to an average of 0.23 mg/kg for selenium concentrations in soils of the western United States (Shacklette and Boerngen, 1984). However, the 1977 programmatic EIS and other environmental impact studies conducted in the area prior to 1996 did not specifically identify selenium found in overburden as being a contaminant of potential concern (COPC).

Selenium in Meade Peak member overburden is present as relatively insoluble selenide (Se -2) in mineral form and elemental selenium (Se 0), which, after weathering and oxidation, can produce soluble forms of selenite (Se +4) and selenate (Se +6). Soluble oxidation products can be mobilized from weathered overburden materials in runoff or infiltration water (Desborough et al., 1999).

In December 1996, six horses grazing on private land downstream from the former South Maybe Canyon phosphate mine in Caribou County, Idaho became ill and were diagnosed with chronic selenosis. Five of these animals had to be destroyed when it was determined they would not recover. In the summer of 1997, two horses pastured on the former Conda Phosphate Mine were also diagnosed with selenosis and both animals had to be destroyed. In mid-summer 1997, 176 sheep were found dead in the Conda Mine area. The cause of death was not confirmed but selenium poisoning was not ruled out. Since then, other occurrences of multiple sheep deaths have been reported at phosphate mines in the area. In 2003, sheep began to die within 72 hours of their exposure to highly seleniferous native plants growing down-gradient of a reclaimed phosphate mine. Forensic examination of samples taken from the dead animals in each case showed elevated selenium concentrations in tissue and rumen although definitive conclusions as to the actual cause of the deaths were not made until 2003. Myocardial necrosis, a symptom of toxic selenosis, was found in dead sheep from both the Wooley Valley and Conda mine areas.

The 1997 publicity related to the selenosis in the horses pastured in Dry Valley prompted agency and public concerns that selenium releases from phosphate mining was apparently an environmental and potential public health concern. A Preliminary Assessment of the South Maybe Mine selenium released in 1997 led the Forest Service to exercise their delegated authority to initiate action under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The current phosphate leaseholder was identified as the Potentially Responsible Party (PRP) for that site. In September 1997, the U.S. Forest Service entered into an Administrative Order on Consent (AOC) with the leaseholder for the South Maybe Mine to conduct a Site Investigation (SI) and Engineering Evaluation/Cost Analysis (EE/CA) under CERCLA.

Early Industry and Agency Responses

Five phosphate mining companies in Southeastern Idaho quickly accepted that the selenium contamination problem was a significant concern and could be systemic throughout the phosphate mining region. Federal and State agency personnel along with the phosphate mining industry generally recognized that the geology, mineralogy, and physical environmental conditions at all the phosphate mines in Southeastern Idaho were similar enough to recognize that known problems at a few mines could be indicative of potential conditions at the other phosphate mines in the region. However, site-specific differences in elevation, ecology, and climate indicated that conclusions may not be universally extrapolated across the phosphate producing region.

In January 1997, agency, industry and concerned citizen representatives in Southeast Idaho were invited to attend a meeting in Soda Springs where information about the situation was presented. The five companies present formed an ad hoc committee of the Idaho Mining Association (IMA)

in early spring 1997; this “Selenium Subcommittee” consisted of: FMC (now Astaris), J.R. Simplot Company, Nu-West Industries (Agrium), Rhodia LLC, and P4 Production LLC (a joint venture between Monsanto Inc. and Solutia Inc.). Members of the IMA Selenium Subcommittee joined voluntarily with representatives from the land management, environmental, and resource management agencies to form the “Selenium Working Group” in order to provide oversight of the investigations into the matter. The IMA Selenium Subcommittee agreed to fund regional studies intended to identify selenium sources and the extent of selenium environmental impacts. The Subcommittee retained technical experts from the consulting industry who subsequently subcontracted specialists from academia to conduct the necessary studies. Montgomery Watson was hired by the Subcommittee as the environmental consultant. The University of Idaho and University of California-Davis joined the consultants in a contractual arrangement.

The initial role of the Selenium Working Group was to direct data collection strategies, identify specific studies, collaterally interpret data, and cooperate with the phosphate mining industry to develop mitigation or management practices to prevent selenium releases from current and future phosphate mining operations. Participating agencies initially included:

- United States Forest Service (USFS)
- United States Bureau of Land Management (BLM)
- Idaho Department of Environmental Quality (IDEQ)
- Idaho Department of Lands (IDL)
- Idaho Department of Fish and Game (IDFG)

Later in the process several other agencies and sovereign parties joined in the process but remained outside the working group. They included:

- U.S. Fish and Wildlife Service (USFWS)
- U.S. Environmental Protection Agency
- U.S. Bureau of Indian Affairs
- Shoshone-Bannock Tribes

Additionally, representatives of the public, local environmental interest groups, academic community, veterinary and agricultural sciences, and the press routinely participated in the open meetings of the Selenium Working Group. Meetings were held regularly to coordinate efforts of the participants in the regional investigations and do the other work of the Selenium Working Group. As this group evolved, sometimes including more than 50 participants, decision-making became difficult and at times controversial. In an attempt to improve effectiveness, the smaller “Selenium Steering Committee”, was formed with a single responsible representative from each organization within the Selenium Working Group.

As data from preliminary investigation in 1997 were received, it became evident that elevated selenium concentrations were being observed in environmental media throughout the phosphate producing area.

Members of the IMA Selenium Subcommittee and their consultant produced a number of documents related to regional investigations performed throughout a 2,500 square mile area in Southeastern Idaho including:

- Fall 1997 Interim Surface Water Survey Report, Southeast Idaho Phosphate Resource Area Selenium Project, February, 1998;
- 1998 Regional Investigation Sampling and Analysis Plan, Southeast Idaho Phosphate Resource Area Selenium Project, April, 1998;
- 1999-2000 Regional Investigation Sampling and Analysis Plan, Southeast Idaho Phosphate Resource Area Selenium Project, August, 1999;
- Final – 1998 Regional Investigation Report, Southeast Idaho Phosphate Resource Area Selenium Project, December, 1999;
- 1999 Interim Investigation Data Report, Southeast Idaho Phosphate Resource Area Selenium Project, October, 2000; and
- 1999-2000 Regional Investigation Data Report for Surface Water, Sediment and Aquatic Biota Sampling Activities, September 1999 Draft, April, 2001.

In addition to these reports, using field data from the 1998 regional investigations, the consultants to the IMA Selenium Subcommittee prepared a Preliminary Human Health Risk Assessment and a Preliminary Ecological Risk Assessment. Regulatory agencies involved in the Selenium Working Group commented on the risk assessments and essentially rejected them for premature conclusions based on the lack of sufficient data. The regulatory agencies thought their comments were not sufficiently addressed or incorporated into the assessments and they subsequently withdrew their support for the reports, writing a disclaimer to this effect.

Two other reports were produced by the IMA Selenium Subcommittee describing management practices that had been or could be employed at the phosphate mines for control of selenium impacts; they were:

- Existing Best Management Practices at Operating Mines, Southeast Idaho Phosphate Resource Area Selenium Project, March, 2000; and
- Draft Best Management Practice Guidance Manual for Active and Future Mines, Southeast Idaho Phosphate Resource Area Selenium Project, April, 2000.

The first of these reports summarized management practices that were being employed at the mines to control sediment. Practices detailed in this report had already been generally endorsed by the State of Idaho as practices suitable to control sediment production and release.

The second document was never finalized. It had attempted to address the release of contaminants from the mine sites in multiple media. However, the regulatory agencies thought

the scope and detail were not sufficient to provide a broad enough range of mitigations to address the problem. Most of the methods discussed again focused on sediment without addressing water treatment. Compared to the extensive discussion of management practices for surface runoff control in these documents, the regulatory agency reviewers were dissatisfied with the relative lack of objective discussion on the use of more expensive management practices such as: capping the tops or lining the bottoms of overburden fills with impermeable materials, and collection and chemical treatment of seleniferous water.

In addition to what the Selenium Subcommittee was doing, other organizations were conducting separate studies, including:

- With funding provided by J.R. Simplot Co., the University of Idaho conducted graduate project studies to identify or refine environmental and selenium treatments at the Smoky Canyon Mine (Simplot, 2002).
- Astaris agreed to conduct independent field studies at their Dry Valley Mine of selenium accumulation in vegetation growth medium and vegetation in response to mitigation employed at their mine.
- Three of the mining companies conducted multi-media environmental baseline studies at their properties, focusing on the selenium impacts, to support upcoming Environmental Impact Statements (EISs).
- The USFS' Rocky Mountain Research Station started research to identify vegetation species adapted to reclamation purposes that would occlude selenium. Studies were implemented to evaluate potential amendments that could permanently capture selenium within waste products; Mustard species, specifically Canola, was tested for its potential as a phytoremediation tool that would not escape cultivation on waste dumps. Correlations between soil salvaged from the mine sites and bioaccumulation in reclamation vegetation are included in their studies. A study was conducted to evaluate geologic material found near most sites to maximize their potential in cap construction.
- The IDEQ began Total Maximum Daily Load (TMDL) studies on known impacted watersheds in the region.

The USGS Western Mineral Resources Team, Western U.S. Phosphate Project, began a 5-year study in 1997 that included investigations of the geology, mineralogy, history, stratigraphy, chemistry and environmental characteristics of many phosphate mining locations in Southeastern Idaho. This work was a collaborative effort between USGS scientists from multiple offices and others from a diverse range of interests including state, federal, tribal, academic, mining, and general public. When all the reports are completed, there will be over 50 separate publications, most of them USGS Open-File Reports (USGS, 2002).

Altogether, the studies conducted by the IMA, State and Federal agencies, academia, and individual mining companies in Southeastern Idaho generated a tremendous amount of information in only 3 - 4 years on the source, pathways, and impacts of selenium contamination

related to phosphate mining. This was a major accomplishment through industry and agency cooperation. Although the regulatory agencies were appreciative of the phosphate mining industry's voluntary efforts on the regional and site-specific investigations, they questioned the role of the mining industry in interpreting the data and objectively considering mitigation measures for existing and future potential selenium-impacted public lands. Conscious of the scope and implications of the situation, the agencies decided that the completely voluntary efforts to date on the part of the mining companies would have to be replaced with a more traditional, agency-controlled approach using State and Federal authorities.

Memorandum of Understanding

In July, 2000, the Federal regulatory agencies participating in the actions of the Selenium Working Group (USFS, BLM, EPA, USFWS, BIA), the IDEQ, and the Shoshone-Bannock Tribes entered into a formal agreement between them titled the, "Memorandum of Understanding concerning Contamination from Phosphate Mining Operations in Southeastern Idaho" (MOU). The stated purpose of this agreement provided a cooperative atmosphere for the regulatory parties to work together on matters related to the environmental contamination at phosphate mines. Commitments were made to follow specific processes to resolve conflicts between them, minimize duplication of efforts, and communicate a single set of instructions to the mining companies.

Parties to the MOU agreed that an area-wide contamination investigation should be conducted by the IDEQ under the criteria and scope of work established in the MOU. This would be done with a commitment for cost recovery and enforcement within the scope of an "Administrative Order on Consent" (AOC) with the members of the IMA Selenium Subcommittee principally responsible for the leases in Southeastern Idaho. Outlined in the AOC was an agreement that subsequent site-specific investigations and remedial actions, conducted under CERCLA and other regulatory authorities, would not duplicate efforts conducted under the area-wide investigations. Site-specific investigations would be managed by specific and agreed upon lead agencies, with identified support agencies. Lead agencies would enter into site-specific, enforceable agreements with the affected companies for each individual mine site. Parties to the AOC also agreed on the general scope of work for the site-specific CERCLA activities.

In signing this MOU, the agencies asserted their regulatory authority under CERCLA to take charge of the regional contamination impact investigations, now called the "Area-wide Investigations" and eventually conduct whatever site-specific studies were necessary to thoroughly investigate all the 15 major operating and inactive phosphate mines for the release or threatened release of hazardous substances. Site Investigations (SIs) and Engineering Evaluation/Cost Analyses (EE/CAs) would eventually lead to another agreements implementing selected alternatives to effectively manage or prevent contaminant releases. Adoption of the MOU changed the former voluntary effort of the Selenium Working Group that was primarily controlled by the companies who made up the IMA Selenium Subcommittee, to a rigorous process under CERCLA that clearly placed the regulatory agencies in charge of the effort.

At first glance, one might think the mining companies would object to this change in management; this has not been the case. Each of the involved mining companies supported this

change for individual reasons related to their continued ability to produce phosphate ore from their leases in Southeastern Idaho. Their display of cooperation demonstrates their commitment to operate within reasonable and informed environmental protection measures for sustained land management. There is a general recognition that without this commitment to care for public lands, citizen opposition could stifle their continued mining in the area. Additionally, industry cooperation in regional studies leading to site-specific investigations offers the prospect of a more effective process, reduced costs, and systematic decision-making. Regulators obtain the ability to chart a clear course to some final end for each individual site. Finally, without a mechanism offering proof that lessees could eventually relinquish their mined leases in a condition suitable for the management of other sustainable resources, permitting future phosphate mining operations on public lands in the region could become impossible.

When the MOU was fully executed on July 15, 2000, the IDEQ took over the former regional investigations calling the new effort the “Area-wide Investigations”, and began planning to do the work. Costs incurred in oversight of the process by IDEQ, EPA, F&WS, and the Shoshone-Bannock Tribes are recovered from the phosphate industry participants in the AOC. Cost recovery, negotiated participation, and stipulated penalties under the AOC provided enforcement necessary for the agencies to protect the public interest.

Area-Wide Consent Order and Administrative Order on Consent

In concert with the interagency MOU and the CERCLA process, the parties to the MOU negotiated an enforceable Area-wide Consent Order and Administrative Order on Consent (CO/AOC) with the mining companies making up the IMA Selenium Subcommittee. Specific deliverables guaranteed by the agreement will conclude Area-wide Investigations. Stated as the purpose of the Area-wide CO/AOC is a scope of work for the Area-wide Investigation that identifies procedures to be used to develop human health and ecological risk assessments that will support a risk management plan intended to focus site-specific investigations on identified mechanisms and pathways releasing contaminants into the environment. Federal land management agencies signing the order were delegated CERCLA authority to implement the studies and response actions consistent with the requirements of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). IDEQ’s authority to participate in the investigation and cleanup of hazardous substances are the: Idaho Environmental Protection and Health Act (“EPHA” Idaho Code § § 39-101 to 39-130), the Hazardous Waste Management Act of 1983 (“HWMA” Idaho Code § § 39-4401 to 39-4432), and other laws including CERCLA and the Federal Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act (42 U.S.C. § 6901 et seq).

The statement of work under the Area-wide CO/AOC was described to include:

- Establishment of area-wide removal action objectives, goals, and risk-based cleanup levels for selenium and other contaminants of concern protective of human health and the environment;
- Development of a monitoring plan that will assess the effectiveness of future response activities within the resource area;

- Development of best available technologies and treatment techniques suitable for use, as appropriate, at sites in the resource area; and
- Providing an opportunity for public involvement in support of future agency directed site investigations and response actions.

Work performed under the order includes a general, area-wide risk assessment, and planning for general response action objectives intended to be considered for future site-specific activities. With the signing of the Area-wide CO/AOC in September 2001, IDEQ began work on the area-wide investigations by hiring an independent third party consulting firm to assemble existing data, gather new data, and prepare the deliverable documents.

Area-Wide Investigations

IDEQ adopted the Selenium Working Group organizational structure to initiate the area-wide investigations. The former Working Group Steering Committee was changed to the “Selenium Area Wide Advisory Committee” (SeAWAC), and the larger Working Group meetings were shifted to a quarterly schedule to distribute information and provide progress reports in a public forum. An “Interagency Technical Group”, comprised of representatives from the MOU parties along with representatives from Idaho Department of Lands, and the Idaho Fish and Game was organized to review deliverable documents. In concert with the participating agencies, IDEQ retained the services of an environmental consultant, Tetra Tech EM Inc.

An Area Wide Scope of Work was developed that utilized existing information from earlier IMA regional investigations and continued work envisioned in the MOU by signatories. With input from the Interagency Technical Group and the Advisory Committee, the Area Wide Scope of Work was defined to include:

- Assess all existing data and prepare a preliminary risk assessment,
- Determine data needs to support an area wide human health and ecological risk assessment,
- Develop sampling and analyses plans and studies to fill identified data gaps,
- Conduct area-wide investigations as required,
- Complete area-wide, population-based ecological and human health risk assessments,
- Establish remediation goals, remedial action objectives, and risk based cleanup levels,
- Develop a regional water quality and aquatic monitoring plan,
- Develop best available technology and response techniques,
- Conduct public involvement and participation activities for the area-wide investigation, and
- Other activities to support area-wide goals.

Each phase of the area wide scope of work was planned with input from the Interagency Technical Group and the Area Wide Advisory Committee. Deliverable products for each phase of work were documented and reviewed by the Technical Group and Advisory Committee.

IDEQ was proactive as they sought public input at all major steps in the area-wide process. Public meetings were held in venues near the greatest populations directly affected by phosphate mining and processing. Notices were published in local newspapers and on IDEQ’s Internet site

to solicit interest from people who may reside beyond the affected communities. Major study plans and draft documents were posted on the IDEQ website for 30-days providing interested citizens the opportunity to participate in the public process. Early involvement came mostly from agency representatives and the Idaho Mining Association; however, as the risk assessment and management plans became available, elements of the public became increasingly involved overwhelming IDEQ and their contractor for a period of time.

Site-specific Investigations

Site-specific investigations mentioned in the MOU will be planned at sites by oversight agencies and the potentially responsible parties. Most of the investigations will move forward using technical contractors approved by the lead agency on each site. With one exception, the Forest Service will be the lead agency on all mine sites that are located within the boundaries of the Caribou-Targhee National Forest. The IDEQ will be the lead agency where the surface is privately owned or where private land is intermingled with BLM or State surface ownership. The BIA will be the lead agency where the surface ownership is tribal. Other parties to the MOU will be “Support Agencies” ensuring that lead agencies provide for their interests as appropriate for each site. Lead agencies will provide an On-Scene Coordinator (OSC) or Remedial Project Manager (RPM) as appropriate for each site; these individuals will have the duties described in the NCP and will coordinate with a site-specific Project Manager also provided by the lead agency and another designated by the lessees.

The scope of work for each site-specific CERCLA project would include the following major tasks:

- Develop a Project Work Plan,
- Prepare and implement a Community Relations/Public Involvement Plan,
- Oversight of the Site Investigation Work Plan,
- Oversight of the Sampling and Analysis Plan,
- Oversight of the Quality Assurance Project Plan,
- Oversight of the Health and Safety Plan,
- Oversight and approval of the Site Investigation,
- Oversight of the Risk Assessment,
- Oversight of the Engineering Evaluation/Cost Analysis and remedial alternative selection,
- Monitoring Oversight of Selected Alternatives, and
- Review of technical and progress reports.

Lead agencies and their industry counterparts have agreed to enter into enforceable, site-specific CO/AOCs that reference site-specific Project work Plans and schedules. Responsible parties and their consultants will coordinate with the lead agencies to develop Scopes of Work to be included in enforceable orders. Detailed work plans developed to specifically outline the studies necessary to conduct a NCP compliant “Site Investigation”(SI) and Engineering Evaluation/Cost Analysis (EE/CA) are developed as part of the process. Phased site-specific investigations are planned to fill data gaps as release mechanisms and pathways are identified. Data collection will be designed to evaluate potential remedial treatments and their effectiveness to reduce releases of

COPCs to concentrations compliant with Appropriate Relevant and Applicable Requirements gathered by the lead agency.

Once alternatives are developed to address site-specific releases, they will be presented to the public according to the instructions listed in the Community Relations Plans prepared by the lead agencies. Subsequent to the public involvement process for each site, each lead agency will publish their site-specific decisions in a "Record of Decision". Alternatives selection will consider the merits of the treatment and their cost effectiveness.

Initial site-specific activities will conclude with the selection of appropriate response alternatives and a decision to proceed with either a response action alternative or a closeout of the investigations where no action is necessary. Beyond this point, negotiations with the responsible party or parties for remediation will result. Negotiations will be undertaken to provide guidelines for the removal of the contamination, reclamation of the site, and monitoring the performance of implemented treatments.

Future Activities

At the time of this paper, three and possibly four of the 15 major phosphate mining sites will have successfully completed site-specific AOCs to conduct SIs and EE/CAs. AOCs for the others are scheduled for negotiation beginning in late 2004 and could be completed by the end of 2005. Each of the Work Plans for these major sites is expected to take from two to three years to execute after which the response actions will take place. Appropriate response actions will likely be different for each site. At this point, one can only guess at the time frames required to complete all the response actions but it is safe to say that these will take years. Long-term removal actions and monitoring activities will likely extend decades into the future.

The approach to the orphaned phosphate mines will be different from the 15 major sites. Orphan sites have no responsible parties; were abandoned early in the last century; and in many cases were prospecting or test operations. Most of these sites were underground operations though some were small open pit operations. Data collected from these sites in 2002 has been evaluated and a "Preliminary Assessment" prepared for each site. Conclusions in the Preliminary Assessments will be used to decide how to proceed. Some sites may not need further investigation, however others may need detailed site investigations. At that time, further efforts may be taken to identify a responsible party or a determination made to further expend public funds to detail the extent of any releases and the risks posed to human health and the environment.

Conclusions

A great deal of information has been generated in an attempt to understand the selenium issue in Southeastern Idaho and, because many aspects of the site-specific situations are still unclear, more information may be required in the future. It is difficult to keep up with all the data and interpretations from the active investigations.

Results of the Area Wide Risk Assessment determined that only subsistence hunter-gatherers may jeopardize their health when consuming a diet high in contaminated animal organs for prolonged periods. Ecological risk is greatest to local populations residing and foraging on or near phosphate mines. Overall, populations that have a wide range and forage from diverse food sources are not at risk. Data gathered by the Idaho Department of Health led them to believe that children under 7 years old should limit their consumption of trout from the lower reaches of East Mill Creek. Selenium concentrations in salmonids and their prey exceed the criteria for this class of receptors. Despite the efforts of the IDEQ, their support agencies, and the phosphate mining companies to be open with the all aspects of these studies, several individuals and interest groups question and doubt these results. Available data led to the following factual conclusions by the participating agencies:

- The sources and potential releases of selenium from phosphate mining sites in Southeastern Idaho are systemic to some degree at all such mine sites throughout the region.
- While other contaminants of concern co-exist with the selenium, they are not as much of a concern as the selenium itself.
- Bioaccumulation of selenium in vegetation growing on seleniferous overburden is the main pathway for exposure of elevated concentrations to foraging animals. Certain plant species are more susceptible to accumulating high concentrations of selenium than others.
- Runoff from terrain with exposed seleniferous overburden is the main pathway for release of the contaminant to surface waters.
- Infiltration of precipitation into seleniferous overburden can cause groundwater contamination but a more problematic release pathway for this leachate is to seeps and springs that may occur at topographic lows along the edges of overburden fills. These discharges can subsequently result in pathways of selenium to surface waters, vegetation, and animals.
- Impacts appear to be relatively confined to the mine sites or immediately down gradient where surface and groundwater passes from the site. At active sites releases may be reduced or eliminated with the proper mitigation/remediation, however, rigorous monitoring must continue for several years to validate the effectiveness of these practices.
- Results to date do not indicate any known immediate or imminent threat to public health.
- Local toxicity threats to wildlife and livestock appear to be the main ecological impacts.
- Some mine engineering designs exacerbate concentrations in surface water, while others work to abate contaminant releases.

From 1996 to now, the administrative/regulatory/political process has been very interesting. An obvious good point is that the government and industry representatives are still talking to each other and trying to cooperate as practically as possible, within the constraints of the major

financial and legal concerns. A large portion of the credit for this goes to the IMA Selenium Subcommittee who proactively accepted responsibility for beginning the expensive work of studying this problem early on when it would have been easy to wait and see what happened from a legal and regulatory approach.

Early mining industry cooperation was good for public relations and the regulatory agencies because the industry provided initial financial support where government funding took time to respond. Early action also illustrated publicly that all parties were anxious to address the problem. Delays resulting from prolonged technical debate and legal argument would have been counterproductive and led to public distrust of both the agencies and the mining companies. Agency intentions from the beginning were not to issue citations or damage the industry but to solve the problem quickly and defensibly.

There were obstacles, distrust, and at times adamant disagreement; however, many of those obstacles were set aside to keep the work of discovering a solution to the problem moving forward. Most companies mining phosphate today continue their attempts to mitigate releases from active phosphate mines and agency representatives have accepted these efforts as well intentioned. Because some of these mitigations are poorly documented, it makes it difficult for the agencies to know if a permanent mitigation has been developed, or if there is only a temporary suppression of releases that may reoccur in the future.

Releases of contaminants, especially those involving public lands require an appropriate agency response mandated by law. Several factors influenced both agency and industry reactions early in this process. Initial industry control of the investigative process provided control of the pace that studies and remediation would occur. Voluntary lead of the initial investigations also allowed the industry to control the rate that money was spent. Under agency direction, industry control was lost but the benefit is that the government approach should lead to more defensible decisions on site remediation. It's true that site investigations in strict compliance with CERCLA may be more expensive but, when compared to the potential costs associated with unsuccessful response activities, these costs are small.

Protection of the public trust is also necessary in the mandated process required by law to implement major actions by the Federal government or on federally administered lands. Without public trust in both the industry and regulatory managers responsible, the ability to permit continued and future phosphate mining in Southeastern Idaho would become increasing difficult and more costly to both the government and the industry. Therefore, agency control and objective, well-conceived decisions on response alternatives and actions related to the selenium issue are best for all involved.

Future success of the phosphate mining industry in Southeastern Idaho is dependent on the ability of the agencies and the industry to cooperate within a regulatory framework that provides for maintenance of the public trust. Continued phosphate production is important not only to the local economy but to the ability of the nation to produce products that sustain a high quality of life. Without this cooperation within a proven regulatory framework, our own laws may increase the possibility that public opponents of land disturbing activities could successfully delay or prevent this extractive industry from operating on public lands.

A tremendous amount of work remains in the effort to continue current and expanded phosphate production in Southeastern Idaho while conducting CERCLA site investigations and remedial activities at existing mine sites. Agency/Industry relations may continue to be strained at times, but as long as their communications and cooperation continue, an important industry can continue to operate in Southeastern Idaho.

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Additional Studies and references can be found at:
<http://giscenter.isu.edu/research/techpg/selenium/selenium.htm>