University of Oregon

Environmental Impact Statements in the Mining Industry

An Evaluation of Mitigation and Monitoring

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Contents

Research Question

Have Environmental Impact Statement requirements resulted in successful monitoring of mitigation measures that have reduced adverse environmental impacts?

Summary / Abstract

The National Environmental Policy Act (NEPA) is one of our nation's most important and far reaching environmental laws, requiring federal agencies to consider and disclose environmental impacts of proposed actions. Environmental Impact Statements (EIS) are the most rigorous level of NEPA compliance, and apply to a wide range of federally funded or authorized projects. A typical EIS may contain hundreds of proposed mitigation measures, but no requirement for follow up monitoring of those measures. Absent such requirements, there is often little assurance that mitigation measures have been carried out as proposed. This research uses Central Idaho's Thompson Creek Mine as a case study to quantitatively examine mitigation measures as they have been proposed within two Environmental Impact Statements, versus how they have been carried out over thirty years of operation. Documentation of mitigation measures was obtained through analysis of state and Federal agency reports, and interviews with agency personnel, Thompson Creek Mine employees, and local conservation group representatives.

Part I

Context

The National Environmental Policy Act (NEPA) requires that federal agencies prepare an Environmental Impact Statement (EIS) whenever the agency proposes an action, grants a permit, or agrees to fund or otherwise authorize any other entity to undertake an action that will have a significant environmental effect.[1] This leads to a wide range of federal actions that are subjected to the EIS process.

The EIS is the major procedural duty imposed on federal agencies under NEPA.[2] The requirement of an EIS process is disclosure of anticipated and/or potential adverse impacts. The intent is to "serve as an action forcing device to ensure that the policies and goals defined in NEPA are infused into the ongoing programs and actions of the federal government."[3] This is to ensure that agencies are informed of a proposed action's potential environmental impacts, and to disclose these impacts to the public. This process is based on the premise that a comprehensive, public accounting of potential environmental impacts of public decisions would promote environmentally responsible public policy and regulatory decisions.[4] An EIS is also used as an analytic, decision making tool to be used by the agency when considering how best to proceed with a project that has the potential to adversely impact the environment, along with increased interaction with interested agencies.

Each component of the environment is evaluated with respect to the federal action and any listed alternatives. Environmental components, such as air quality, vegetation, land use, or water resources, are evaluated for potential adverse impacts due to the proposed actions. Agencies gain the opportunity to build consensus among interested parties regarding the final decision on a proposed action. Because EIS's contain detailed information about environmental resources, they can also serve as valuable sources of environmental information and as forecasting tools for state, local and tribal government officials.[5]

Issue

Because NEPA requires completion of an EIS from such a broad range of federal actions, there are strengths and weaknesses of the process within each field. In response to this, a task force consisting of members of the U.S. House of Representatives was assembled in 2005, and given the job of reviewing the NEPA process and providing recommendations for updating and improving the process. NEPA reformation such as this is done to add certainty and clarity to the NEPA process, and to ensure that NEPA continues to meet its intent.[6]

The study concluded that although the NEPA process has been used to modify actions to minimize or avoid environmental impacts, relatively little is known about the ultimate success of these efforts. Post-approval monitoring has not been widely used by federal agencies, and while most agencies recognize the need for improved monitoring, they are continuing monitoring only on a limited basis.[7] It was stated that overall "NEPA plays a vital role in meeting the environmental, social, and economic goals of the nation. However, substantial opportunities exist to improve NEPA's effectiveness."[8]

As noted above, monitoring is one area of potential improvement. Another area involves the implementation of mitigation measures. Mitigation measures are actions included within an EIS that are intended to result in a physical change to the proposed action that will reduce or eliminate the environmental impact. In simplest terms, a mitigation measure should be a solution to an identified environmental problem.[9] Inclusion of mitigation measures in the EIS process has been a great step forward in protecting natural resources. However, a survey of NEPA scholars and practitioners conducted 25 years after NEPA's establishment revealed that the foremost weakness within NEPA is that because NEPA does not require follow-up monitoring of mitigation measures, there is little assurance that predictions of environmental impacts were accurate, or that mitigation measures were implemented.[10] These two related issues, monitoring and mitigation implementation are equally necessary in ensuring that mining practices match those proposed. This is reflected in the following quote from Alan Harwood, a representative of the environmental consulting firm EDAW Inc. to the House of Representatives task force:

> "*One of the most useful outcomes of the NEPA process is the identification and development of mitigation measures. Unfortunately, implementation of recommended mitigation measures is voluntary."* [11]

Mitigation Measures that are voluntary may lead to unnecessary adverse impacts to these resources, although, very little research has attempted to quantify the extent to which mitigation measures are implemented. Research has been conducted on the results of inadequate mitigation monitoring, such as a 2006 study conducted by mining engineer Jim Kuipers and geochemist Ann Maest – *Comparison of Predicted and Actual Water Quality at Hardrock Mines (Comparison Report).*[12] The results of this study were presented at the t 2006 International Conference for Acid Drainage (ICARD). The results indicated that at 19 of the 25 mines sampled, water quality standards were not met at some point due to mining activity. This was despite all 25 of the mines predicting compliance with water quality standards before operations began. Additionally, mitigation measures that were put in place and predicted to prevent water quality exceedances, failed at 16 of the 25 mines studied.[13] These results indicate that problems related to mitigation and monitoring are a common occurrence within the mining industry. This issue, which I will call *mitigation monitoring,* is the focus of this research project. The mining industry was chosen because of its numerous associated environmental impacts, including impacts to surface water, ground water, air quality, terrestrial and aquatic ecosystems, hydrology, ground stability, and soil.[14]

Thompson Creek Case Study

Thompson Creek Mine is a conventional open pit hard rock mine, extracting primary Molybdenum. Thompson Creek utilizes drilling and blasting to fragment rock; electric shovels to excavate waste rock and ore; off-road diesel haul trucks and a conveyor to transport excavated materials; crushing, grinding, and flotation to process the ore; waste rock facilities; and a tailings impoundment for storage of mill tailings.[15]

Located in Idaho's Salmon River Mountains, near Challis, Idaho, it is Idaho's largest mining operation and Custer County's largest employer with a workforce of approximately 350 employees. Thompson Creek Mine produces 12 – 18 million pounds of Molybdenum annually, which is used as an alloying agent to

Figure 1: Location - Custer County, Idaho

enhance the strength, toughness, and corrosion resistance of steel.[16] The mine currently covers approximately 3,400 acres within a block of patented and unpatented claims comprising approximately 17,000 acres. The permitted surface disturbance comprises approximately 820 acres on BLM-administered land, 280 acres on National Forest System lands, and 2,300 on private land. The mine is currently in full production mining and milling approximately 30,000 tons per day of ore and removing 107,000 tons per day of overburden.[17] Facilities include an open pit, mill, and tailings facility.[18] There are a variety of ancillary facilities including; maintenance shops, warehouses, change houses, and administrative offices. The mine infrastructure includes a road network, pipeline, power lines, systems to supply process and potable water, to dispose of solid waste, to treat sewage and water, and to distribute electrical power.[19]

Cyprus Mines Corporation staked the first mining claims at the mine site in 1967. In 1979 Cyprus submitted a Notice of Intent to Operate and a Plan of Operations to the Forest Service and BLM. The Forest Service and BLM prepared a Final EIS and approved a plan of operations for the mine in 1980. Mine construction followed in 1981, and open pit mining began in 1983. During the intervening time, the mine has experienced changes in ownership several times, and is currently owned by Thompson Creek Mining Company Inc.

There have been two EIS's conducted for the Thompson Creek Mine. A new project EIS was conducted in 1980 by the Challis National Forest and BLM, Salmon District, and a Supplemental Plan of Operations (SPOO) EIS was completed in 1999 by the U.S. Forest Service Salmon-Challis National Forest in cooperation with BLM Challis Field Office. Currently, a third EIS is underway to allow Thompson Creek to expand their operation, and continue mining until

Figure 2: Air Photo of Thompson Creek Mine. Credit: Katherine Jones, Idaho Statesman, 2011.

approximately 2026.[20] The Thompson Creek Mine was chosen for this research after an online search for an appropriate case study revealed existing research of the impacts that Thompson Creek Mine has had on groundwater, surface water, and pit water.[21] The findings indicated differences between the predicted impacts and the actual impacts in all three areas, prompting further exploration of the mitigation measures and monitoring of mitigation measures at this particular site.

Since operations began at the mine in 1983, monitoring, mitigation, and responses to environmental impacts have indicated that the central issue of concern for Thompson Creek Mine has been, and is predicted to be waste management, more specifically; how waste management practices and mitigations have been needed to prevent or control acid rock drainage. Acid Rock Drainage can have harmful impacts on water quality, and on aquatic resources. Thompson Creek mine produces waste materials that have to be managed to avoid impacts to surface and groundwater quality due to acid rock drainage. Nearly all ongoing mitigation and monitoring is focused on controlling this issue.

Part II

Methodology

Research Question: *Have Environmental Impact Statement requirements resulted in successful monitoring of mitigation measures that have reduced adverse environmental impacts?*

Both EIS documents listed proposed mitigation measures. These mitigation measures were noted, and compared to data collected about documented mitigation measures gathered from government reports, permits, private consultant evaluations, interviews, and press releases. This method attempts to quantify the extent to which proposed mitigation measures have been implemented through comparison of the proposed mitigation measures, and mitigation measures that have been documented, using several sources.

"Documented" mitigation measures are those mitigation measures that were listed within either the 1980 or 1999 EIS, and were confirmed in one of several potential sources. These documented mitigation measures are considered an indication of the extent to which mitigations are implemented as proposed within an EIS, and by extension, how successful the EIS process is in influencing mitigation monitoring. The information gathered was also used to draw conclusions about the research question, and informed recommendations as to what changes can be made to NEPA as well as the EIS process that would result in more effective/fully implemented mitigation measures and monitoring.

Thompson Creek Mine Case Study:

A case study was sought during the spring of 2011 from an online inventory of operating members of the Idaho Mining Association.[22] The purpose of the case study was to illustrate the issues regarding the EIS requirements and how they influence monitoring of mitigation efforts. Criteria for selection of the mining operation to be used as a case study were as follows;

- The mine must have been operational for several years to ensure mitigation measures, and all forms of monitoring have been given ample time to be established and conducted as part of operating procedures.
- Mining operation must have required development of at least one EIS containing documented proposed mitigation measures to ensure the project could act as an example of how mitigation measures are carried out.
- The operation must exist in the United States Pacific Northwest (Oregon, Washington, or Idaho). Projects located in the Pacific Northwest were preferable, as they reduce interview scheduling conflicts and to keep open the possibility of a site visit.

The Thompson Creek Mine was selected from the list of operating members of the Idaho Mining Association as it met the required criteria.

Environmental Impact Statement Analysis

Initial contact was made with Thompson Creek Mine and the U.S. Forest Service June 2011, to request copies of the 1980 EIS and the 1999 SPOO EIS. Both organizations supplied copies of both EIS documents. A review of the 1980 EIS, and the 1999 Supplemental Plan of Operations EIS was conducted to obtain information on the baseline conditions of the site, the proposed actions, potential impacts, mitigations measures, monitoring efforts, and agency involvement.

Impacts, Response, and Mitigations

Information regarding the Thompson Creek Mine facility, operations, mitigation measures, monitoring efforts, environmental impacts, and responses to those impacts were gathered from several sources to further investigate the issue of mitigation monitoring. The sources fit three categories: 1) Government Reports, Permits, and Private Consultant Evaluations, 2) Interviews with State and Federal Agency and Thompson Creek Mine representatives. 3) Press releases. These sources provided a quantitative evaluation of documented mitigation measures, as well as qualitative information on best practices, and successes, constraints, and recurring issues surrounding the mining industry in Idaho.

Government Reports, Permits, and Private Consultant Evaluations:

Reports containing descriptions of facility and descriptions of operations which could be used to verify proposed mitigation measures were available online from agency websites. Archives of state and federal agencies who participate in the oversight of the Thompson Creek Mine were searched using "Thompson Creek" as a key word during the months of September and October 2011. Sources included the Idaho Department of Environmental Quality, the Forest Service, U.S. Environmental Protection Agency, Thompson Creek Mine, and Environmental Consulting Firms LORAX, and GEI Consulting. This data was analyzed for content related to the mitigation measures using a key-word search, pulling terms from the original mitigation measures themselves. A list of the reports is included in Appendix B.

Interviews:

Information regarding the various agencies involved with the oversight of the Thompson Creek Mine was collected from the 1980 and 1999 EIS's. The two EIS's noted that an Interagency Task Force of applicable agency representatives and Thompson Creek Mine representatives responsible for coordinating regulatory activities. Each agency represented on the Interagency Task Force was contacted during October 2011, and further contact information of the individual(s) on the Task force was collected. the Thompson Creek Mine Interagency Task Force were Interview subjects from the Interagency Task Force, Thompson Creek Mine, Boulder White Clouds Council, and the Idaho Conservation League provided further information regarding the presence of mitigation measures. In addition, these interviews provided further insight into mining issues in regard to mitigation measures, monitoring, best practices, and constraints, all of which helped to inform portions of the conclusion and recommendation section of this research. Press release information helped provide further insight into the specific issues surrounding the mining industry, specifically the incompatibility of the NEPA process with mining operations requiring swift operational changes.

Subjects:

Interviewees were contacted in September and October 2011, with interviews scheduled and conducted with available participants during November, 2011. Individuals were contacted based upon their inclusion in the 1999 Thompson Creek Mining Company Supplemental EIS Interagency Task Force. The Boulder White Clouds Council and Idaho Conservation League were chosen to provide a conservation-based perspective on mining mitigation and monitoring activities. There were a total of 10 individuals interviewed. Interview subjects were representatives of the following agencies or organizations:

- Thompson Creek Mining Company – Three Thompson Creek employees participated. Each had knowledge and experience with the oversight of Thompson Creek's monitoring program and relationship to operations.
- Forest Service – Agency that approved the SPOO in accordance with applicable regulations
- BLM – Agency that approved SPOO in accordance with applicable regulations
- Idaho Department of Health & Welfare, Division of Environmental Quality – State Water Quality Certification Safe Drinking Water Compliance, Air Quality permitting and Certification
- Idaho Department of Lands – Review and approval of reclamation plans
- Idaho Department of Water Resources – Dam safety for tailings impoundment
- Boulder White Clouds Council – local conservation group, active participant in EIS process
- Idaho Conservation League – Conservation group dedicated to protecting Idaho's air, wilderness, wildlife and water resources.

Interview Questions

Data was collected from human subjects through a series of interview question interview administered only once Interview questions were formulated to address the research question, and focused on gaining further information on the environmental impacts, operational efforts to mitigate adverse environmental impacts, successes, constraints of fulfilling all requirements, and how Thompson Creek Mine coordinated with the agencies to ensure environmental obligations were fulfilled while maintaining economic viability.

Of the 10 subjects interviewed, 9 were contacted and interviewed by telephone; the remaining interview was conducted via email. Telephone interviews were audio recorded and transcribed to Microsoft Word, email responses were transferred and saved to Microsoft Word. Contact information was then deleted from responses, and any other correspondence was deleted to de-identify the data. The email response was exactly the same, minus the need for transcription. The questions were asked during the course of a conversation with the interview subjects. The length of time of each interview ranged from 7 minutes to more than ½ hour. Oral consent was gained during discussions with interview subjects, or through email correspondence.

Responses were analyzed for information on successful practices and experience regarding monitoring efforts, barriers to effective monitoring, and for how these successes could be applied to existing barriers and constraints in monitoring of mitigation measures, and how this could advance the efforts of mitigating adverse environmental impacts.

Press Releases:

Press releases regarding Thompson Creek Mine using all newspapers and magazines published in Idaho using media search resources – University of Oregon Lexus-Nexus, and U.S. Newspaper List.[23] A key word search - 'Thompson Creek Mine,' was used to collect applicable news articles from Lexus Nexus and the USNPL database on November 15th, 2011. The articles containing those key phrases were narrowed by examination for content related to mining, and further still for content relating to mitigation, monitoring, or environmental impacts. These two searches yielded 56 and 9 articles respectively. Of this total of 65 articles, 8 were deemed pertinent to this research project.

Part III

Findings

The findings listed attempt to quantitatively analyze the extent to which monitoring of the proposed mitigation measures have been documented. "Documented" mitigation measures are mitigation measures contained within either EIS document that were confirmed as existing through analysis of government reports, permits, private consultant evaluations, press releases, and interviews. The data sources were also used to identify recurring issues, constraints, and best practices of mining operations.

EIS Documents

The 1980 EIS included the NEPA requirements of an EIS, such as baseline conditions, the environmental impacts of the proposed action and alternatives, adverse environmental effects, and irreversible commitments of resources resulting from implementation of the proposed action. This differed from the 1999 EIS, which was required because the mine was significantly altering their plan of operations. The 1999 EIS was a Supplemental Plan of Operations EIS (SPOO EIS). As a supplemental EIS, the 1999 document did not repeat information or mitigation measures from the previous EIS and instead focused on the sections that were to be updated.

Findings - 1980 EIS

The 1980 EIS provided a list of 50 mitigation measures total. These mitigation measures were divided to address potential impacts to air quality, noise, liquid effluents, solid waste, erosion and sedimentation control, fisheries, terrestrial vegetation and wildlife, cultural resources, and socioeconomics.

Table 1.1: Documented 1980 Mitigation Measures Summary.

Mitigation Measures - 1980 EIS	
Potential Impact	***Documented Mitigations***
Atmospheric Emissions	Documented: 7 of 10
Noise	Documented: 1 of 2
Liquid Effluents	Documented: 7 of 7
Solid Waste	Documented: 0 of 1
Erosion and Sedimentation Control	Documented: 5 of 16
Fisheries	Documented: 0 of 1
Terrestrial Vegetation and Wildlife	Documented: 1 of 11
Cultural Resources	Documented: 1 of 1
Socioeconomics	Documented: 0 of 1
Summary: 22 of 50 mitigations were confirmed during EPA site visit	

Government Reports, permits, and environmental consultant reports, interviews, and press releases were searched for documentation of all 50 mitigation measures. This search resulted in documentation of **22 of the 50** mitigation measures listed in the 1980 EIS. A mitigation measure matrix documenting the mitigation measures documenting source is included in Appendix C.

1999 EIS

The 1999 EIS was different from the 1980 EIS in that it was undertaken as a response to existing adverse environmental impacts – specifically, acid rock drainage. The issue of acid rock drainage required Thompson Creek to implement significant operational changes to better manage their waste materials. Therefore, all mitigation measures included in the 1999 EIS were effectively mitigation measures addressing water quality. The 12 mitigation measures are divided into sections based upon their relationship to the mining operation. Mitigation measures are included for; the tailings facility, waste dump, water quality, and comprehensive management.

Table 1.2: Documented 1999 Mitigation Measures Summary.

Mitigation Measures - 1999 EIS	
Potential Impacts	***Documented Mitigations***
Tailings Facility	Documented: 3 of 3
Waste Dump	Documented: 2 of 6
Water Quality	Documented: 1 of 1
Comprehensive Management	Documented: 1 of 1
Summary: 7 of the 11 mitigation measures were confirmed	

7 of the 12 mitigation measures listed within the 1999 EIS were documented from one of the agency reports, or confirmed as completed during one of the interviews.

Total: of the 62 mitigation measures listed within the two EIS documents, 29 of those mitigation measures have been documented.

Interviews

The research includes interviews with 10 subjects who agreed to describe their involvement with the Thompson Creek Mine and discuss their role in monitoring and mitigation. These interviews contributed to verification of mitigation measures as described within the two EIS's. The interview data also contributed to the '*Recurring Issues'* section of the analysis, as well as the '*Best Practices'* section of the concluding analysis. The recurring issues regarding the Thompson Creek Mining Operation that were brought up more than once during the interviews include; The Interagency Task Force, original

predictions, mine closure and reclamation, the bonding process and externalized cost. These issues are discussed in the analysis, as well as the findings of best practices and barriers for Thompson Creek.

Part IV – Analysis

This section contains review and analysis of the documented mitigation measures, recurring issues, and an inventory of best practices revealed through the data collection process.

Mitigation Measure Compilation

The findings indicate that 29 of the 61 proposed mitigation measures have been documented. "Documented" meaning those mitigation measures contained within either EIS document that were confirmed as existing through analysis of government reports, permits, private consultant evaluations, press releases, and interviews. Furthermore, as documentation was considered an indication of implementation, the results indicate that 32 mitigation measures have not been monitored or implemented successfully as proposed within the EIS documents. However, this statistic is misleading due to a limitation of this research, and in the mitigations themselves. The overarching limitation is that there exists a possibility that some of the mitigation measure have been completed, but have not been documented. Mitigation measures that may have been completed but left undocumented generally fall into two categories; Unverifiable/Paper Mitigations, and Reclamation Mitigations. These are described in further detail below.

Unverifiable/Paper Mitigations

The possibility exists that some of the mitigation measures have been completed as proposed, but are unverifiable after the fact. An example of this kind of mitigation measure found in the 1980 EIS in regard to mitigating the adverse impact on terrestrial vegetation and wildlife is for Thompson Creek Mine to utilize "Minimum fencing." There is no indication as to what constitutes the minimum; thus there is not definitive documentation of whether the mitigation measure has been implemented.

Another kind of unverifiable mitigation measure is called "Paper Mitigation." These are mitigation measures that fail to solve the environmental problems disclosed in the NEPA document, and exist only on paper, making them difficult to document.[24] "Cooperation with enforcement agencies" is one example of paper mitigation from the 1980 EIS. There is no indication of what constitutes "cooperation." With no indication of what constitutes cooperation, the mitigation measure is un-measureable and cannot be definitively considered complete or incomplete.

Reclamation Mitigations

The following mitigation measure, from the 1999 EIS, is an example of a currently undocumented mitigation measure that may be included in the reclamation plan:

> "A long-term waste dump cover to include: an 18-inch thick hydraulic barrier of compacted volcanics, a 5-foot thick thermal barrier, and a 12-inch thick topsoil (growth medium) layer."

The long-term waste dump cover is likely to be completed upon closure of the waste dump. During mining operations, the waste dump is also likely to be actively receiving waste materials. This and other

mitigation measures may be completed upon mine closure, or as part of the mine reclamation plan, and as such, have not been documented.

Excluded Mitigation Measures

These possible reasons for undocumented mitigation measures reflect the limitations of this research. They also reflect how successful the EIS process is in influencing monitoring of mitigation measures as proposed in an EIS. However, this research attempts to identify some of the reasons why mitigation measures included in an EIS may not be implemented beyond the reasons stated above. The possibility remains that there are valid mitigation measures that were necessary for ensuring adverse environmental impacts were avoided, but that are not implemented. Some of the issues raised during interviews and research include; No requirement/no incentive for implementation, over-monitoring, and perceived efficiency.

The most direct conclusion is that mitigation measures as proposed in an EIS are not required. As such, mitigation measures can be evaluated further and incorporated or excluded before mining operations commence. Interview subjects also indicated that during their oversight of monitoring efforts, certain monitoring activities were essential, and focus was placed on those areas. Unnecessary and/or redundant monitoring activities were phased out. The reason was to increase efficiency, and eliminate 'over-monitoring', which happens as a result of unnecessary mitigation measures. Searching for mitigation with which to discontinue monitoring can add efficiency in the short term. However, longer term efficiency suffers through less mitigation. As one interview subject pointed out – "It is easier to keep the water clean than it is to clean the water after it is polluted."[25] This illustrates the point that overall cost is much less if mitigation measures are incorporated fully.

Recurring Issues

Several issues were discussed by interview subjects that helped to clarify the role and implications that mitigation measures and monitoring have on mining operations. These issues were condensed into three categories of discussion: Bonding and Externalized Cost, Reclamation and Mine Closure, and Inaccurate Predictions.

Bonding and Externalized Cost

Under the Idaho Surface Mining Ac of 1971, the Idaho Department of Lands requires a bond from mining operations conducting surface mining activities on all lands, public and private. If and when it is needed, this bond serves as an insurance policy, to be used to fund clean-up activities. The bond amount is the amount necessary to reclaim the land. The State of Idaho averages nearly $7,000 per acre, among the mid-range for western states.[26] The exact amount for individual projects is determined through private negotiations between the Mining Company and the Idaho Department of Lands. One interview subject stated that such negotiations have historically resulted in "severely under-bonded operations." This is especially problematic if a mining operation were shut down for unanticipated reasons, or if adverse environmental impacts were more severe than originally anticipated during bond amount negotiations. In either case, the mining operation would be unable to fund reclamation of the site, leaving federal

agencies (U.S. EPA) to take action at taxpayer cost. This was referred to as "externalizing" the cost, or shifting the financial burden of cleanup measures to government agencies.

The risk of higher than anticipated clean up activities is illustrated in the case of the nearby Grouse Creek Gold Mine, also located within the Challis-Salmon National Forest. The Grouse Creek Mine began operating under Hecla Mining Company in 1994 only to close in 1997 due to a combination of unanticipated environmental impacts, less-than-predicted ore, and low gold prices. In 2003, the site was declared an "imminent and substantial endangerment" by the Forest Service and EPA and required dewatering of the tailings impoundment.[27] Hecla had committed $32 million to the performance bond. In addition to this bond, Hecla eventually agreed to fund clean up of the region at a $263 million total cost.[28] The additional $263 million expense illustrates the issue of "under-bonded operations" when faced with clean-up costs that far outpace the bond amounts set aside to fund such efforts.

Reclamation and Mine Closure

The issue of reclamation and mine closure was discussed several times in response to interview question. The reclamation plan at Thompson Creek is a requirement of the Idaho Surface Mining Act of 1971, which requires an approved reclamation plan prior to commencement of mining operations. The reclamation plan is also closely related to the issue of bonding in that the reclamation plan must include a performance bond, or money to ensure reclamation activities are fully completed and the site is restored to productive condition.[29] Thompson Creek Mine's reclamation plan is used to help determine weekly operations. The relationship of the reclamation plan to mitigation measures, as well as general operations, was described by one interview subject below:

> *"Some of the measures that we have in place here at Thompson Creek…work towards a reclamation plan. And I often times say that the reclamation plan is like a cookbook, it's like the ultimate document. We also have a weekly mine plan, and the two go together in where to place the rock, and where we plan to place the rock in terms of the waste stream."*[30]

Another issue discussed several times is the concern that although the mine currently addresses environmental impacts adequately, the greater uncertainty is in post-closure impacts. This concern was expressed by Thompson Creek Mining Company, and echoed by State and Federal agencies, and the Idaho Conservation League. The continuous water treatment necessary at Thompson Creek to prevent acid rock drainage post-closure was noted as the main area of concern. One interview subject describes the issue below:

> "*There will still be some water treatment and handling needs even after closure. What happened years ago when our rules and regulations were written, people were under the false impression that once you reclaim the site, if you did a good enough job you could just walk away from it and it would take care of itself. I think we've found out by now, not just in Idaho, but in Montana and other states – that's just not reality. There are other long-term post closure requirements that are needed. Unfortunately, our rules and regulations don't really address that at the current time."* [31]

Inaccurate Predictions

According to CEQ NEPA Regulations, the 'Environmental consequences' section of an EIS must include discussion of each of the alternatives, and the lead agency must make a good faith effort to disclose all the environmental consequences of a proposed action as well as those of each alternative. This section forms the scientific and analytic basis for the comparison of the proposed action and alternatives.[32] Proposed mining activities and mitigation measures are a response to these predicted and potential impacts. The issue stated by several interview subjects and documented in existing research, is that these predictions can be incorrect. In these cases, the mitigation measures, and the bond amount may no longer be sufficient. This issue has been quantified by Kuippers and Maest in their 2006 study; *Comparison of Predicted and Actual Water Quality at Hardrock Mines: The Reliability of Predictions in Environmental Impact Statements.* 64% of the hardrock mines studied experienced mitigation measure failures, or unpredicted adverse impacts.[33]

Best Practices and Recommendations

The following list of recommendations and best practices are topics discussed during interviews, or examples found during research to help address the recurring issues faced by Thompson Creek Mine, and the various State and Federal Agencies. Some insight was gained regarding ways in which to overcome these constraints through the interview process, and review of existing literature regarding the issues discussed. The following are recommendations and best practices that may help overcome the recurring issues.

Best Practices

Little NEPA

One best practice adopted by several states is the "little NEPA," which is a state's equivalent of the federal NEPA process. A "little NEPA" could be used to directly address the issue of mitigation monitoring. Idaho is currently without a state "little-NEPA", however, many nearby states have adopted such laws. Examples include Washington, California, and Montana. California has what is considered one of the most comprehensive little-NEPA laws, including a mitigation monitoring program requirement in place of a Record of Decision.[34] The presence of this mitigation monitoring requirement provides additional incentive for mining operations, state, and federal agencies, to consider the issue of mitigation monitoring. Such a requirement in Idaho could help strengthen state oversight of mining operations.

Perpetual fund

A perpetual fund was described by an interview subject as a method that could help in addressing the issue of Reclamation and Closure. This practice is currently proposed by Formation Metals Inc. as part of their Idaho Cobalt Project, and consists of the mining company setting up a fund capable of funding water treatment for 100 years. If this were done, annual interest would be sufficient to fund water treatment in perpetuity. For mining operations such as Thompson Creek where water treatment will continue indefinitely after mine closure, such a fund could be very beneficial. The interview subject description follows below:

"Idaho Cobalt Project, outside of Salmon has an interesting approach with the bonding issues, which will include payments for water treatment in perpetuity, up front. Their models show that there won't be any impacts, but the forest service looked at the models and said there might be impacts. So Idaho Cobalt set aside a sum of money that will treat the water for 100 years. And if you do the numbers, you treat it out for 100 years, that's basically the same as perpetuity in that you're y creating a trust fund, and you're treating the water off of income generated from that. Now if the company is right, and there are no impacts to water quality and they can show that for 10 years after closure, the company gets that money back…in some cases you may not see a problem 'til 50 years later, but in this case, it's a small enough system that they think they can detect a problem within 10 years. So you have to customize it.[35]

Interagency Task Force:

The Thompson Creek Interagency Task Force is a group consisting of state and federal regulatory agency representatives and Thompson Creek Mine officials who work together to ensure cooperative oversight of the mine.[36] The task force is an especially useful best practice in addressing the difficulty that state agencies typically face by having to administer various acts separately. While the task force is administrative in nature, and outside of the NEPA process, it is useful in ensuring that environmental obligations are carried out as efficiently as possible. An interview subject was quoted as saying the following:

"Each agency has its own regulations, and they haven't given up the authority to any other agency. But in order to coordinate, so that they (TCMC) don't get the same question from the forest service and the BLM, they try to do things somewhat jointly. They don't submit a plan of operations to each agency, they just submit one and each agency deals with their portion of the plan. That's what it is - a case by case basis, set up for efficiency.[37]

The task force was proposed in the 1980 EIS, and has persisted since. It was praised during interviews by Thompson Creek Mine state, state and federal agencies, and the environmental advocacy groups for adding efficiency to the oversight of the mine.

Emergency Response Cash Fund

As previously stated, mining operations often experience unanticipated adverse impacts. Interview subjects indicated that predicting the impacts is difficult, and that potential for failure needs to be considered to a greater extent in the EIS process. An interview subject suggested that a best practice for any future EIS processes is to incorporate "Murphy's Law." One way to incorporate this concept into current practices would be to set an Emergency Response Cash Fund, for conducting emergency response or for performing emergency reclamation activities. The state of Colorado could be used as an example, as it has adopted such a practice as part of their Mined Land Reclamation Act.[38]

Trend Analysis

Trend analysis of water quality is a beneficial practice that has been used by Thompson Creek Mine. Trend analysis is used to help identify significant trends in concentrations of certain chemicals in surface

and ground water resources.[39] This practice has helped Thompson Creek predict that acid rock drainage at one of their waste facilities would exceed standards before it happened.

> "*The Pat Hughes dump, through trend analysis, predicted it would turn into an acid drainage, and it has…we have to collect that water, bring it onsite, and not discharge it to Thompson Creek."*[40]

Trend analysis allowed Thompson Creek Mine to implement a system to capture and treat the acid rock drainage water before it was released, mitigating the impact.

Bond Adjustment

Washington State's Surface Mining Act, and Metal Mining and Milling Act allow for a bond to be adjusted at any time to compensate for any alteration in conditions which might affect reclamation cost, and requires that the bond be reviewed every 2 years.[41] A similar regulation could be incorporated into the Idaho Surface Mining Act to help address the issue of bond measures that no longer reflect the amount needed to address changing conditions, increasing the probability of externalized cost.

Recommendations

In addition to incorporating elements of the best practices listed above, the following recommendations could be applied during the formulation of mitigation measures and monitoring activities to address shortcomings in mitigation monitoring.

Monitoring Scope

A recommendation for future mining operation requirements is for monitoring efforts to be expanded to include mitigation monitoring. Interview subjects indicated that while resources such as air and water are being monitored, they did not discuss systems to monitoring the mitigation measures themselves. Adopting a statute such as the following, from California's Mitigation Monitoring or Reporting Statute, would be sufficient for adding mitigation monitoring to state regulations;

> *"The public agency shall adopt a program for monitoring or reporting on the revisions which it has required in the project and the measures it has imposed to mitigate or avoid significant environmental effects."*[42]

Such a statute could be beneficial for mining operations by expanding monitoring efforts to not only monitor the resource, but to ensure mitigations which are intended to avoid adverse environmental impacts are in place. By simply verifying the existence of all proposed mitigation measures, agencies and mining operations could be certain that any impact to the resource is not a result of inadequate mitigation or monitoring.

EIS Requirements

CEQ requirements should be adhered to during the formation of mitigation measures. Specifically, mitigation measures should always consist of; "an action that will result in a physical change to the proposed action that will actually reduce or eliminate impacts."[43] Such efforts would help to eliminate unverifiable mitigation measures and provide a roadmap for clear, definitive mitigation measure actions.

Part V - Summary and Conclusion

This section contains a summary of the findings and analysis, and a conclusion based upon the findings and analysis.

Summary

Mitigation Measures

The Mitigation Measure Compilation revealed that over half of the mitigation measures were undocumented. Reasons for this include; unverifiable, or "paper mitigations," and mitigation measures to be completed as part of the reclamation plan. Unverifiable/paper mitigations reflect a deficiency in the formulation of the mitigation measures, while the reclamation plan mitigation measures have yet to be implemented. However, those mitigation measures that fit neither category, and have not been documented in any source can be considered "excluded mitigation measures." This means they have been excluded from documentation because they have not been implemented. While the limitations of this research preclude a definitive estimation of the number of excluded mitigation measures, some possible reasons for exclusion were revealed during data collection. These include; no requirement or incentive for implementation, and an inherent opposition to increased monitoring on the part of the mining company to decrease overhead cost, and maximize efficiency.

Recurring Issues

Several recurring issues that act as constraints on mining companies and agencies became evident during the data collection process. These issues are related in several ways, most notably, each deal with unpredicted impacts changing the circumstances faced by a mining operation in the future. These issues included:

Bonding and Externalized Cost: There exists potential for mining operations to be under-bonded. This can lead tax funded clean-up activities if the mine were to experience adverse impacts exceeding their initial expectation, and subsequently exceeding their capacity to respond to those impacts.

Reclamation and Mine Closure: In the case of Thompson Creek Mine, water treatment will have to continue after mine closure, and could require oversight in perpetuity. In this situation, questions arise as to who will be responsible for the continued oversight and if mitigation measures will continue to mitigate adverse impacts. This issue is closely tied to the issue of bonding.

Inaccurate Predictions: Interview subject and existing data reveal a recurring difficulty in the EIS process; predicting environmental impacts. Mitigation measures and alternatives are selected based upon these predictions. When they are inaccurate, additional actions are necessary to address the subsequent impacts.

These issues are issues faced by all mining operations, but as the Best Practices and Recommendations reveal, different states and individual mining operations have implemented practices or requirements that address mitigation measures and the recurring issues differently.

Best Practices and Recommendations

Several Best Practices and Recommendations were determined after identifying some of the issues that Thompson Creek Mine faces. These best practices and recommendations include several methods that could be utilized at the state level, and practices that already have been, or could be introduced at the Thompson Creek Mine to address current weaknesses in mitigation of adverse impacts. Overall, new requirements at the state level need to be evaluated and considered, along with new practices for private mining companies. The foremost recommendation is for the State of Idaho to adopt a statute similar to the California Mitigation Monitoring or Reporting statute described within the Recommendations section.

Conclusion

Research Question: *Have Environmental Impact Statement requirements resulted in successful monitoring of mitigation measures that have reduced adverse environmental impacts?*

EIS requirements have resulted in monitoring of mitigation measures that have reduced adverse environmental impacts. However, there remain weaknesses within the EIS process, and individual states must address these shortcomings through state regulations. Idaho regulations under the Idaho Surface Mining Act have strengths and weaknesses as well. As such, there exists room for improvement, as evidenced by the 32 mitigation measures that were left undocumented. Limitations of this research – unverifiable/paper mitigations, reclamation mitigations - prevent this number from being a definitive measure of how well EIS requirements resulted in successful monitoring of mitigation measures. However, the recurring issues reveal some of the constraints faced by many mining operations, state, and federal agencies, and the Best Practices and Recommendations listed could help Idaho mining operations and agencies to address these constraints.

Specifically, state oversight could be adjusted to include requirements listed in the best practices section, including creation of a “Little NEPA,” requiring an Emergency Response Cash Fund, and a Bond Adjustment Requirement. Incorporation of these best practices would help in addressing the recurring issues section of the analysis. Thompson Creek Mine has pioneered the Interagency Task Force in Idaho, and been successful in their trend analysis of water quality. Thompson Creek Mine could bolster their proactive environmental standing by expanding the scope of their monitoring program to include monitoring of on-the-ground mitigation measures, assuring adherence to CEQ NEPA guidelines, and ensuring externalization of cost will not occur by setting up a perpetual fund for ongoing treatment of water upon mine closure.

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Appendix A – Interview Questions

Interview Questions

Environmental Impact Statements in the Mining Industry: An Evaluation of Monitoring and Mitigation.

Thompson Creek Mine, Idaho.

Research Question

Have Environmental Impact Statement requirements resulted in successful monitoring of mitigation measures that have reduced adverse environmental impacts.

Preface the interview with the following:

Begin by selecting the environmental impact, and subsequent mitigation measure(s) that pertain to the subject of the interview. - Issues include: water balance and stability of the tailings facility; predictions of acid drainage from the tailings and waste rock facilities; predictions of impacts on water quality and aquatic biota in receiving streams from tailings and waste rock effluent; and cumulative impacts on surface or groundwater resulting from the mine pit.

Interview Questions:

1. How effective has the Thompson Creek Mine Monitoring Program been in monitoring mitigation measures?
2. Has the monitoring plan observed unpredicted adverse environmental impacts? (Specify the impact that would apply to this person's involvement).
    - (If yes -)What happened as a result?
        - Changes in plan of operations?
        - Changes to the mitigation?
        - Additional mitigation?
        - Other?
3. Now that TCMC is in the process of producing another EIS, are there monitoring and mitigation lessons or experiences from the past that stand out, or that are being applied?
4. What are the constraints of producing and implementing an effective monitoring program for a mining operation like Thompson Creek?
    - Can these constraints be overcome? How?
5. What are the keys to success in creating and implementing an effective monitoring plan?
    - Why is this a successful piece of monitoring program efforts?
6. Good, or bad, is there anything that you from your past experience either in creating or carrying out monitoring programs?
    - Can that knowledge be applied in the future? Is it being applied now?

    - Are there changes in how monitoring plans are developed based on these past experiences?
7. Do you think that this/these mitigation measures have been successful in mitigating adverse environmental impacts as intended?
8. Is there anything else you would like to add about monitoring efforts at Thompson Creek, or in monitoring programs in general?

Appendix B – Government Reports, Permits, and Private Consultant Evaluations

Reports:

- U.S. EPA Thompson Creek Mine Site Visit – 1992
- Idaho DEQ – Evaluation of Proposed New Point Source Discharges to a Special Resource Water and Mixing Zone Determinations: Thompson Creek Mine facility, Upper Salmon River Subbasin, Idaho - 2000
- Idaho Conservation League: Hardrock and Phosphate Mining in Idaho - 2002
- GEI Consulting(Contractor), Aquatic Biological Monitoring of Thompson Creek and Squaw Creek - 2008
- Thompson Creek Mining Company, Annual Report – 2009
- Thompson Creek Mine Environmental Impact Statement: Mine Expansion, 404 Permit. Land Use Plan Amendment and Federal Land Disposal. Project Description – 2010
- LORAX Environmental (Contractor) TCMC Phase 8 EIS Water Management Summary – 2011

Appendix C – Mitigation Measure Matrix

Table 1.3 – 1980 Mitigation Measures

Mitigation measures as indicated in 1980 EIS			
Atmospheric Emissions	**Documented**	**Where**	**Notes**
Ore transferred by conveyor belt	Yes	EPA Visit	
Underground feed to concentrator	No	n/a	
Concentrator process by floatation	Yes	EPA Visit	
8 – inch min. ore size	Yes	EPA Visit	
Venturi scrubber system	Yes	TCMC Report	
Minimum surface disturbance	Yes	EPA Visit	
Mulch to prevent erosion	No	n/a	Unverifiable
Road surface spray for dust abatement	Yes	EPA Visit	Using Magnesium Chloride
Minimal truck travel distance/time	Yes	EPA Visit	Operational Mitigation Measure
Regular equipment maintenance/service	No	n/a	Operational Mitigation Measure
Noise	**Documented**	**Where**	**Notes**
Blasting only for short duration	Yes	EPA Visit	Once every other day
Daylight hour blasting - low exposure level	No	n/a	
Liquid Effluents	**Documented**	**Where**	**Notes**
Tailings foundation blanket and finger drains	Yes	Interview/EPA Visit	Several Water drainage system references
Embankment drainage to seepage control pond	Yes	Interview/EPA Visit	Several references to seepage pond
Observation wells for water under embankment	Yes	EPA Visit	Location description in EPA site visit report
Settling ponds below waste dump areas	Yes	EPA Visit	
Interception ditches near tailings pipelines	Yes	EPA Visit	
Sewage collection/treatment	Yes	EPA Visit	
Petroleum/chemical storage: appropriate containers	Yes	EPA Visit	

Table 1.3 Continued – 1980 Mitigation Measures

Solid Waste	**Documented**	**Where**	**Notes**
Garbage disposal at Challis Sanitary Landfill	No	n/a	Mitigation before waste rock sites were established
Erosion and Sedimentation Control	**Documented**	**Where**	**Notes**
Limit vegetation removal: areas directly affected by project	No	n/a	
Topsoil stockpiled and stabilized for revegetation	No	n/a	
Cut and fill slopes for conveyor and service roads	No	n/a	Mitigation Measure from construction period
Drainage channels incorporated where necessary	Yes	EPA Visit	Several references to drainage controls
Disturbed slopes to be revegetated	No	n/a	
Revegetation and grading of embankments	Yes	EPA Visit	Indirect reference - describes 1990 TCMC Report
Runoff handled through engineering control measures	Yes	EPA Visit	Several descriptions of surface water management
Bridge/road abutments to avoid stream channel alteration	No	n/a	
Bridge decks completely span all streams	No	n/a	
Minimize off-road vehicle travel	No	n/a	Unverifiable
Divert Bruno Creek for tailings impoundment construction	Yes	EPA Visit	
Vegetate tailings pipeline berms after installation	No	n/a	
Permanent road erosion controls	Yes	EPA Visit	
Road stabilization techniques	No	n/a	
Revegetation of areas disturbed during construction	No	n/a	
Contouring of waste dumps	No	n/a	Likely reclamation activity
Fisheries	**Documented**	**Where**	**Notes**
Restoration of Squaw Creek anadromous fishery.	No	n/a	Available data indicates - hasn't happened

Table 1.3 Continued – 1980 Mitigation Measures

Terrestrial Vegetation and Wildlife	**Documented**	**Where**	**Notes**
Minimum use of Thompson Creek Road	No	n/a	Unverifiable
Minimal rights-of-ways along all roads	No	n/a	
Posted and enforced speed limits	No	n/a	
Controlled access on roads	Yes	EPA Visit	
Minimum fencing	No	n/a	Unverifiable
Appropriate big-game passageways	No	n/a	
Limited vegetation removal	No	n/a	Unverifiable
Hunting prohibition within claim area	No	n/a	
Wildlife, fish/game law employee education	No	n/a	
Cooperation with enforcement agencies	No	n/a	
Funding for Challis fish and game officer through 1984	No	n/a	
Cultural Resources	**Documented**	**Where**	**Notes**
Evaluate archeological, architectural, historical resources.	Yes	EPA Visit	Historic mining claims in the area
Socioeconomics	**Documented**	**Where**	**Notes**
Assist preparation of City/County land use plans.	No	n/a	
Summary: 22 of 50 mitigation measures documented			

Table 1.4 – 1999 Mitigation Measures

Mitigation measures as indicated in 1999 EIS			
Tailings Facility	**Documented**	**Where**	**Notes**
Pyrite reduction facility and construction of the tailings embankment	Yes	Interview	
Permanent subaqueous pyrite depositions within tailings impoundment	Yes	Interviews/TCMC Report	
Pyrite tailings line placed within secondary spill containment facility	Yes	Interview	
Waste Dump	**Documented**	**Where**	**Notes**
Selective segregation of pyrite in waste dumps	Yes	Interview/Project Description	
Final waste dumps graded and covered with a low-permeability cap	No	n/a	Likely reclamation activity
Divert surface water runoff from waste material	Yes	Interview/Lorax Memo	Water is contained on-site, treated, and re-used
Short term waste facility cover	No	n/a	
Long-term waste facility cover	No	n/a	Likely reclamation activity
Thermal barrier incorporated in waste facility cover	No	n/a	Likely reclamation activity
Water Quality	**Documented**	**Where**	**Notes**
500-year, and 24-hour storm event diversions and drains	Yes	Interview	Tailings embankment safety
Comprehensive Management	**Documented**	**Where**	**Notes**
Monitoring plan assuring periodic inspection of facility.	Yes	Interagency Task Force	Consists of agency and TCMC monitoring efforts
Summary: 7 of 11 mitigation measures documented			