Hardrock Mining and Beneficiation Environmental Management System Guide

NMA
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SME
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Contents

1. EXECUTIVE SUMMARY

A. Background

This *Hardrock Mining and Beneficiation Environmental Management System Guide* (EMS Guide) was developed to assist hardrock mining companies in developing and implementing environmental management systems (EMSs) that can be customized to a company's unique operating circumstance and management culture. Although this guide is specifically intended for small- to medium-sized operators, larger operators may also benefit from using this guide, even if they have already implemented an EMS. The guide includes several tools and examples to help companies get started quickly and avoid common pitfalls. This guide does not focus on third-party certification of an ISO 14001 EMS; however, ISO 14001 and certification is covered.

B. Overview of an Environmental Management System

An EMS provides a clearly defined and structured approach to managing environmental performance—it includes all of the procedures, practices, people, equipment, and technology at a facility. An EMS typically follows a "plan-do-check-act" continuous improvement process. Although many models and structures are used for an EMS, they all essentially address the following items:

- Identifying applicable legal requirements, impacts, and risks;
- Implementing controls to manage those requirements, impacts, and risks (controls are broadly defined to include procedures, training, inspections, equipment, etc.);
- Monitoring the implementation of the controls and resulting performance over time; and
- Setting goals and taking action to ensure continuous improvement.

Most EMSs are focused on delivering reliable regulatory compliance and reducing adverse impacts to the environment, though reductions in costs and risks as well as improved reputation and access to markets are also important outcomes for many.

C. Overview of This Guide

This EMS Guide describes a process for implementing an EMS at hardrock mining and beneficiation operations. The process is supported by specific tools and examples to assist with EMS implementation. Specifically, this guide provides:

1. An example of an EMS task force charter and kickoff meeting agenda;
2. An example of an environmental policy;
3. Typical environmental aspects and potential impacts for a mining and beneficiation operation;
4. Example of a compliance calendar;
5. A tool for assessing the significance of environmental aspects for mining operations;
6. A tool for assessing controls and residual risk for mining operations;
7. An example of a training needs assessment matrix;
8. Example of a list of EMS documents and records that facilities should maintain and control;
9. Example of operational controls for significant environmental aspects for mining operations; and
10. An example of an action plan format.

In addition, this EMS guide provides a process for monitoring and assessing performance through management review and presents an overview of U.S. federal environmental laws and regulations that are potentially applicable to hardrock mining operations.

2. INTRODUCTION

A. Purpose of This Guide

The purpose of this EMS Guide is to assist hardrock mining companies in developing and implementing an effective EMS. The guide is specifically intended for small- to medium-sized operators and employees of the hardrock mining sector who have decided to implement an EMS for their facility or company. Large-sized operators who have already designed and implemented an EMS for their facility or company may also benefit from using this guide.

By providing guidance and tools, this guide will help companies get started quickly, avoid common pitfalls in designing and implementing an effective EMS, and effectively manage the costs associated with EMS design, development, and implementation. The guide is specifically designed to provide useful tools that will improve a company's environmental stewardship by addressing environmental impacts uniquely associated with the hardrock mining sector. Companies or facilities may realize other benefits from implementing an EMS, including improved regulatory compliance, reduced regulatory compliance costs, reduced future environmental liabilities, improved access to new markets, and improved community reputation.

This guide does not focus on third-party certification of an ISO 14001 EMS. Its focus is on value-added EMS implementation at a typical hardrock mining operation. The guide does, however, reference ISO 14001 as the basic EMS framework, though variations on the ISO EMS model are discussed. For those interested in certification, please see Section 5.

B. Overview of an Environmental Management System

Simply stated, an EMS is how you manage environmental performance. The essence of the EMS concept is straightforward:

1. Identify which aspects of your operations need to be controlled to achieve your environmental objectives (e.g., compliance with environmental permits and regulations, reducing environmental impacts, and controlling long-term and short-term environmental risks).
2. Ensure that processes are in place to effectively manage those aspects.
3. Monitor the implementation of those processes and controls as well as the resulting environmental performance.
4. Set goals and take actions to continually improve.

If you have structured processes to identify applicable legal and other requirements, identify and assess risks that arise from your operations, implement controls to mitigate risks to an acceptable level, and monitor and improve your programs and performance over time, then you have a solid EMS. However, for the EMS to succeed, all levels of management and the workforce must know their specific roles and responsibilities.

Every company has an approach to managing environmental performance, and those approaches may vary in their formality and effectiveness. To maximize effectiveness, questions that must be asked are listed here:

- How comprehensive is it? Do you have controls in place for all of your known regulatory requirements? Do you have controls in place to manage potentially significant environmental risks, even if they are not regulated?

- How well are the regulatory requirements, risks, controls, and overall environmental compliance approach understood throughout your organization? Does everyone know their roles and responsibilities, and are they competent to carry them out?
- How efficient is it (i.e., the cost/investment for the results achieved)?
- How effective is your approach to environmental compliance as people, operational and management processes, and business circumstances change?

It is important to note that the EMS is not just the documentation of your environmental program; it is the people, processes, and technology that deliver the results. Care should be taken to avoid focusing on the documentation at the expense of actual practices and implementation.

The international standard ISO 14001:2004 from the International Organization for Standardization (ISO) defines an explicit 17-element EMS framework that is described in Appendix 1. It is a flexible, risk-based, plan-do-check-act continual improvement approach that requires formal documented processes for many of its elements. The EMS implementation process described in this guide is consistent with the intent of ISO 14001.

C. Implementation Process

This guide will take you through a proven EMS implementation approach, which is illustrated in Figure 1. Each step of the process shown in Figure 1 is described in more detail in the sections that follow.

3. INITIAL IMPLEMENTATION

A. Plan Project

What and Why

As with any important initiative or project, the EMS implementation must be well planned to help ensure its success. The scope must be specifically defined, a project plan should be developed and approved by appropriate management, and an implementation team should be formed. Engagement and involvement of relevant staff early in the process will help with implementation down the road. Visible support from senior executives down through local site management is also critical for an initiative such as this, ensuring the EMS is properly resourced and given appropriate priority among the many projects and initiatives typically occurring at an operating mine.

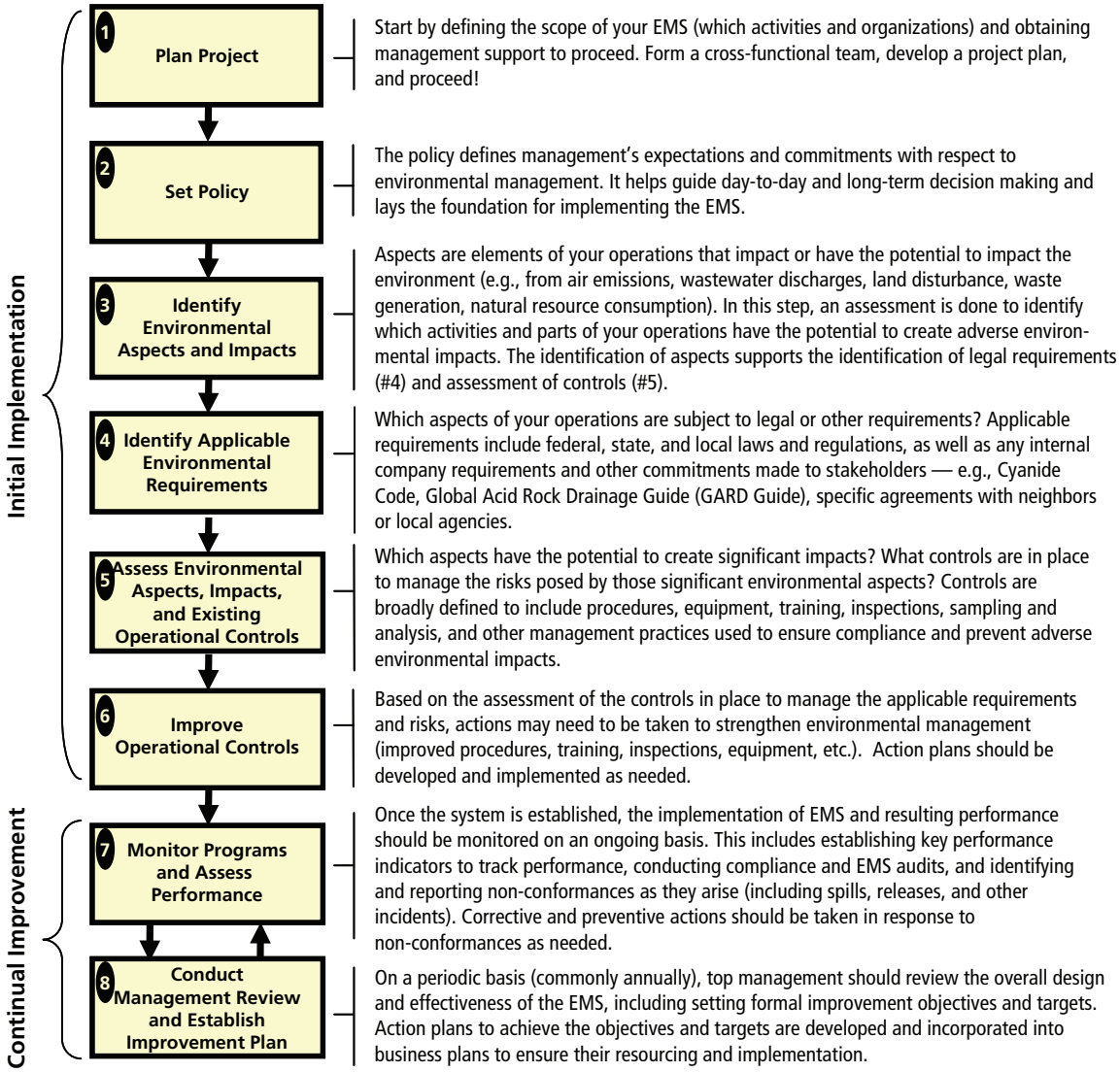
For the purposes of this guide, we have assumed that you already have management agreement to improve your EMS and therefore no significant discussion of the advantages of drafting and implementing an EMS is provided.

How and Who

i. *Define EMS project objectives and scope:* A fundamental first step in the implementation of an EMS is establishing the objectives and scope of the EMS. Management typically assigns someone to lead the overall effort, referred to as the EMS Coordinator in this guide. The EMS Coordinator is responsible for developing the overall plan, presenting and obtaining necessary approvals from management, and leading the implementation effort.

   Objectives—Companies implement an EMS for different reasons. In all cases, improving the consistency and quality of regulatory compliance and reducing environmental risks are primary objectives. Additional objectives may include

Figure 1. EMS Implementation Process



- Reducing environmental impacts (i.e., preventing pollution, reducing consumption of and protecting natural resources);
- Obtaining third-party certification to ISO 14001; and/or
- Improving a company's reputation with external stakeholders.

These objectives will impact your implementation approach. Since the primary goal is improving compliance, companies will need to take a rigorous approach in documenting applicable legal requirements and developing compliance calendars as well as inspection and audit programs. However, if reducing your environmental impact is an important objective, you will also need to focus on establishing programs to monitor and measure the impacts and take actions to reduce those impacts. If your objective is to obtain ISO 14001 certification, your company will need to concentrate more on the documented part of its program, since that is what the registrars will focus on. And if an objective

is improving your company's reputation with external stakeholders, external communications and outreach will be an important part of the EMS program. Some operations may have all these objectives in mind when they implement an EMS program.

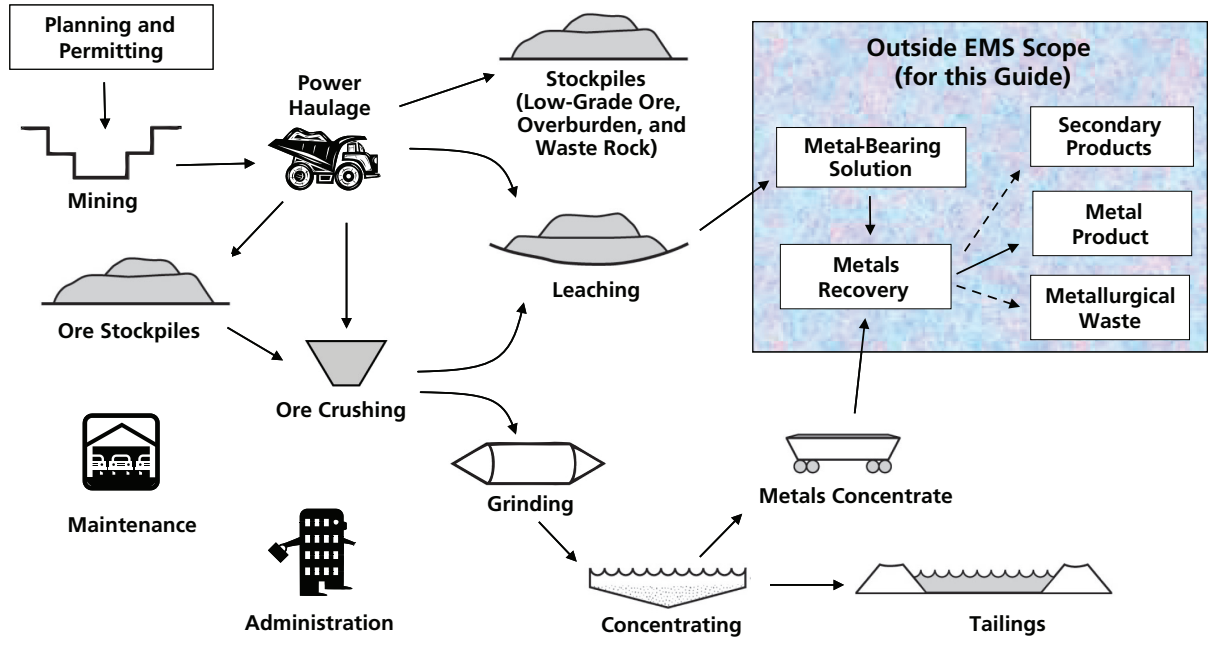
When developing the objectives, consider your organization's overall business climate and core business objectives. How can this EMS initiative create value for the company? How can it help your company achieve its business goals? Aligning the EMS objectives with the business's objectives will help build support for the EMS initiative and facilitate implementation.

Scope—The organizational/operational scope defines which specific sites, operations, departments, or process operations the EMS will address. Does the EMS cover only the extraction and beneficiation operations of the mine (i.e., ore extraction, leaching, crushing and grinding, flotation, electrowinning, and waste rock and tailings management)? Is there a need to include downstream activities such as smelting and refining? Should the EMS cover the upstream activities such as exploration and development? When dealing with an individual site, it is common for the EMS to address all on-site operations rather than parsing out specific parts of the mine and process. There is no right or wrong way to characterize the organizational/operational scope, but it must be defined. In fact, the very first clause of the ISO 14001 specification (Section 4.1) requires that the organization define and document the scope of its EMS.

For the purposes of this EMS guide, the scope is assumed to be solely mining extraction and beneficiation operations as illustrated in Figure 2.

ii. *Develop a project plan:* A good project plan can help ensure the success of any initiative. For an EMS implementation, the project plan should document your objectives, major steps in the process, responsibilities, timeline, and resource requirements (e.g., personnel and financial). The project plan

Figure 2. Generalized Hardrock Mining and Beneficiation Process



is useful for communications with key internal staff and for obtaining approval from management for the budget and other resources to support implementation.

This guide provides direction regarding the steps in the process and typical roles. The timeline will vary depending on the urgency and level of resources committed (considering both internal staff and consultants). An EMS can typically be implemented over a six-to-nine-month period. The level of resources required will vary primarily based on the extent and quality of existing environmental programs and systems. Experience has shown that the full-time equivalent (FTE) effort to implement an EMS is typically in the range of 0.5 to 1.0 FTE (~100–200 person-days, internal and external resources) for a medium-sized operation that has little in the way of formally defined systems.

iii. *Obtain management support:* It is critical to obtain top management's explicit support for EMS implementation during the initial planning phase, as they need to provide strategic direction and can help facilitate key actions, including formation of the team and allocation of resources. Given the typical complexity and level of activities at an operating mine, top management support is critical for ensuring the EMS initiative gets adequate priority in light of constrained budgets and competing initiatives.

iv. *Form a team:* Two key parts of the team are typical: (1) an EMS Coordinator (sometimes termed the "Management Representative"); and (2) an EMS Task Force or implementation team.

- The EMS Coordinator will have lead responsibility for planning and managing EMS implementation. This includes developing the project plan, forming and leading the task force, monitoring execution of the project plan and individual EMS tasks, and reporting to management on EMS implementation progress. The EMS Coordinator should be an experienced project manager who has adequate authority and credibility with management and staff to carry out the role.
- A task force should be formed to help plan and implement the EMS. The team can help ensure the quality of the implementation by ensuring that the perspectives of all relevant departments are factored into the implementation process. Participation in the team also helps build buy-in through staff members' direct involvement in managing the project and carrying out specific tasks. Team members should be assigned from all of the major departments, including operations, maintenance, engineering, shipping/receiving, facilities, and so forth, and should have detailed process knowledge of their respective area. Other departments that may participate in the team include health and safety, procurement, human resources, and external/community affairs. An example charter and kickoff meeting agenda is shown in Figure 3.

B. Set Policy

What and Why

The environmental policy states an organization's overall environmental commitments and guides the actions of employees and top management. The policy also represents a commitment to employees, the community, customers, and other stakeholders.

How and Who

i. *Develop a policy:* The policy is typically drafted by the EMS Coordinator in collaboration with the EMS Task Force for approval by senior management. However, the policy can also be drafted directly by senior site management, as it reflects their direction and expectations for environmental programs and performance. Other management and staff at the mine will be held accountable for acting in a manner consistent with those expectations. A simple, generic example of an environmental policy is shown in Figure 4. Most environmental policies are one page in length. At a minimum, they should

Figure 3. Example of an EMS Task Force Charter and Kickoff Meeting Agenda

EMS TASK FORCE CHARTER

- *Purpose:* To implement an effective environmental management system (EMS) that supports the achievement of our business goals, meets ISO 14001 [if applicable], and drives continual improvement in environmental performance.
- *Membership:* The EMS Task Force includes representatives from each of the operating areas at the site, as well as key support functions such as procurement, human resources, safety and occupational health, and engineering.
- *Member Roles:* The EMS Task Force members are expected to provide their perspectives on and constructively contribute to EMS planning and implementation, including the aspect assessment, establishment of operational controls, training, and setting of objectives and targets. They should also be visibly supportive of the initiative, particularly, bringing back messages to their departments.
- *Meeting Frequency:* The EMS Task Force will meet monthly, with additional meetings scheduled as needed during critical times throughout the implementation.

EMS TASK FORCE KICKOFF MEETING AGENGA

- Project overview, scope, and objectives
- Draft work plan
- Team charter and team member roles
- Detailed project planning
  - EMS model
  - Gap analysis
  - Existing systems to leverage
  - Legal registry
  - Aspects and impacts
  - Project management
- Wrap-up
  - Agreements
  - Short-term next steps
  - Next meeting

include clear commitments to (1) compliance with applicable legal requirements and any other requirements or commitments made (e.g., Cyanide Code and GARD Guide); (2) prevention of pollution; and (3) continual improvement of environmental programs and performance.

ii. *Issue the policy:* Senior management is responsible for issuing the policy and ensuring its implementation. The policy should be effectively communicated to all employees, as well as others working on behalf of the organization (e.g., contractors working on-site). Approaches for rolling out and communicating the policy internally include in-person briefings at staff meetings and other ongoing meeting venues, e-mail notification, posting on electronic and physical bulletin boards, and articles in company newsletters. Many companies reinforce the policy by including it in refresher training and other ongoing communications. The policy is commonly incorporated into new employee orientation training. The policy should also be made available to external stakeholders, either on request or by posting it on the company's Internet site.

C. Identify Environmental Aspects and Impacts

What and Why

Environmental aspects are the elements of your facility's activities that can impact environmental performance, that is, impact the environment or regulatory compliance status. By identifying your environmental aspects, you identify what activities and associated impacts need to be controlled to achieve your environmental performance objectives. More significant aspects require more significant controls, helping to manage environmental risk.

How and Who

The EMS Task Force should take the lead in identifying your environmental aspects and associated impacts. Consider the following recommended steps:

Figure 4. Example of an Environmental Policy

ABC Environmental Policy

At ABC, we believe good environmental performance is fundamental to our business success. We are committed to the following:

- Compliance with applicable legal requirements
- Prevention of pollution, with an emphasis on source reduction and managing long-term risks
- Reduction in the use of natural resources, including through energy and water conservation
- Implementation of formal management systems to drive consistent and continually improving programs and performance
- Communication with internal and external stakeholders regarding our environmental programs and performance

All employees are responsible for understanding this policy and incorporating its intent into day-to-day activities and decision making.

i. *List or map out activities:* The first step is to identify the activities and operations that are within the scope of your management system. This typically includes core production activities such as mining, ore crushing and grinding, leaching, metals recovery, concentrating, and tailings management, as well as supporting activities such as permitting and planning, conveyance, maintenance, and construction. Refer to Figure 2 for a simplified schematic of a typical hardrock mine's operations.

ii. *Determine aspects and impacts associated with the activities:* Next, identify all of the environmental aspects associated with those activities and operations and the actual and potential impacts they can have on the environment. Refer to the example in Figure 5. As previously mentioned, this activity should be carried out with the input of the cross-functional task force, ensuring that a complete view of your operations has been considered and that no relevant aspects are missed.

D. Identify Applicable Environmental Requirements

What and Why

Since reliable and consistent regulatory compliance is a primary objective of the EMS, staying current on applicable environmental requirements and ensuring specific tasks to achieve compliance with those requirements are defined and communicated to relevant staff is core to the EMS. Applicable requirements include both legal requirements and other commitments made to stakeholders.

- Legal requirements include those coming from federal, state, and local regulatory agencies. They could include requirements from permits, regulations, laws, ordinances, and any enforcement agreements. They can also cover topics such as monitoring and reporting, training, inspections, maintenance, and other activities. Some of the requirements may recur on a regular basis (e.g., annual training, monthly reporting, and daily sampling), and others may be triggered by an event or activity (e.g., reporting spills, maintaining manifests when shipping hazardous wastes). Non-compliance could result in significant fines, additional regulatory scrutiny, and negative media coverage depending on the nature and severity of the non-compliance. If severe, regulatory non-compliance can directly affect your license to operate.

Figure 5. Typical Environmental Aspects and Potential Impacts for a Mining and Beneficiation Operation

Activity/Operation	Environmental Aspects	Environmental Impacts
Planning and Permitting	Land disturbance	Disturbances of floodways and river ways
	Land disturbance	Potential degradation of sensitive areas: archeological, cultural, aquatic, terrestrial; threatened and endangered species
	Land disturbance	Property boundaries, stockpile height restrictions, visual impacts
	Land disturbance—Reclamation and closure	Terrestrial habitat (flora and fauna) and aquatic habitat recovery; mitigating impacts to surface aquatic habitat and groundwater
Mining	Stormwater runoff	Acid rock, alkaline, or saline drainage impact on soil, surface water, and groundwater
	Greenhouse gas (GHG)/combustion byproducts from equipment	Deposition of particulates, climate change, acid rain, air quality degradation
	Water and wastewater disposition from mine dewatering and/or mine water disposal	Surface or underground mining—Water table reduction/ depletion: acid rock, alkaline, or saline drainage impact on soil, surface water, and groundwater degradation
	Water use in drilling	Water usage in drilling operations
	Land disturbance	Cutting new haul roads, mine portal or surface mine development, haul road development: potential disturbance of terrestrial and/or aquatic habitat
	Fugitive dust emissions (blasting, loading)	Deposition of particulates, air quality degradation
	Blasting: noise and vibration	Nuisance to neighbors and fauna
	Blasting: waste explosives packaging materials	Potential fire or explosive hazard, potential release to water or soils
Power Haulage	Fugitive dust emissions (transfer locations, road traffic, dumping)	Deposition of particulates, air quality degradation
	Anti-tampering devices on large off-road vehicles	Deposition of particulates, air quality degradation
	Truck hitting wildlife	Fauna
	Noise	Noise from operation of trucks
	GHG/combustion byproducts from mobile sources	Deposition of particulates, climate change, acid rain, air quality degradation
Stockpiles (Ore, Low-Grade Ore, Overburden)	Infiltration and stormwater runoff	Acid rock, alkaline, or saline drainage impact on soil, surface water, and groundwater
	Slope stability	Potential impact to human health and to soil, surface water, and groundwater
	Ore stockpile: fugitive dust emissions (dumping, wind erosion)	Deposition of particulates, air quality degradation
Ore Crushing	Crushing: fugitive dust emissions	Deposition of particulates, air quality degradation
	Air pollutant emissions from energy use (electricity) and equipment combustion sources	Deposition of particulates, climate change, acid rain, air quality degradation

(continues)

Figure 5. Typical Environmental Aspects and Potential Impacts for a Mining and Beneficiation Operation (continued)

Activity/Operation	Environmental Aspects	Environmental Impacts
Leaching	Leachate potential to escape pad containment systems	Groundwater contamination
	Leach pad slope stability	Potential impact to human health and to soil, surface water, and groundwater
	Stormwater runoff from pad	Surface water contamination
	Spills/leakage or waste generation from process chemicals (cyanide, acid, or pregnant leach solution [PLS])	Soil, surface water, and groundwater
	PLS collection and holding ponds	Groundwater and/or surface water contamination
	PLS collection and holding ponds	Wildlife
	Process wastewater discharge	Soil, surface water, groundwater, air emissions
Solvent Extraction/ Electrowinning (SX/EW)	Spills from tanks or pipes or waste generation from process chemicals mismanagement	Soil, surface water, groundwater, air emissions
	SX plant volatile organic compound (VOC) emissions	Air quality
	EW tankhouse acid mist emissions	Air quality
	Air pollutant emissions from energy use (electricity)	Deposition of particulates, climate change, acid rain, air quality degradation
	Generation and management of lead flake and lead anodes	Potential impact on soil, surface water, and groundwater
Grinding	Spills	Potential impact on surface water and groundwater
	Generation of dust	Air quality
	Air pollutant emissions from energy use (electricity)	Deposition of particulates, climate change, acid rain, air quality degradation, mercury volatilization
Concentrating	Process wastewater disposition	Soil, surface water, and groundwater
	Spills or waste generation from metallic mineral concentrate mishandling	Acid rock drainage and metals leaching impact on soil, surface water, and groundwater
	Concentrate storage	Potential migration from wind erosion or stormwater
	Flotation reagents: fugitive VOC air emissions	Air quality
Tailings	Tailings conveyance/piping—spills	Potential impact on surface water and groundwater
	Fugitive dust emissions	Deposition of particulates, air quality degradation
	Leakage to groundwater	Degradation of groundwater quality
	Seepage collection, management, and disposition	Degradation of surface water and groundwater quality
	Stormwater runoff	Surface water contamination
	Dam slope stability	Potential impact to human health and to soil, surface water, and groundwater
	Pond water quality	Wildlife through ingestion and/or contact
Maintenance Activities	Generation of used tires	Waste disposal/land use
	Generation of used oil and grease	Waste disposal

(continues)

Figure 5. Typical Environmental Aspects and Potential Impacts for a Mining and Beneficiation Operation (continued)

Activity/Operation	Environmental Aspects	Environmental Impacts
Maintenance Activities (continued)	Generation of used lead acid batteries	Waste disposal
	Parts washer management	Waste disposal and potential air emissions
	Polychlorinated biphenyls (PCBs) equipment	Potential impact to human health and to soil, surface water, and groundwater
	Spray painting	Air quality
	Impacted stormwater runoff (maintenance areas)	Surface water contamination
	Wastewater generation (wash racks, oil–water separators, sewage treatment systems, wastewater treatment systems)	Soil, surface water, and groundwater
Sitewide	Chemical management/inventory	Potential impact to human health (spills, fire, explosion); waste disposal
	Generation of potentially hazardous wastes (e.g., aerosol cans, paint)	Waste disposal
	Fuel storage/dispensing	Spills and leaks—potential impact to soil, surface water, and groundwater
	Drinking water supply (water quality)	Human health
	Contact stormwater ponds	Soil, surface water, and groundwater
	Non-contact stormwater runoff	Potential impact on soil, surface water, and groundwater
	Asbestos-containing materials	Potential impact to human health; waste disposal
	Equipment storage/laydown yards potential leakage (ozone-depleting substances, PCBs, oil, and grease)	Potential impact on soil, surface water, and groundwater
	Building demolition	Waste disposal
	Housekeeping	Visual impacts, potential impacts to groundwater
	Waste disposal (proper segregation of wastes and management of landfills)	Potential impact to human health and groundwater
	Waste management—off-site recycling	Waste disposal
	Petroleum-contaminated soils management	Waste disposal
	Open burning	Air quality degradation
	Legacy environmental issues	Surface water/groundwater contamination
	Water usage	Depletion of natural resources/exceed allowable water withdrawals
Office/Administration	Office and food waste generation and disposal	Soil, surface water, groundwater, nuisance litter, vector (rodent) management
	Resource use (paper, plastic, toner, etc.)	Reduction in non-renewable resources
	Air pollutant emissions from energy use (electricity) and HVAC sources	Deposition of particulates, climate change, acid rain, air quality degradation

- Other commitments to stakeholders could include agreements with neighbors, industry associations (e.g., Cyanide Code and GARD Guide), or local emergency planning and response organizations, as well as self-imposed corporate or site requirements (e.g., banning the use of chlorinated solvents).

How and Who

Typically, the site environmental department is responsible for identifying all legal and other requirements. The process consists of developing an inventory or register of all environmental permits, regulations, commitments, and so on, and then defining all of the individual compliance tasks associated with these requirements. These tasks can then be put into a "compliance calendar" or other management tool that can be used to manage compliance on a day-to-day basis.

i. *Create and maintain a register of requirements:* Applicable legal and other requirements (as previously described) should be documented in a register or similar document. The intent is not to restate the Code of Federal Regulations, but rather to ensure that the key laws and regulations that apply (in addition to the "other" commitments) are explicitly identified. Appendix 2 provides an overview of the major federal laws and regulations that may apply to a typical hardrock mining and beneficiation operation. However, this must be an ongoing process, as legal requirements change over time. This can be achieved by subscribing to newsletters, contracting with third-party services, monitoring agency Websites, and so on. **Note:** *Refer to the environmental aspects identified in the previous step to confirm that you have considered any regulations pertaining to those activities and aspects.*

ii. *Create and maintain a compliance calendar:* The applicable requirements should then be translated into specific actions assigned and communicated to specific individuals and managed through a compliance calendar or similar tool. An example tool is shown in Figure 6. Increasingly, companies are using information technology to manage the compliance calendar, whether it be a simple spreadsheet or database, or part of a larger enterprise EMIS (environmental management information system) application. Regardless of the tool used, compliance-related actions should be defined, assigned, communicated, and tracked through closure.

    Companies starting new mining projects may also want to meet with local and state regulators early in the process to identify the staff members who will be involved in permitting the project, to understand the sequence of permitting activities, to learn the specifics of what may be required beyond what is provided in the regulations, and to determine how various agencies work together.

E. Assess Environmental Aspects, Impacts, and Existing Operational Controls

What and Why

In Section 3.C of this EMS Guide, a comprehensive list of activities and aspects that can impact environmental performance was developed. In Section 3.D, applicable legal and other requirements were identified. In this step, the environmental aspects are assessed to determine which aspects are significant and warrant formal operational controls to ensure regulatory compliance, prevent adverse impacts, and manage risk. A two-step process is used:

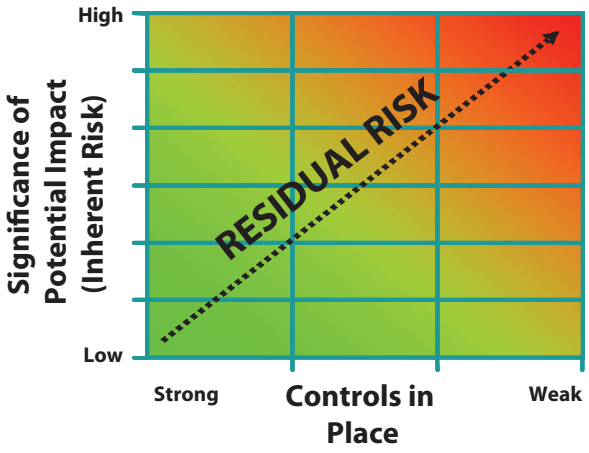
1. Assess the relative significance of the aspects based on actual or potential impacts.
2. Determine the residual risk associated with each of the significant aspects based on the operational controls currently in place to manage them. This will help to identify where improvements to controls may be needed.

Figure 6. Example of a Compliance Calendar

Topic/Action	Comments	Owner	Timing											
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wastewater														
Discharge Monitoring Report (DMR)	Monthly, by 28th of following month	Bill J.	M	M	M	M	M	M	M	M	M	M	M	M
Wastewater sampling per NPDES permit	Monthly requirement	Bill J.	M	M	M	M	M	M	M	M	M	M	M	M
Wastewater sampling per NPDES permit	See permit for analyses	Bill J.	S						S					
NPDES Permit Fee	$8,700 payable to State of Nevada	Tanya R.												1st
Etc.														
Atmospheric Emissions														
Annual Emissions Statement	Start at least one month before due date	Sue S.			1st									
Semi-Annual Certification		Sue S.	31st						31st					
Fuel consumed (6 regulated combustion units)	Log book to be completed	Sue S.	D	D	D	D	D	D	D	D	D	D	D	D
Annual Emissions Fee	Should receive invoice from State	Tanya R.					A							
Fugitive emissions visual inspections	Must complete inspection form	Sue S.	D	D	D	D	D	D	D	D	D	D	D	D
Etc.														
Spills (SPCC, ICP)														
Containment Area Inspection for Rain	Document when precipitation is drained	Bill J.	W	W	W	W	W	W	W	W	W	W	W	W
Bulk Storage Container Inspections	Use designated inspection form	Bill J.	M	M	M	M	M	M	M	M	M	M	M	M
Five-Year Plan Renewal	Next due by April 2011	Bill J.												
SPCC Training (Oil Briefing)	Only oil-handling employees	Bill J.							A					
Etc.														
Stormwater														
Visual inspections during rainfall event	Can be any point in each quarter	Bill J.			Q			Q			Q			Q
Collection of stormwater samples (for TSS)	Must be a qualifying rain event	Bill J.					A							
DMR required for quarterly sampling results	March 31 of year following monitoring period	Bill J.	31st			31st			31st			31st		
Annual Comprehensive Facility Audit	Not submitted—filed on-site	Bill J.						A						
Etc.														
Emergency Planning and Community Right-to-Know Act (EPCRA)														
Tier II Reporting (SARA 312)	Submit to State, LEPC, and local fire department	Tom N.			1st									
Form R Reporting (SARA 313)	Start at least one month before due date	Tom N.						1st						
Etc.														

ICP = Integrated Contingency Plan
LEPC = Local Emergency Planning Committee
NPDES = National Pollutant Discharge Elimination System
SARA = Superfund Amendments and Reauthorization Act of 1986
SPCC = Spill Prevention, Control, and Countermeasure
TSS = total suspended solids
A = annually; D = daily; M = monthly; Q = quarterly; S = semi-annually; W = weekly.

Figure 7. Conceptual Model for Assessing Aspects and Risk



This process is illustrated in Figure 7 and described in more detail, with specific examples, in the text that follows.

How and Who

The EMS Task Force is responsible for developing the list of significant aspects and assessing the adequacy of controls in place to manage them. Many ways can be used to determine significance, but whatever approach is selected, you need to document the process so it can be repeated consistently.

The objective is to review all the aspects in a methodical, common-sense way to determine what aspects are critical to environmental performance (regulatory compliance and control of environmental risks/impacts) and therefore need to be managed and/or controlled to ensure that you are achieving your objectives consistent with the environmental policy.

An example of a proposed process is described here, consistent with the conceptual model shown in Figure 7.

i. *Assess the relative significance of your environmental aspects:* A range of tools are available for making this determination, including detailed quantitative risk assessment methodologies. However, simpler and less data-intensive approaches can be used. For example, using the table shown in Figure 8, rate each aspect based on (1) its potential impacts to people and the environment (in both the short and long term); (2) whether it is regulated and the level of regulatory scrutiny; and (3) other potential business impacts (e.g., damage to reputation, creation of financial liability). A simple 0, 1, 2, and 3 or low/medium/high scoring system can be used. Figure 8a describes the scoring scheme used in this specific example. Figure 8 focuses on the mining operations only. See Appendix 3 for a more complete tool that assesses significant environmental aspects for mining and beneficiation operations.

   When rating the aspects, consider the impacts assuming that any existing controls are not in place or are not effective—this allows you to determine the inherent risk associated with the aspect, its potential to create adverse impacts, and the need for formal operational controls. The adequacy of existing controls will be factored in during the next step.

   Please note that this tool is just that, a tool. It is important to apply common sense and professional judgment to this process and not let the tool constrain you. Other approaches can also be used.

Figure 8. Tool for Assessing the Significance of Environmental Aspects—Example for Mining Operations Only

(See Appendix 3 for a complete example that addresses all aspects in Figure 5.)

Activity/ Operation	Environmental Aspects (from Figure 5)	Environmental Impacts (from Figure 5)	Significance Ratings				Significant [Y/N]
			People and the Environment	Compliance	Other Business Impacts	Total*	
Mining	Stormwater runoff	Acid rock, alkaline, or saline drainage impact on soil, surface water, and groundwater	2	3	2	7	Y
	Greenhouse gas (GHG)/ combustion byprod- ucts from equipment	Deposition of particulates, climate change, acid rain, air quality degradation	2	1	2	5	N
	Water and wastewater disposition from mine dewatering and/or mine water disposal	Surface or underground mining—Water table reduction/ depletion: acid rock, alkaline, or saline drainage impact on soil, surface water, and groundwater degradation	3	3	3	9	Y
	Water use in drilling	Water usage in drilling operations	1	1	1	3	N
	Land disturbance	Cutting new haul roads, mine portal or surface mine develop- ment, haul road development: potential disturbance of terrestrial and/or aquatic habitat	2	2	1	5	N
	Fugitive dust emissions (blasting, loading)	Deposition of particulates, air quality degradation	2	2	2	6	Y
	Blasting: noise and vibration	Nuisance to neighbors and fauna	3	1	1	5	N
	Blasting: waste explosives packaging materials	Potential fire or explosive hazard, potential release to water or soils	1	2	1	4	N

*The total "significance" score is the sum of the three individual significance ratings. Guidance for scoring is described in Figure 8a. For the purposes of this example, any aspect with a score of 6 or higher is deemed "significant aspect."

ii. *Assess the controls in place to manage the aspects and identify opportunities to improve them:* All significant aspects need to have formal controls to ensure they are properly managed. In this step, controls are assessed to ensure acceptable environmental performance outcomes and to identify opportunities to improve consistency/robustness of controls (which can be incorporated into the action plan described later in Section 3.F). The process includes documenting the controls in place and assessing their adequacy. Controls are broadly defined to include administrative controls such as standard operating procedures, training, inspections, preventive maintenance programs, monitoring and measurement activities, emergency plans, and document/records management, as well as engineered controls such as pollution control equipment, containment structures, alarm systems, and so on. Refer to

Figure 8a. Significance Rating Scoring Guidance for Figure 8

Rating	Potential Impacts to People and the Environment	Compliance	Other Potential Impacts to the Business (e.g., cost, reputation)
0	No measurable effect on people (those working on-site or neighbors/other stakeholders) and/or the environment.	Not regulated, no potential for non-compliance.	No cost impact. No effect on reputation.
1	Potential for localized and limited effect that is quickly reversed. • **Environmental:** Limited impacts to the environment that have limited and relatively quickly reversible effects. • **Health & Safety:** Minor employee or neighbor illness or injury; would not likely result in any significant lost time.	Not regulated, no potential for non-compliance.	Cost impact, but not material or disruptive to business. Reputation impacts to a few local and relatively low-priority stakeholders.
2	Potential for more widespread and significant impact that is not quickly or easily reversed. • **Environmental:** Off-site environmental impacts that are not quickly or easily reversed. • **Health & Safety:** Lost-time injuries or credible third-party health claims.	Regulated, potential for non-compliance.	Material cost impact; minor business loss due to delay, stoppage, or damage to property. Local and national reputation impacts to local and national stakeholders and will likely impact their decision making; causes adverse media attention.
3	Potential for very serious and sustained damage. • **Environmental:** Sustained or catastrophic impacts causing widespread and irreversible environmental damage. • **Health & Safety:** Potential for fatalities among employees and/or neighbors.	Regulated, potential for non-compliance, a focus area for regulators.	Material cost impact; major loss due to delay, stoppage, or damage to property that will seriously impact business results. Serious damage to reputation of local, national, and international stakeholders; directly impacts license to operate and commercial performance; causes adverse international media attention.

Figure 9, which ties-in with Figure 8. As with the significance ratings, this can be done in a qualitative or quantitative fashion.

Note that in Figure 9, this analysis is only done for the "significant aspects"—the others are shown as not applicable (NA). Over time, this same analysis can be applied to all of the aspects, but it is important to start with the significant ones, since they have the greatest inherent risk and should have the most robust controls in place.

As with the aspect assessment process and tool shown in Figure 8, common sense and professional judgment should be applied in the use of the process and tool for the assessment of controls and residual risk illustrated in Figure 9.

Consider the following guidance on each type of control, recognizing that the effective management of environmental compliance, impact, and risk will likely require combinations of most of these types of controls.

a. *Procedures:* Formal procedures should be in place to manage the significant environmental aspects. These need not be discrete procedures for the aspect itself. They may take the form of standard operating procedures and work instructions for specific equipment, activities, or process operations

Figure 9. Tool for Assessing Controls and Residual Risk—Example for Mining Operations Only

(See Appendix 4 for a complete example that addresses all aspects in Figure 5.)

Activity/ Operation	Environmental Aspects	Significant Aspects		Controls in Place	Controls Rating*	Residual Risk†	Improvement Actions
		Score	Y/N				
Mining	Stormwater runoff	7	Y	Stormwater Pollution Prevention Plan (SWPPP), potentially acid generating (PAG) waste containment cells, diversion ditches, collection ponds, stormwater reuse, training, procedures, excess water treatment, stormwater discharge permit	2	3.5	Annual review and update of SWPPP along with monitoring results to drive improvements to applicable engineering and administrative controls.
	Greenhouse gas (GHG)/combustion byproducts from equipment	5	N	NA	NA	NA	NA
	Water and wastewater disposition from mine dewatering and/or mine water disposal	9	Y	Dewater water reuse, excess water treatment, water discharge permit, water quality monitoring	3	3	Develop and maintain a water use/reuse program and treatment of excess dewater and/or process water as required.
	Water use in drilling	3	N	NA	NA	NA	NA
	Land disturbance	5	N	NA	NA	NA	NA
	Fugitive dust emissions (blasting, loading)	6	Y	Dust mitigation plan, including water truck spraying, chemical suppressants, no blasting in strong winds, air monitoring at facility perimeter	2	3	Develop and maintain a Fugitive Dust Plan.
	Blasting: noise and vibration	5	N	NA	NA	NA	NA
	Blasting: waste explosives packaging materials	4	N	NA	NA	NA	NA

* The controls rating scheme is described in Figure 9a.

† In this example tool, the residual risk score is the significance (inherent risk) score divided by the controls score.

Figure 9a. Controls Rating Scoring Guidance for Figure 9	
Rating	**Quality and Effectiveness of Controls**
1	No controls in place. • No engineered controls in place (such as containment devices, spill response equipment, tank leak detection, etc.). • People not aware of or trained to manage aspects, no procedures, etc. History of non-compliance and frequent incidents or near misses.
2	Some administrative and engineered controls in place; however, extent is limited (e.g., there are no redundant controls) and they are not consistently maintained or applied. • Some engineered controls in place. • Awareness of aspects, some simple procedures (inconsistently applied), basic training of employees. • Limited control of pollution and higher ratio of resource consumption and waste given work activity level than rest of company/industry. Incident history (including near misses), inspection/audit results, or stakeholder actions demonstrate shortcomings in performance.
3	Administrative and engineered controls in place and are generally effective. A single failure in a control unlikely to lead to an incident. • Procedures, pollution control equipment, technology, prevention plans, and monitoring in place. • Good awareness, procedures defined and generally followed for all hazards, advanced training for employees and contractors. However, incident history (including near misses), inspection/audit results, or stakeholder actions indicate some ongoing exposures and modest gaps in performance.
4	Engineered controls in place and well-maintained, well-established standard operating procedures, high level of awareness among employees and contractors. • Best available technology to physically *prevent* adverse impacts, frequent monitoring, programs/investments in eco-efficiency or industrial ecology to minimize resource consumption and waste. • Excellent training programs in place for employees and contractors, strong evidence of an environmental culture among employees and contractors, rigorous application of comprehensive and well-defined procedures. Sustained history of demonstrated control based on lack of incidents and near misses.

in which the environmental aspects are explicitly addressed. In addition, procedures should be in place to address management of change, ensuring potential environmental issues (compliance, impact, risk) are factored into new projects and operational changes. Employees, contractors, and visitors should be trained in relevant procedures. Procedures should be periodically reviewed and updated as needed.

b. *Engineered controls:* Engineered controls include pollution control equipment such as baghouses, electrostatic precipitators, and water and wastewater treatment equipment, as well as containment structures for fuel and chemical storage, and drainage systems to control the flow of stormwater. Engineered controls need to be properly operated and maintained to remain effective and should be incorporated into a mine and beneficiation plant's preventive maintenance program.

c. *Training:* Employees, contractors, and visitors whose activities have the potential to impact environmental performance must be competent to carry out their assigned roles (e.g., as defined in procedures, job descriptions) based on experience, education, or training. Many organizations develop a training requirements matrix to define who needs what type of training. This is most commonly done on a position-by-position basis. An example of a training requirements matrix is shown in Figure 10. Training needs can be met through classroom training, toolbox talks, computer-based training, or other means as appropriate.

Figure 10. Example of a Training Needs Assessment

	Course/Topic	Frequency/Timing		Environmental Staff	Miners	Mine Maintenance	Processing Operations	Process Maintenance	Warehouse	Lab Technicians	Contractor Management	Etc.
Regulatory	Spills Management	Annual	1Q	x	x	x	x	x	x	x	x	
	Wastewater Management	Annual	1Q	x	x	x	x	x	x	x	x	
	Emergency Response Training	Annual	1Q	x	x	x	x	x	x	x	x	
	Waste Management	Annual	1Q	x	x	x	x	x	x	x	x	
	Department of Transportation	3 years	1Q	x	x	x	NA	NA	x	NA	x	
	Etc.											
General	Contractor EMS Awareness	Annual	1Q	x	x	x	x	x	NA	NA	x	
	Employee EMS Awareness	Initial+	NA	x	x	x	x	x	x	x	NA	
	Etc.											
Job-Specific	Tailings Management	Initial+	3Q	x	x	x	x	NA	NA	NA	NA	
	Wastewater Outfall Management	Initial+	4Q	x	x	x	x	x	NA	NA	NA	
	Mining, Milling/Processing	Initial+	4Q	x	x	x	x	x	NA	x	NA	
	Fugitive Dust Control Plan	Initial+	3Q	x	x	x	x	x	x	x	NA	
	Process Water Management	Initial+	1Q	x	x	x	x	x	NA	x	NA	
	Stormwater Management	Initial+	2Q	x	x	x	NA	NA	NA	NA	NA	
	Chemical & Waste Management	Initial+	2Q	x	x	x	x	x	x	x	x	
	Wildlife Protection	Initial+	4Q	x	x	x	x	x	x	x	NA	
	Etc.											

d. *Monitoring and measurement:* Monitoring and measurement activities can include physical sampling and analysis of emissions, discharges, and other waste streams; process control systems that monitor and control key operational parameters; and visual observations of work activities/operations. Many environmental permits specify sampling and analysis requirements, including the streams that should be sampled, frequency of sampling, sampling technique (e.g., grab, composite), constituents to sample for (acid-base account, metals, pH, acidity, weak and dissociable cyanides, etc.), analytical techniques to use (ASTM standards, GARD Guide, etc.), equipment calibration, and agency reporting requirements. Chain-of-custody procedures should be in place for quality assurance. Routine sampling, equipment calibration, and reporting activities should be incorporated into the compliance calendar discussed in Section 3.D. Many companies establish key performance indicators to measure and track performance in key areas, based on the results of the aspect assessment. These can include measurements of environmental impacts (e.g., energy use, water use, wastewater discharges, and waste generation and disposal on an absolute or production-adjusted basis) and compliance performance (e.g., completion of compliance calendar activities, reportable spills/releases). Audits are also an important tool in monitoring EMS implementation, compliance, and performance. A formal audit plan should be developed to ensure that all areas of the site and EMS are audited with special emphasis on the areas with higher risk. Finally, routine inspections can be used to monitor operations on a day-to-day basis. Common topics/areas to

address during inspections include waste storage, potentially leaking equipment, visible emissions, slope stability and berm integrity, discoloration of emissions/discharges, and soil and vegetation that might indicate malfunctioning equipment or other problems with operations.

e. *Emergency response:* Plans should be in place to anticipate and respond to emergencies. Plans should address an appropriate range of emergency scenarios, including unplanned and uncontrolled releases (e.g., spills) resulting from accidents, equipment failure, and so forth. Consider the results of the aspect assessment when defining the types of scenarios that should be addressed in the emergency plans (e.g., fuel spill, cyanide or tailings spill, pollution control device failure). Where possible, integrate various environmental-related emergency response plans (ERPs) into one integrated plan (e.g., Spill Prevention Control and Countermeasure Plan, Stormwater Pollution Prevention Plan). All employees should be trained on the basics of the emergency plans and their roles in responding to an emergency. Those with special roles (e.g., first responders, incident commanders) will require special training. The plans should be tested on a regular basis to ensure that equipment is properly deployed and functional and that everyone is aware and competent to carry out their assigned roles in the event of an emergency. Emergency plans should be modified based on the results of those tests and lessons learned from plan deployment in the event of an actual emergency. A table of contents for a typical ERP is shown in Figure 11.

f. *Documentation and recordkeeping:* Documentation of key processes and procedures provides important reference materials and the basis for training activities. Documents need to be controlled to ensure they are reviewed and updated as needed and that only current versions are being used. Records retention is particularly important for regulatory compliance. Some regulations specify records retention requirements. Having ready access to records allows you to easily demonstrate compliance during agency visits. Good records retention practices also allow you to analyze past performance and manage the EMS on an ongoing basis. A listing of typical documents and records that are commonly part of a mine's EMS (and that require document control and maintenance) is shown in Figure 12.

   Figure 13 provides an example approach for documenting the controls in place to manage a significant environmental aspect (in this case, wastewater discharges). Appendix 5 provides two additional tables, using a format similar to the example shown in Figure 13, which describe the types of controls that could be put in place to manage stormwater runoff and fugitive dust emissions from hardrock mining operations. These aspects were identified in Figure 8 as being significant for mining operations. These tables may also prove helpful in assessing your controls and identifying opportunities to improve them, mitigating environmental risk (per the process illustrated in Figure 9).

F. Improve Operational Controls

What and Why

Based on the identification of significant environmental aspects (Section 3.C) and applicable legal and other requirements (Section 3.D), and the assessment of controls in place to manage them (Section 3.E), actions should be taken to improve the controls as needed to ensure regulatory compliance and effective management of impacts and risk. It is not uncommon for sites to determine that formal controls do not exist for some of the risks or that they are missing important supporting processes (e.g., document control for procedures; environmental review of operational changes; communications of critical information across shifts, departments, and organizational levels).

Figure 11. Example of a Table of Contents for an Emergency Response Plan

This element focuses on developing and implementing an action plan to improve the controls in place to ensure effective environmental management.

How and Who

i. *Develop an action plan:* Led by the EMS Task Force and based on the assessment of controls, specific improvement actions should be formalized into a plan for approval by management to ensure resourcing and follow-through. An example of a formal action plan can be found in Figure 14. Key elements of the plan include the following.

- *Action:* Describe the action in adequate detail so that a third party not involved in plan development could understand it.
- *Who:* Each action should be clearly assigned to an individual (not just a department) with lead responsibility for implementing it.
- *Resources required:* Define the level of effort needed to carry out the action, including person-days of internal effort, external consulting support, and capital requirements.
- *Timing:* Establish a time frame for each action. Actions may need to be staggered based on priorities, dependencies, the overall capacity of the organization to absorb change (i.e., you may not be able to do everything at once without overwhelming people given their existing day-to-day operational responsibilities), and other considerations (e.g., cash flow/capital constraints).

Figure 12. Example of EMS Documents and Records to Maintain and Control

Environmental Management Systems

- Environmental policy and records demonstrating its dissemination
- Emergency management systems manual
- Environmental aspects assessment process and results
- Objectives, targets, and improvement plan and status reports
- Inspection and audit reports
- Incident (and investigation) reports
- Corrective and preventive action plans and status reports
- Management review documentation
- Employee and contractor training records
- Standard operating procedures
- Change management reviews
- Preventive maintenance records
- Piping and instrumentation diagrams
- Internal and external communications
- Emergency planning and response plans and documentation of training and drills

Air Emissions

- Air permits, applications, and emissions inventories
- Equipment operation and maintenance (O&M) and calibration records
- Boiler operator training certifications
- Refrigerant technician training certifications
- Refrigerant management procedures and records

Waste Management

- Hazardous waste manifests
- Waste analyses test results (metals, static, leaching and kinetic tests for ore, waste rock, and process wastes)
- Inspection and training records
- Contingency plans
- Biennial/annual reports
- Recycling records for universal waste
- Used oil, medical waste, and off-spec disposal records

Stormwater

- Notice of intent or no exposure certification
- Stormwater permit and pollution prevention plan
- Training and inspection records
- Monitoring/testing records
- Piping/drain diagrams

Hazardous Chemicals

- Toxic release inventory (Forms R or A)
- Hazardous chemical inventories (Tier II)
- Release/spill reports

Oil Operations/Tanks

- Spill plan/State spill plan
- Oil discharge reports/notifications
- Inspection and training records
- Tank registrations or closure records
- Underground and aboveground storage tank records

Wastewater Discharges

- Piping/drain diagrams
- Permit and application from publicly owned treatment works or letter of authorization
- Sewer ordinance
- Discharge permit, application, and monitoring reports
- Exception reports
- Laboratory certifications
- Monitoring/testing records
- Off-site disposal records
- Operator training certifications
- Equipment O&M and calibration records
- Slug prevention plan
- Septic tank registration and maintenance records

Drinking Water/Groundwater

- Records on water system repairs
- Maintenance, changes, and analytical records
- Backflow prevention inspections
- Groundwater well installation records
- Groundwater appropriations permit

Note: *Many companies establish record retention guidelines for specific records.*

Figure 13. Example of Operational Controls for Significant Environmental Aspects	
Significant Environmental Aspects Wastewater Discharges from Mining Operations Only	
Potential Impacts	• Permit non-compliance of water quality standards or discharge flow rates • Exceed water quality standards at treated effluent discharge point in river • Adverse impact to aquatic ecology in river • Operating cost inefficiencies at wastewater treatment plant (WWTP)
Programs, Procedures, Work Instructions	• Standard design and operating procedures • Assigned responsibilities • Shift change communications • Operating logs and corrective actions • Critical ranges of vital operating/compliance indicators • Calibration protocols for monitoring and measuring devices • Inspection and maintenance procedures • Integration of WWTP with site operations—communications procedures
Engineered Controls (hardware)	• PLC (programmable logic controller) systems—integration with operation systems • Flow measurement, pH and conductivity adjustment systems, automated samplers, filtration systems, thickeners, and other tank systems, etc. • Automated alarms (out of spec)
Training	• Standard operating procedures (safety, equipment operating tolerances, flow management, change-outs, shift logs, sampling, housekeeping, and preventive maintenance, etc.) • Monitoring and reporting procedures and requirements • Learning management system (document who gets training and when, including training records management)
Monitoring and Measurement Activities	• Of formal compliance requirements (e.g., flow, pH, total suspended solids, key metals, monitoring schedules) • Of internal company requirements (if any in addition to compliance requirements) • External and internal communications • Out-of-spec reporting • Operating logs and responses
Emergency Planning and Response	• Failure of critical components action plan (including power failure at WWTP) • Spills or breaches response plan • Non-routine flows or chemical changes, management plan

Other considerations when developing your action plan:

- Design the improvement actions to be integrated with existing business/operational processes where practical. Integrating specific EMS improvements into existing processes saves time and money, and usually enhances the quality and effectiveness of implementation. Some common integration opportunities where improved controls can be layered include existing safety programs, standard operating procedures, inspection programs, training programs, communications programs, job descriptions, procurement processes, capital authorization processes, preventive maintenance programs, management dashboards and routine reporting processes, and document control systems.
- Engage those directly involved in the relevant operational activities in the improvement action. This also improves the quality of the design of the improvement action and helps ensure buy-in to any planned changes.

Figure 14. Example of an Action Plan Format

Action		Who	Resources		Timing	
No.	Description		Internal Days	$	Start	End
1	Stormwater management of sulfide waste rock stockpile runoff (acid rock drainage water)—Develop a collaborative revision (Mining Department and Environmental Department coordinators) to structural controls (sloping and ditching) to ensure gravity flow only of runoff from Main West Stockpile all the way to the mill makeup water pond. Goal is to eliminate need for the stormwater pump station near south toe of the stockpile.	RM	6–10	10,000–30,000	15 Apr	30 Jul
2	Haul-road fugitive dust reduction—Mining Department to conduct road watering vs. chemical suppressant cost/benefit analysis. Emphasis to include increasing chemical suppressant application just before summer dry season and before winter season (when freeze drying occurs and water application is an icing hazard).	RM	3–5	5,000	15 Apr	30 Jun
3	Tailings basin fugitive dust reduction—Mill Department and Environmental Department coordinators to evaluate causes and mitigation options to prevent winter freeze dry fugitive dust (lift off). Test areas should be developed for monitoring during winter season 2009 with goal of full tailings basin mitigation measure being implemented in 2010.	RM	6–10	10,000–30,000	15 May	31 Sep
4	Revise Reclamation Plan—Mining and Environmental Departments will develop enhanced concurrent reclamation to accelerate replacement of wildlife and vegetation habitats.	DG	6–10	10,000–30,000	1 Feb	30 Apr
5	Revise Tailings Management Plan—Process and Environmental Departments to revise plan to significantly reduce fugitive dust on exposed beach area during high wind, dry heat, and freeze dry weather conditions. Consider interim revegetation that can survive pond footprint fluctuation, chemical suppressants, etc.	DG	10	10,000–30,000	1 Jul	15 Oct
6	Develop a plan to reuse process and dewatered water—Environmental Department to evaluate potential water reuse sources, what equipment is applicable or necessary to ensure water quality, and where reclaimed water can be applied (e.g., dust suppression).	RM	20–30	10,000–30,000	1 Apr	30 Jun

ii. *Obtain management approval:* Once the plan has been developed and reviewed with key internal staff, in particular those who have responsibility for leading the implementation of specific actions and others that may be affected by the plan, it should be taken to senior management for approval. This process of obtaining management approval is important to ensure their support of the planned actions and resourcing of them.

iii. *Monitor plan implementation:* The EMS Task Force should monitor implementation of the action plan. Implementation issues can be brought to the attention of senior management as needed.

4. CONTINUAL IMPROVEMENT

Having issued a policy, identified applicable legal requirements, established a compliance calendar, assessed aspects and controls, and taken action to improve controls, initial implementation of the EMS is complete. However, EMS implementation is an ongoing process. Environmental programs and performance should be continually improved based on the results of inspections and audits, environmental monitoring, incidents and ongoing changes in the organization, operations, and overall business climate.

A. Monitor Programs and Assess Performance

What and Why

Implementation of the EMS and resulting performance must be monitored and assessed on an ongoing basis to ensure the controls are being effectively implemented and that resulting performance is consistent with policy expectations (e.g., in compliance with legal and other requirements, ongoing pollution prevention). Corrective actions can then be taken as needed to improve programs and performance. Key information to collect and review to assess performance includes environmental monitoring of specific media; incident data; tracking of key performance indicators; and results from work observations, inspections, and audits.

How and Who

i. *Monitor environmental releases and impacts:* Regulations and site-specific permits may dictate specific sampling and monitoring activities (e.g., chemical constituents of wastewater or air emissions). These should be covered in the compliance calendar and carried out by assigned staff using appropriate procedures. However, based on the assessment of controls, additional monitoring actions could be implemented (e.g., of flora, fauna). In particular, it is important to monitor impacts associated with the significant environmental aspects and risks. (Refer to the discussion of monitoring and measurement in Section 3.E.ii.d.)

ii. *Identify and report incidents:* Environmental incidents should be identified, reported to management, and addressed to mitigate impacts and risks associated with them and to implement actions to prevent their recurrence. "Incidents" can be broadly defined to address a range of potential scenarios including spills, unplanned releases, regulatory notices of violation or other non-compliance notification or action, third-party environmental-related damage claim, and so forth. Procedures should be put in place that define what types of incidents should be reported to what levels of management and in what time frame. The procedures should also address the need to conduct incident investigations and take corrective and preventive actions to address the immediate and underlying causes of incidents.

iii. *Track and report key performance indicators (KPIs):* KPIs should be defined, tracked, and reported to management on a routine basis. This allows management to understand and assess performance and take targeted actions to address performance issues as needed. KPIs can include both lagging and leading indicators. Common lagging indicators include water withdrawal and consumption on a production-adjusted basis; energy consumption on a production-adjusted basis; waste sent off-site for disposal on a production-adjusted basis; hectares affected and reclaimed; notices of violation, spills, permit exceedances, and so forth. Leading indicators typically relate to implementation of your management systems and include items such as training completed, inspections/audit completed, preventive maintenance completed, compliance calendar actions completed, and so on. Depending on the specific KPI, they can be packaged monthly, quarterly, or annually into reports for management. Goals can also be set for these metrics, and performance against those goals can be incorporated into the business planning and performance appraisal and incentive compensation processes.

iv. *Conduct audits:* Audits are used to verify that the mine and process is in compliance with applicable legal requirements and that the EMS (and supporting programs and procedures) is being effectively implemented. Audits are formal processes carried out by individuals that are independent of the site being audited (e.g., corporate environmental staff, consultants), ensuring independence and objectivity. Audit activities typically include the following key activities:

- Pre-audit planning—team formation, development of protocols, coordination with site management, audit team preparation

- Opening meeting—to explain objectives and activities to site management and review the on-site work schedule
- Verification activities—the core substance of the audit, including document/records review, interviews of site staff, and site/work observations
- Closing meeting—to report findings to site management (some auditors conduct daily debriefings with site management to keep them abreast of progress)
- Report issuance—draft report, site review and comment, final report, distribution to management
- Corrective action management—development of corrective and preventive action plans by site, implementation of the plans, including tracking through closure

Formal independent regulatory compliance and EMS audits are typically carried out every two or three years, depending on site size, complexity, and overall risk profile. These independent audits are often complemented by more frequent self-audits and routine inspections (refer to Section 3.E.ii.d).

Many resources are available to provide guidance on conducting audits, including the U.S. Environmental Protection Agency, the Department of Justice, ISO 19011, the International Cyanide Code, the GARD Guide, and the Auditing Roundtable.

B. Conduct Management Review and Establish Improvement Plan

What and Why

EMS implementation is an ongoing, continual improvement process. This element includes a formal process for top management to review the adequacy and effectiveness of the EMS and the development of objectives and targets to drive improvement in the EMS and resulting environmental performance.

How and Who

i. *Management review:* An organization's top management should continue to be involved and at least annually conduct a comprehensive review of its performance to evaluate the EMS's continuing suitability, adequacy, and effectiveness. This is a critical part of the continual improvement process and ensures that management stays engaged with the EMS. Inputs to the management review may include

   - Results of audits and evaluations of compliance with applicable legal and other requirements;
   - Environmental performance of the organization (including incidents and progress in achieving objectives and targets, incidents);
   - Status of corrective and preventive actions;
   - Communications from external interested parties, including complaints; and
   - Changing circumstances within the business climate.

   The management review should be documented and improvement actions agreed and tracked through implementation. An example management review meeting agenda is shown in Figure 15.

ii. *Objectives, targets, and action plan:* Objectives are typically general, qualitative statements about improvement, whereas targets are typically quantifiable and associated with milestones. The setting of objectives and targets should be linked to the assessment of aspects, impacts, and controls described earlier. The objectives and targets should also be aligned with the organization's core business goals, helping to ensure their acceptance across the organization. Formal action plans specifying responsible individuals and timing should be developed to achieve the objectives and targets. The process of setting the objectives and targets should be integrated with the organization's business planning and

Figure 15. Example of a Management Review Meeting Agenda

Management Review Meeting Agenda

- Meeting objectives
- Review of the EMS
- Stakeholder/business issues
- Performance
  - Inspections and audits
  - Objectives and targets
  - Other key performance indicators
  - Incidents, events
- Improvement opportunities
  - EMS
  - Significant aspects/risks
  - New objectives and targets
- Agreed next steps

budgeting cycle so the resulting plans are adequately resourced and formally approved by management. Refer to the example in Figure 16.

The following considerations should be taken into account when developing objectives and targets:

- Consider improvements to programs as well as performance.
- Focus on areas that link to the most significant aspects, where performance is lacking, and where cost reductions can be achieved.
- Ensure you have a solid baseline of performance data prior to establishing targets.
- Consider setting "stretch" targets as appropriate to challenge the organization to achieve significant improvements.
- Involve key internal stakeholders in the process, especially those who may be impacted by or responsible for taking actions to achieve the objectives and targets.
- Targets can be annual or multi-year.
- Align objectives and targets with any higher-level ones (e.g., by corporate).
- Cascade objectives and targets to lower levels of the organization as appropriate (including individual departments; e.g., the mine, the mill).

5. THIRD-PARTY CERTIFICATION

If you are seeking third-party certification to ISO 14001, you will have to successfully pass an audit completed by an accredited ISO 14001 registrar. This is typically a two-stage process—first, a desk audit is conducted by the registrar to review the EMS design and site readiness (Stage 1), and then a separate on-site review is performed to verify the effectiveness of EMS implementation (Stage 2). This second stage is a more rigorous review and includes interviews with site staff to verify that the EMS is indeed being implemented and achieving the desired results. To maintain certification, sites need to pass periodic (annual or semi-annual) surveillance audits by the accredited registrar. Sites need to go through a recertification process every three years.

Figure 16. Example of Objectives, Targets, and Action Plan

Objective	Associated Target	Plan
Improve compliance performance	Reduce reportable incidents by 20% year over year.	• Conduct formal root-cause analysis on every reportable incident. Have management review and approve every action plan. Put actions into site action tracking system (Douglas, ongoing). • Revise inspection program per OpEx recommendations (4/10). • Implement new EMIS solution (6/10).
Reduce energy use	Reduce energy use per ton of product by 15% by 2010 using 2007 baseline.	• Conduct energy audits by process unit (Jones, 4/09). • Incorporate recommendations into OpEx process (Smith, 8/09). • Convert 12% of fleet to hybrid vehicles (Wilkins, 12/09). • Increase use of biodiesel by 30% over 2007 levels (Wilkins, 3/10).
Improve reputation	Implement Community Advisory Panel by 3Q 2009.	• Define charter (Smith, 3/09). • Identify targeted stakeholders (Collins, 5/09). • Individually engage targeted stakeholders (Collins, 7/09). • Conduct first meeting (9/09).
	Publish site-specific environmental report by 2Q 2009.	• Develop report design outline and plan (Collins, 3/09). • Define data elements and definitions (Wilkins, 5/09). • Distribute data collection protocol (Wilkins, 7/09). • Collect anecdotes and performance data (Collins, 12/09). • Develop first draft for management review (Collins, 4/10). • Post report on Website (Collins, 6/10).

It is recommended that registrars be selected early in the EMS development and implementation process for several reasons. First, registrars often have different philosophies and interpretations of EMS elements (e.g., what can be excluded from the EMS scope, the level of detail in the aspects evaluation, the extent to which the EMS elements must be documented). It is useful to talk through each of the EMS elements with the registrars so that site personnel understand the registrar's expectations. Second, some registrars will contract to conduct a pre-assessment to determine whether a site is ready for certification and identify actions that must be taken to close gaps in the EMS. By selecting the registrar early in the process and contracting for a pre-assessment, the site benefits from an official assessment of the EMS by the registrar with time to address any gaps. As an added benefit, in many cases the registrars will treat the pre-assessment as a Stage 1 assessment if the site EMS is sufficiently mature. Finally, selecting the registrar early in the process gives the site more flexibility in scheduling the assessment dates and, therefore, scheduling the pace of implementation. Sites that delay in choosing a registrar often struggle to meet internal registration milestones.

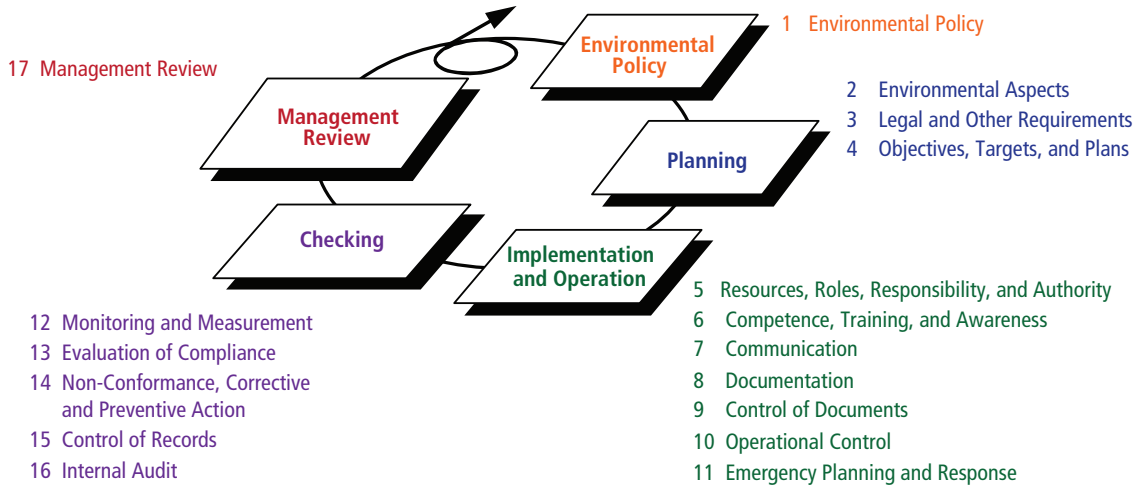
Appendix 1
Overview of ISO 14001

International standard ISO 14001:2004 from the International Organization for Standardization (ISO) defines an environmental management system (EMS) as "Organization structure, responsibilities, practices, procedures, processes, and resources for implementing and maintaining environmental management." ISO 14001 defines an explicit framework for this, which is illustrated in Figure 17. It is a flexible, risk-based, plan-do-check-act continual improvement approach that requires formal documented processes for many of its elements.

Underlying this framework, ISO defines specific requirements for each of the 17 EMS elements. A short, user-friendly summary of each of these 17 elements is provided here. These summary descriptions include some interpretation of the standard based on discussions with numerous registrars and the practical implementation experience of industry. More detail on some of these elements is provided throughout this guide.

1. *Environmental Policy:* Issue and maintain a publicly available environmental policy that commits to compliance, pollution prevention, and continual improvement.
2. *Environmental Aspects:* Conduct an assessment of environmental aspects and impacts (actual and potential) of the organization's activities, products, and services to determine where formal controls are needed or performance improvements should be made, and to inform goal-setting.
3. *Legal and Other Requirements:* Identify, have access to, and track applicable legal requirements, company requirements, and other commitments to stakeholders. Take those into account when implementing the EMS (e.g., through procedures, training, monitoring).
4. *Objectives, Targets, and Plans:* Set objectives and targets (linked to the aspect assessment, legal requirements, and recognizing business realities) to improve programs and performance. Develop and implement plans to achieve the objectives and targets.
5. *Resources, Roles, Responsibility, and Authority:* Allocate resources to implement the EMS and appoint a management representative to champion EMS implementation. Document and communicate environmental roles, responsibilities, and authorities.

Figure 17. ISO 14001 EMS Framework



6. *Competence, Training, and Awareness:* Ensure that people (including contractors) are competent to carry out their defined roles. (**Note:** *People can be competent based on experience, education, or training.*) Identify training needs, implement a training program to address those needs, and document the training completed. Ensure that people are aware of the policy as well as significant aspects, procedures, and EMS requirements relevant to their jobs.
7. *Communication:* Communicate relevant environmental information to personnel. Typically this means top-down communication of expectations, bottom-up communication of performance and concerns, and lateral communication of best practices and lessons learned. Public reporting is not required, though a process for managing external inquiries is necessary.
8. *Documentation:* Document the core elements of the EMS and reference relevant procedures. An EMS manual is not required but is commonly developed.
9. *Control of Documents:* Implement document control procedures so people have access to the right versions of documents, documents stay current, and documents are protected from damage and inappropriate use.
10. *Operational Control:* Systematically manage operations associated with significant aspects to minimize impacts. This may be through implementing documented procedures or the use of appropriate engineered controls. Have a management-of-change process to proactively address environmental risks associated with operational changes. Although management-of-change is not explicitly specified in the ISO 14001 standard, it is commonly viewed as an essential component of an EMS.
11. *Emergency Planning and Response:* Maintain emergency plans and deploy appropriate response resources. Train staff, test procedures and equipment, and make adjustments as needed.
12. *Monitoring and Measurement:* Monitor operations and controls to anticipate upsets and non-conformances. Maintain and calibrate measurement devices. Measure and document progress in achieving objectives and targets.
13. *Evaluation of Compliance:* Periodically verify compliance with legal and other requirements.
14. *Non-Conformance, Corrective and Preventive Action:* Identify and investigate the causes of actual and potential EMS non-conformances, and implement corrective and preventive actions to address them. Review the effectiveness of the actions taken. Non-conformances include, but are not limited to, the findings from audits and inspections, as well as environmental incidents and near misses.
15. *Control of Records:* Maintain and protect records that demonstrate conformance to the EMS requirements and compliance with legal and other requirements.
16. *Internal Audit:* Develop and implement an audit program to verify that the EMS is effectively implemented and conforms to the design requirements. Provide information on the results of audits to management.
17. *Management Review:* Through periodic, planned discussions with senior management, identify potential improvements in the EMS and take action as needed.

A few key aspects of the ISO 14001 design are described here:

- *Plan-Do-Check-Act:* The ISO 14001 EMS uses this well-established and proven model of continual improvement. It requires you to identify your impacts, risks, and requirements ("plan"); implement controls/programs to manage those risks and requirements ("do"); verify they are working ("check"); and then implement corrective and preventive actions and set goals for continual improvement ("act").
- *Risk-Based Methodology:* The heart of the ISO 14001 EMS methodology is to identify risks and implement appropriate controls to manage them. The risk-based approach resonates well with business and operations managers who have to effectively manage limited resources.

- *Flexibility:* ISO 14001 was written to apply to any organization, and a full range of companies have implemented it. ISO 14001 does not dictate *how* to implement its EMS elements, only *what* is required.

Although the ISO 14001 EMS design is an excellent model for developing and implementing an EMS, many organizations choose to customize the standard to better fit their operations and management culture, improving acceptance of the EMS initiative and increasing the likelihood that the desired outcomes will be achieved. Some of the common adjustments companies make to the ISO 14001 EMS model include the following:

- *Documentation and Recordkeeping:* Some companies consolidate the three discrete ISO 14001 elements of Documentation, Control of Documents, and Control of Records into one element. The idea is to de-emphasize what might be perceived to be low value-added or bureaucratic aspects of the system.
- *Change Control:* Some companies put additional emphasis on managing change. This is about proactively addressing environmental risks and requirements associated with new equipment, modified process operations, new chemicals, and so forth. It often involves formalizing environmental review of capital projects as part of the capital authorization process.
- *Preventive Maintenance:* ISO 14001 is not explicit about ensuring all critical operational and pollution control equipment is subject to preventive maintenance and that repairs to malfunctioning equipment are taken care of in a timely fashion. Properly maintained equipment is critical to regulatory compliance and preventing environmental incidents.
- *Contractor Management:* Throughout ISO 14001 text refers to "those working on behalf of the organization." For this reason, contractor management is spread throughout the standard. However, some companies have chosen to elevate this as a separate and higher profile EMS element, covering topics such as contractor selection, environmental requirements in contracts, pre-job briefings, and contractor oversight.
- *Employee Involvement:* Safety professionals have long advocated that active employee involvement is an important element of an effective safety program. The same can be argued for environmental management. Incorporating environmental topics into safety committees, forming green teams, and developing recycling and community environmental initiatives all help raise awareness and build a supportive environmental culture.
- *Leadership and Commitment:* Beyond the requirement that senior management issue a policy and conduct a management review, some EMSs are not explicit about the need for visible, ongoing leadership from senior management. Many people believe this is critical to building a supportive environmental culture and to the long-term success of EMS implementation.
- *Accountability:* While ISO 14001 talks about roles, responsibilities, and authorities, it is not explicit about accountability. Some companies have had great success in achieving desired culture change by incorporating environmental factors into accountability processes such as annual performance reviews and incentive compensation schemes.

Companies typically formalize their EMS requirements/specifications (including the above examples that go beyond ISO 14001) in a documented EMS standard or manual.

Appendix 2
Overview of U.S. Federal Environmental Laws and Regulations Potentially Applicable to Hardrock Mining Operations

Clean Air Act (CAA) 42 USC § 7401 et seq. [40 CFR Parts 50–99] Establishes ambient and source emission standards and permit requirements for conventional and hazardous air pollutants. Specifically, the CAA establishes air pollution prevention and control measures, including National Ambient Air Quality Standards (NAAQS) and New Source Performance Standards (NSPS).	• Key regulations that may apply to mining and mineral processing facilities: • 40 CFR Part 60—Standards of Performance for New Stationary Sources (NSPS). – Subpart Db—Standards of Performance for Industrial-Commercial-Institutional Steam Generating Units. – Subpart Dc—Standards of Performance for Small Industrial-Commercial-Institutional Steam Generating Units. – Subpart H—Standards of Performance for Sulfuric Acid Plants. – Subpart Ka—Standards of Performance for Storage Vessels for Petroleum Liquids for Which Construction, Reconstruction, or Modification Commenced After May 18, 1978, and Prior to July 23, 1984. – Subpart Kb—Standards of Performance for Volatile Organic Liquid Storage Vessels (Including Petroleum Liquid Storage Vessels) for Which Construction, Reconstruction, or Modification Commenced After July 23, 1984. – Subpart LL—Standards of Performance for Metallic Mineral Processing Plants. • 40 CFR Part 61—Requirements Reference Tables. – Subpart O—Copper Converter Facilities. • 40 CFR Part 63—National Emission Standards for Hazardous Air Pollutants (NESHAP) for Source Categories. – Subpart QQQ—Primary Copper Smelting NESHAP.
Clean Water Act (CWA) 33 USC § 1251 et seq. [40 CFR Parts 100–149, 220–232, 410–417] Establishes standards and permit requirements for water pollutants, including sources that discharge directly to a water body or to a public sewer system. Also includes stormwater management requirements.	Key regulations that may apply to mining and mineral processing facilities: • 40 CFR Part 112—Oil Pollution Prevention (Spill Prevention Control and Countermeasure Plans) • 40 CFR Part 122—The National Pollutant Discharge Elimination System (includes Stormwater Regulations) • 40 CFR Part 125—Criteria and Standards for the National Pollutant Discharge Elimination System • 40 CFR Part 440—Ore Mining and Dressing Point Source Category – Subpart J—Copper, Lead, Zinc, Gold, Silver, and Molybdenum Ores Subcategory – Subpart M—Gold Placer Mine Subcategory • 33 CFR Part 320—U.S. Army Corps of Engineers Regulatory Approach and Forms of Authorizations • 33 CFR § 321.2—Definition of Navigable Waters of the United States • 33 CFR Part 323—Permits for Discharges of Dredged or Fill Material into Waters of the United States – 33 CFR § 323.2(f)—Defines the term "discharge of fill material" – 33 CFR § 323.3—Discharges requiring permits – 33 CFR § 323.4—Discharges not requiring permits • 33 CFR Part 325—Processing of Department of the Army Permits • 33 CFR Part 328—Definition of Waters of the United States • 33 CFR Part 330—Nationwide Permit Program

(continues)

Overview of U.S. Federal Environmental Laws and Regulations Potentially Applicable to Hardrock Mining Operations (continued)

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) 42 USC § 9601 et seq. [40 CFR Parts 300–311] Establishes a program for cleaning up contaminated waste sites and establishes liability for cleanup costs. Provides reporting requirements for releases of hazardous substances.	Key regulations that may apply to mining and mineral processing facilities: • 40 CFR Part 300—National Oil and Hazardous Substances Pollution Contingency Plan • 40 CFR Part 302—Designation, Reportable Quantities, and Notification
Emergency Planning and Community Right-to-Know Act (EPCRA) 42 USC § 11001 et seq. [40 CFR Parts 355, 370 & 372] Establishes a program (the "Toxics Release Inventory") to inform the public about releases of hazardous and toxic chemicals. Reporting requirements apply to companies that manufacture, process, or otherwise use listed toxic chemicals over a certain quantity.	Key regulations that may apply to mining and mineral processing facilities: • 40 CFR Part 355—Emergency Planning and Notification • 40 CFR Part 370—Hazardous Chemical Reporting: Community Right-to-Know • 40 CFR Part 372—Toxic Chemical Release Reporting: Community Right-to-Know **Further Guidance:** USEPA, EPCRA Section 313 Industry Guidance: Metal Mining Facilities, EPA 745-B-99-001 (Jan. 1999). **Pertinent Case Law:** *NMA v. Browner*, 2001 U.S. Dist. LEXIS 915 (D. Colo. 2001). *Barrick Goldstrike Mines v. Whitman*, 260 F. Supp. 2d 28 (D.D.C. 2003).
National Environmental Policy Act (NEPA) 42 USC § 4321 et seq. [40 CFR Parts 1500–1508] Defines processes for evaluating major federal actions that significantly affect the environment, including permitting of new mine development on federal lands.	See 40 CFR Parts 1500–1508—Council on Environmental Quality (CEQ)—Regulations for Implementing NEPA • CEQ NEPAnet: **www.nepa.gov/nepa/nepanet.htm** • Federal Agency NEPA Procedures: **www.nepa.gov/nepa/regs/agency/agencies.cfm** • Federal Agency Website: **www.nepa.gov/nepa/agencies.cfm**
Resource Conservation and Recovery Act (RCRA)—42 USC § 6901 et seq. [40 CFR Parts 260–282] Establishes regulations and permit requirements for hazardous waste management (transportation, treatment, storage, and disposal). Specifically, RCRA defines what constitutes a solid waste and requires certain methods for treatment, storage, and disposal. RCRA also defines what a hazardous waste is. A material is hazardous waste if it meets the definition of solid waste (40 CFR § 261.2) and exhibits one of the characteristics of a hazardous waste (40 CFR §§ 261.20–24) or is listed as a hazardous waste (40 CFR §§ 261.31–33). A hazardous waste is subject to Subtitle C generator (40 CFR 262), transporter (40 CFR § 263), and treatment, storage, and disposal facility (40 CFR § 254 & 265) requirements.	Key regulations that may apply to mining and mineral processing facilities: • 40 CFR Part 261—Identification and Listing of Hazardous Waste – 40 CFR § 261.2(c)(3)—Unlisted byproducts or sludges that are reclaimed are not solid wastes. – 40 CFR § 261.4—Solid wastes which are not hazardous wastes: – 40 CFR § 261.4(a)(5)—In-situ mining exclusion – 40 CFR § 261.4(a)(7)—Spent sulfuric acid exclusion – 40 CFR § 261.4(a)(8)—Secondary materials that are reclaimed and returned to the original process exclusion – 40 CFR § 261.4(a)(13)—Recycled scrap metal exclusion – 40 CFR § 261.4(a)(14)—Shredded circuit boards exclusion – 40 CFR § 261.4(a)(17)—The exclusion applicable to spent materials generated within the mineral processing industry that are recovered by mineral processing or beneficiation – 40 CFR § 261.4(b)(17)—Solid waste from the extraction, beneficiation, and processing of ores and minerals, except as provided by § 266.122

(continues)

Overview of U.S. Federal Environmental Laws and Regulations Potentially Applicable to Hardrock Mining Operations (continued)

Many mine wastes are exempt from RCRA Subtitle C hazardous waste regulations. A hazardous waste generator is any person or site whose processes and actions create hazardous waste See 40 CFR § 260.10. Generators are divided into three categories based on the quantity of waste they produce: 1. Large Quantity Generators (LQGs) generate 1,000 kg per month or more of hazardous waste, more than 1 kg per month of acutely hazardous waste, or more than 100 kg per month of acute spill residue or soil. 2. Small Quantity Generators (SQGs) generate more than 100 kg, but less than 1,000 kg, of hazardous waste per month. 3. Conditionally Exempt Small Quantity Generators (CESQGs) generate 100 g or less per month of hazardous waste, or 1 kg or less per month of acutely hazardous waste, or less than 100 kg per month of acute spill residue or soil. RCRA also establishes standards for underground storage tanks storing petroleum and other hazardous substances.	• 40 CFR Part 262—Standards Applicable to Generators of Hazardous Waste • 40 CFR Part 263—Standards Applicable to Transporters of Hazardous Waste • 40 CFR Part 264—Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities • 40 CFR Part 265—Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities • 40 CFR Part 266—Standards for the Management of Specific Hazardous Wastes and Specific Types of Hazardous Waste Management Facilities – 40 CFR § 266.70—The precious metals exemption – 40 CFR § 266.100(g)—The counterpart to the exemption for precious metals – 40 CFR § 266.100(d)—The "smelting, melting, and refining furnace" exemption • 40 CFR Part 267—Standards for Owners and Operators of Hazardous Waste Facilities Operating Under a Standardized Permit • 40 CFR Part 268—Land Disposal Restrictions • 40 CFR Part 270—EPA Administered Permit Programs: The Hazardous Waste Permit Program **Further Guidance:** USEPA, Regulatory Determination on Wastes from Mineral Processing (1986). USEPA, Report to Congress on Special Wastes from Mineral Processing (1990). USEPA, Final Regulatory Determination for Special Wastes from Mineral Processing (Mining Waste Exclusion, established in response to the Bevill Amendment) (1991). **Pertinent Case Law:** *American Mining Congress v. EPA*, 824 F.2d 1177 (D.C. Cir. 1987). *Association of Battery Recyclers v. EPA*, 208 F.3d 1047 (D.C. Cir. 2000).
Toxic Substances Control Act (TSCA) 15 USC § 2601 et seq. [40 CFR Parts 700–766] Regulates the production, importation, use, and disposal of specific chemicals. Also establishes reporting, record-keeping and testing requirements, and restrictions relating to chemical substances and/or mixtures.	Key regulations that may apply to mining and mineral processing facilities: • 40 CFR Part 704—Reporting and Recordkeeping Requirements • 40 CFR Part 710—TSCA Chemical Inventory Regulations • 40 CFR Part 761—Polychlorinated Biphenyls (PCBs) manufacturing, processing, distribution in commerce, and use prohibitions

Appendix 3
Assessment of Significant Environmental Aspects—Example

(Aligns with and addresses all aspects in Figure 5.)

Activity/ Operation	Environmental Aspects	Environmental Impacts	Significance Ratings				Significant [Y/N]
			People and the Environment	Compliance	Other Business Impacts	Total	
Planning and Permitting	Land disturbance	Disturbances of floodways and river ways	3	3	3	9	Y
	Land disturbance	Potential degradation of sensitive areas: archeological, cultural, aquatic, terrestrial; threatened and endangered species	3	3	3	9	Y
	Land disturbance	Property boundaries, stock-pile height restrictions, visual impacts	3	3	3	9	Y
	Land disturbance—Reclamation and closure	Terrestrial habitat (flora and fauna) and aquatic habitat recovery; mitigating impacts to surface aquatic habitat and groundwater	3	3	3	9	Y
Mining	Stormwater runoff	Acid rock, alkaline, or saline drainage impact on soil, surface water, and groundwater	2	3	2	7	Y
	Greenhouse gas (GHG)/combustion byproducts from equipment	Deposition of particulates, climate change, acid rain, air quality degradation	2	1	2	5	N
	Water and wastewater disposition from mine dewatering and/or mine water disposal	Surface or underground mining—Water table reduction/depletion: acid rock, alkaline, or saline drainage impact on soil, surface water, and groundwater degradation	3	3	3	9	Y
	Water use in drilling	Water usage in drilling operations	1	1	1	3	N
	Land disturbance	Cutting new haul roads, mine portal or surface mine development, haul road development: potential disturbance of terrestrial and/or aquatic habitat	2	2	1	5	N
	Fugitive dust emissions (blasting, loading)	Deposition of particulates, air quality degradation	2	2	2	6	Y
	Blasting: noise and vibration	Nuisance to neighbors and fauna	3	1	1	5	N
	Blasting: waste explosives packaging materials	Potential fire or explosive hazard, potential release to water or soils	1	2	1	4	N

(continues)

Assessment of Significant Environmental Aspects—Example (continued)

Activity/ Operation	Environmental Aspects	Environmental Impacts	Significance Ratings				Significant [Y/N]
			People and the Environment	Compliance	Other Business Impacts	Total	
Power Haulage	Fugitive dust emissions (transfer locations, road traffic, dumping)	Deposition of particulates, air quality degradation	2	2	2	6	Y
	Anti-tampering devices on large off-road vehicles	Deposition of particulates, air quality degradation	1	1	1	3	N
	Truck hitting wildlife	Fauna	1	1	1	3	N
	Noise	Noise from operation of trucks	1	1	1	3	N
	GHG/combustion byproducts from mobile sources	Deposition of particulates, climate change, acid rain, air quality degradation	2	1	2	5	N
Stockpiles (Ore, Low-Grade Ore, Overburden)	Infiltration and storm-water runoff	Acid rock, alkaline, or saline drainage impact on soil, surface water, and groundwater	3	2	3	8	Y
	Slope stability	Potential impact to human health and to soil, surface water, and groundwater	3	2	1	6	Y
	Ore stockpile: fugitive dust emissions (dumping, wind erosion)	Deposition of particulates, air quality degradation	2	2	2	6	Y
Ore Crushing	Crushing: fugitive dust emissions	Deposition of particulates, air quality degradation	2	2	2	6	Y
	Air pollutant emissions from energy use (electricity) and equipment combustion sources	Deposition of particulates, climate change, acid rain, air quality degradation	2	1	2	5	N
Leaching	Leachate potential to escape pad containment systems	Groundwater contamination	3	3	3	9	Y
	Leach pad slope stability	Potential impact to human health and to soil, surface water, and groundwater	2	2	2	6	Y
	Stormwater runoff from pad	Surface water contamination	3	2	2	7	Y
	Spills/leakage or waste generation from process chemicals (cyanide, acid, or pregnant leach solution [PLS])	Soil, surface water, and groundwater	3	2	2	7	Y
	PLS collection and holding ponds	Groundwater and/or surface water contamination	3	3	3	9	Y
	PLS collection and holding ponds	Wildlife	3	2	3	8	Y
	Process wastewater discharge	Soil, surface water, groundwater, air emissions	2	3	2	7	Y

(continues)

Assessment of Significant Environmental Aspects—Example (continued)

Activity/ Operation	Environmental Aspects	Environmental Impacts	Significance Ratings				Significant [Y/N]
			People and the Environment	Compliance	Other Business Impacts	Total	
Solvent Extraction/ Electrowinning (SX/EW)	Spills from tanks or pipes or waste generation from process chemicals mismanagement	Soil, surface water, groundwater, air emissions	3	2	2	7	Y
	SX plant volatile organic compound (VOC) emissions	Air quality	2	2	2	6	Y
	EW tankhouse acid mist emissions	Air quality	2	2	2	6	Y
	Air pollutant emissions from energy use (electricity)	Deposition of particulates, climate change, acid rain, air quality degradation	2	1	2	5	N
	Generation and management of lead flake and lead anodes	Potential impact on soil, surface water, and groundwater	3	2	2	7	Y
Grinding	Spills	Potential impact on surface water and groundwater	1	1	1	3	N
	Generation of dust	Air quality	1	1	1	3	N
	Air pollutant emissions from energy use (electricity)	Deposition of particulates, climate change, acid rain, air quality degradation, mercury volatilization	2	1	2	5	N
Concentrating	Process wastewater disposition	Soil, surface water, and groundwater	2	3	2	7	Y
	Spills or waste generation from metallic mineral concentrate mishandling	Acid rock drainage and metals leaching impact on soil, surface water, and groundwater	2	3	3	8	Y
	Concentrate storage	Potential migration from wind erosion or stormwater	2	2	2	6	Y
	Flotation reagents: fugitive VOC air emissions	Air quality	2	2	1	5	N
Tailings	Tailings conveyance/ piping—spills	Potential impact on surface water and groundwater	3	2	3	8	Y
	Fugitive dust emissions	Deposition of particulates, air quality degradation	2	2	2	6	Y
	Leakage to groundwater	Degradation of groundwater quality	2	3	2	7	Y
	Seepage collection, management, and disposition	Degradation of surface water and groundwater quality	2	3	2	7	Y
	Stormwater runoff	Surface water contamination	2	2	2	6	Y
	Dam slope stability	Potential impact to human health and to soil, surface water, and groundwater	3	3	3	9	Y
	Pond water quality	Wildlife through ingestion and/ or contact	2	2	1	5	N

(continues)

Assessment of Significant Environmental Aspects—Example (continued)

Activity/ Operation	Environmental Aspects	Environmental Impacts	Significance Ratings				Significant [Y/N]
			People and the Environment	Compliance	Other Business Impacts	Total	
Maintenance Activities	Generation of used tires	Waste disposal/land use	1	2	1	4	N
	Generation of used oil and grease	Waste disposal	1	1	1	3	N
	Generation of used lead acid batteries	Waste disposal	1	1	1	3	N
	Parts washer management	Waste disposal and potential air emissions	2	1	1	4	N
	Polychlorinated biphenyls (PCBs) equipment	Potential impact to human health and to soil, surface water, and groundwater	3	3	2	8	Y
	Spray painting	Air quality	2	2	1	5	N
	Impacted stormwater runoff (maintenance areas)	Surface water contamination	1	2	1	4	N
	Wastewater generation (wash racks, oil–water separators, sewage treatment systems, wastewater treatment systems)	Soil, surface water, and groundwater	2	2	1	5	N
Sitewide	Chemical management/ inventory	Potential impact to human health (spills, fire, explosion); waste disposal	2	1	1	4	N
	Generation of potentially hazardous wastes (e.g., aerosol cans, paint)	Waste disposal	1	1	1	3	N
	Fuel storage/ dispensing	Spills and leaks—potential impact to soil, surface water, and groundwater	2	2	2	6	Y
	Drinking water supply (water quality)	Human health	3	3	3	9	Y
	Contact stormwater ponds	Soil, surface water, and groundwater	3	2	2	7	Y
	Non-contact stormwater runoff	Potential impact on soil, surface water, and groundwater	1	1	1	3	N
	Asbestos-containing materials	Potential impact to human health; waste disposal	3	3	2	8	Y
	Equipment storage/ laydown yards potential leakage (ozone-depleting substances, PCBs, oil, and grease)	Potential impact on soil, surface water, and groundwater	2	2	1	5	N
	Building demolition	Waste disposal	1	1	1	3	N
	Housekeeping	Visual impacts, potential impacts to groundwater	1	1	1	3	N

(continues)

Assessment of Significant Environmental Aspects—Example (continued)

Activity/ Operation	Environmental Aspects	Environmental Impacts	Significance Ratings				Significant [Y/N]
			People and the Environment	Compliance	Other Business Impacts	Total	
Sitewide (continued)	Waste disposal (proper segregation of wastes and management of landfills)	Potential impact to human health and groundwater	3	3	1	7	Y
	Waste management—off-site recycling	Waste disposal	1	1	1	3	N
	Petroleum-contaminated soils management	Waste disposal	2	2	2	6	Y
	Open burning	Air quality degradation	2	2	1	5	N
	Legacy environmental issues	Surface water/groundwater contamination	3	3	3	9	Y
	Water usage	Depletion of natural resources/ exceed allowable water withdrawals	3	2	3	8	Y
Office/ Administration	Office and food waste generation and disposal	Soil, surface water, ground-water, nuisance litter, vector (rodent) management	1	0	1	2	N
	Resource use (paper, plastic, toner, etc.)	Reduction in non-renewable resources	1	0	0	1	N
	Air pollutant emissions from energy use (electricity) and HVAC sources	Deposition of particulates, climate change, acid rain, air quality degradation	1	1	1	3	N

Appendix 4
Assessment of Controls and Residual Risk—Example

(Aligns with and addresses all aspects in Figure 5 and Appendix 3.)

Activity/ Operation	Environmental Aspects	Significant Aspects		Controls in Place	Controls Rating	Residual Risk	Improvement Actions
		Score	Y/N				
Planning and Permitting	Land disturbance	9	Y	Engineered structures to divert water around mine and processing facilities. Current site maps with floodways and river ways clearly noted as restricted areas.	3	3	Develop and implement a written Monitoring and Maintenance Plan for stormwater diversion structures.
	Land disturbance	9	Y	Current site maps with sensitive areas clearly noted. Boundaries of sensitive areas marked in the field.	2.5	3.6	Annual review of maps and field verification of boundary markings.
	Land disturbance	9	Y	Current site maps with boundaries and height restrictions clearly indicated. Management of change process employed to ensure careful review of all changes/ expansions.	2.5	3.6	Document management of change procedure and establish procedure to review any discrepancies noted in the field.
	Land disturbance — Reclamation and closure	9	Y	Mine closure plan with concurrent reclamation	2	4.5	Annual review of reclamation target areas and performance of reclaimed areas.
Mining	Stormwater runoff	7	Y	Stormwater Pollution Prevention Plan (SWPPP), potentially acid generating (PAG) waste containment cells, diversion ditches, collection ponds, stormwater reuse, training, procedures, excess water treatment, stormwater discharge permit	2	3.5	Annual review and update of SWPPP along with monitoring results to drive improvements to applicable engineering and administrative controls.
	Greenhouse gas (GHG)/combustion byproducts from equipment	5	N	NA	NA	NA	NA
	Water and wastewater disposition from mine dewatering and/or mine water disposal	9	Y	Dewater water reuse, excess water treatment, water discharge permit, water quality monitoring	3	3	Develop and maintain a water use/reuse program and treatment of excess dewater and/ or process water as required.
	Water use in drilling	3	N	NA	NA	NA	NA
	Land disturbance	5	N	NA	NA	NA	NA

(continues)

Assessment of Controls and Residual Risk—Example (continued)

Activity/ Operation	Environmental Aspects	Significant Aspects		Controls in Place	Controls Rating	Residual Risk	Improvement Actions
		Score	Y/N				
Mining (continued)	Fugitive dust emissions (blasting, loading)	6	Y	Dust mitigation plan, including: water truck spraying, chemical suppressants, no blasting in strong winds, air monitoring at facility perimeter	2	3	Develop and maintain a Fugitive Dust Plan
	Blasting: noise and vibration	5	N	NA	NA	NA	NA
	Blasting: waste explosives packaging materials	4	N	NA	NA	NA	NA
Power Haulage	Fugitive dust emissions (transfer locations, road traffic, dumping)	6	Y	Dust mitigation plan, including water truck spraying, water bars and sprays, chemical suppressants, air monitoring at facility perimeter	2	3	Develop and maintain a Fugitive Dust Plan.
	Anti-tampering devices on large off-road vehicles	3	N	NA	NA	NA	NA
	Truck hitting wildlife	3	N	NA	NA	NA	NA
	Noise	3	N	NA	NA	NA	NA
	GHG/combustion byproducts from mobile sources	5	N	NA	NA	NA	NA
Stockpiles (Ore, Low-Grade Ore, Overburden)	Infiltration and stormwater runoff	8	Y	Characterization of materials and planned placement. SWPPP, PAG waste containment cells, diversion ditches, collection ponds, stormwater reuse, training, procedures, excess water treatment, stormwater discharge permit	2	4	Develop system for monthly review of stormwater controls for PAG stockpile/ cells and quarterly inspections and maintenance of engineered stormwater structures.
	Slope stability	6	Y	Design and operate stockpiles for slope stability.	2	3	Develop and implement a program to monitor slope stability of critical stockpiles.
	Ore Stockpile: fugitive dust emissions (dumping, wind erosion)	6	Y	Dust mitigation plan, including water truck spraying	2.5	2.4	Develop and implement a program to minimize ore drop-height; add water sprays to conveyor transfer points.

(continues)

Assessment of Controls and Residual Risk—Example (continued)

Activity/ Operation	Environmental Aspects	Significant Aspects		Controls in Place	Controls Rating	Residual Risk	Improvement Actions
		Score	Y/N				
Ore Crushing	Crushing: fugitive dust emissions	6	Y	Dust mitigation plan, including water bars and sprays, chemical suppressants, air monitoring at facility perimeter. Periodic inspections to ensure systems working as designed.	2	3	Develop and maintain a Fugitive Dust Plan.
	Air pollutant emissions from energy use (electricity) and equipment combustion sources	5	N	NA	NA	NA	NA
Leaching	Leachate potential to escape pad containment systems	9	Y	Design facilities to minimize potential to discharge to groundwater and surface water—consider liners. Groundwater monitoring to confirm integrity of containment. Frequent inspections of facilities.	2	4.5	Develop a program to trend groundwater monitoring data to detect any changes in water quality.
	Leach pad slope stability	6	Y	Heaps designed for slope stability and frequent inspections to confirm no deformations such as surface cracks, slides, sloughs, or unusual settlement.	3	2	No improvements needed at this time.
	Stormwater runoff from pad	7	Y	SWPPP, including run-on and runoff controls designed for the proper storm event.	3	2.3	Develop a program to ensure that designed capacity and controls for stormwater events are available in advance of severe weather conditions.
	Spills/leakage or waste generation from process chemicals (cyanide, acid, or pregnant leach solution [PLS])	7	Y	Piping and tank systems should be designed to minimize potential for leakage/ spillage that may include secondary containment and leak detection systems. Emergency response plans for addressing any spills. All systems should be frequently monitored.	2	3.5	Develop a facility-specific checklist to ensure that frequent system inspections are conducted to expectations.

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Assessment of Controls and Residual Risk—Example (continued)

Activity/ Operation	Environmental Aspects	Significant Aspects		Controls in Place	Controls Rating	Residual Risk	Improvement Actions
		Score	Y/N				
Leaching (continued)	PLS collection and holding ponds	9	Y	Ponds should also be sited and designed to minimize the potential for leakage and have sufficient capacity and pumping to ensure adequate freeboard during the design storm events. Utilize leachate collection and recovery systems. All systems should be frequently monitored/ inspected.	2.7	3.3	Develop a preventive maintenance program for PLS pond pumps; evaluate the need for in-line spares.
	PLS collection and holding ponds	8	Y	If required, wildlife deterrence systems such as fencing, hazing, or covers should be implemented to control wildlife exposure to leach solutions.	3	2.7	Develop a program for quarterly inspections on facilities to ensure they are maintained as designed.
	Process wastewater discharge	7	Y	Treatment, chemical management plan, training, chemical storage locations and equipment, inspections, secondary containment, qualified disposal vendors, waste management plan.	4	1.8	Develop and maintain chemical and waste management plans.
Solvent Extraction/ Electrowinning (SX/EW)	Spills from tanks or pipes or waste generation from process chemicals mismanagement	7	Y	Construct tanks and pipes to minimize potential for discharge. Properly designed and operated secondary containment. Periodic inspections for tank/pipe integrity.	3	2.3	Develop and maintain a water use/ reuse program and treatment of pond and excess water as required.
	SX plant volatile organic compound (VOC) emissions	6	Y	Construct tanks with provisions to minimize VOC emissions. Tank covers should be considered and in place/closed when installed.	2.8	2.1	Develop a program for regular inspections of tank covers to ensure they are closed.
	EW tankhouse acid mist emissions	6	Y	Design and operate facilities to minimize air emissions (floating balls, chemical additives).	3.2	1.9	Develop criteria for replacement of floating balls.
	Air pollutant emissions from energy use (electricity)	5	N	NA	NA	NA	NA
	Generation and management of lead flake and lead anodes	7	Y	Written procedure for the management and storage of lead flake. Use of secondary containment. Waste characterization and proper recycle and/or disposal options.	2.9	2.4	Improve written procedures and training for lead flake handling.

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Assessment of Controls and Residual Risk—Example (continued)

Activity/ Operation	Environmental Aspects	Significant Aspects		Controls in Place	Controls Rating	Residual Risk	Improvement Actions
		Score	Y/N				
Grinding	Spills	3	N	NA	NA	NA	NA
	Generation of dust	3	N	NA			
	Air pollutant emissions from energy use (electricity)	5	N	NA	NA	NA	NA
Concentrating	Process wastewater disposition	7	Y	Chemical management plan, training, chemical storage locations and equipment, inspections, secondary containment, qualified disposal vendors, waste management plan.	4	1.8	Develop and maintain chemical and waste management plans.
	Spills or waste generation from metallic mineral concentrate mishandling	8	Y	Metallic mineral concentrate management plan, training, storage locations and equipment, inspections, secondary containment, qualified disposal vendors, waste management plan, shipping methods. Emergency response plans to address any spills.	4	2	Implement improved housekeeping plan (increased sweeping frequency and maintenance of controls in place) to minimize exposure to the environment.
	Concentrate storage	6	Y	Dust management plans, stormwater management plans, and associated engineered controls.	3	2	Investigate installation of wind fences in appropriate areas.
	Flotation reagents: fugitive VOC air emissions	5	N	NA	NA	NA	NA
Tailings	Tailings conveyance/piping —spills	8	Y	Secondary containment, leakage/break detection systems, and periodic integrity testing should be considered. Provide frequent inspection and emergency response plans to address spills.	1.8	4.4	Improve tailings pipe leak detection to include pressure monitoring and daily inspections.
	Fugitive dust emissions	6	Y	Dust mitigation plan considering the following: managing water coverage on tailings disposal area, water spraying, chemical suppressants, air monitoring at facility perimeter, interim revegetation.	2	3	Develop improved Tailings Management Plan to anticipate seasonal variations and demands.

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Assessment of Controls and Residual Risk—Example (continued)

Activity/ Operation	Environmental Aspects	Significant Aspects		Controls in Place	Controls Rating	Residual Risk	Improvement Actions
		Score	Y/N				
Tailings (continued)	Leakage to groundwater	7	Y	Design to control potential leakage to groundwater. Groundwater monitoring to ensure integrity.	2	3.5	Develop a program to trend groundwater monitoring data to detect any changes in water quality.
	Seepage collection, management, and disposition	7	Y	Seepage water reuse, water discharge permit, engineered collection system, regular inspections.	3	2.3	Develop and maintain a Seepage Management Plan.
	Stormwater runoff	6	Y	Run-on and runoff controls—capacity for designed storm event.	3	2	No improvements needed at this time.
	Dam slope stability	9	Y	Design for stable slopes. Frequent monitoring for slope stability. Consider revegetation.	2.5	3.6	Develop criteria/ checklist for a slope inspection program.
	Pond water quality	5	N	NA	NA	NA	NA
Maintenance Activities	Generation of used tires	4	N	NA	NA	NA	NA
	Generation of used oil and grease	3	N	NA	NA	NA	NA
	Generation of used lead acid batteries	3	N	NA	NA	NA	NA
	Parts washer management	4	N	NA	NA	NA	NA
	Polychlorinated biphenyls (PCBs) equipment	8	Y	PCB management plan, regular inspections; planned elimination of PCB-containing equipment	2.5	3.2	Develop a program to clearly label all potentially PCB-containing equipment (e.g., transformers).
	Spray painting	5	N	NA	NA	NA	NA
	Impacted stormwater runoff (maintenance areas)	4	N	NA	NA	NA	NA
	Wastewater generation (wash racks, oil–water separators, sewage treatment systems, wastewater treatment systems)	5	N	NA	NA	NA	NA

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Assessment of Controls and Residual Risk—Example (continued)

Activity/ Operation	Environmental Aspects	Significant Aspects		Controls in Place	Controls Rating	Residual Risk	Improvement Actions
		Score	Y/N				
Sitewide	Chemical management/ inventory	4	N	NA	NA	NA	NA
	Generation of potentially hazardous wastes (e.g., aerosol cans, paint)	3	N	NA	NA	NA	NA
	Fuel storage/ dispensing	6	Y	Designed to prevent fuel spillage and leakage from storage facilities to ground. Frequent inspections to ensure spills are cleaned up promptly and controls such as secondary containment, locks, and fill nozzles are working properly.	2.9	2.1	No improvements needed at this time.
	Drinking water supply (water quality)	9	Y	Systems are in place to ensure a safe water supply for the site (water quality monitoring, backflow prevention)	3.6	2.5	No improvements needed at this time.
	Contact storm-water ponds	7	Y	Engineered pond which may be lined with synthetic liner, clay or compacted earth. Sized to contain designated storm events and/or controlled with piping or pumps. Periodic inspections	2.8	2.5	Develop a Maintenance Plan for stormwater diversion structures.
	Non-contact stormwater runoff	3	N	NA	NA	NA	NA
	Asbestos-containing materials	8	Y	Management systems in place to identify where friable asbestos exists at the site and that any removal/ remediation is done properly.	2.8	2.9	Include asbestos review in management of change procedure (demolition projects).
	Equipment storage/laydown yards potential leakage (ozone-depleting substances, PCBs, oil, and grease)	5	N	NA	NA	NA	NA
	Building demolition	3	N	NA	NA	NA	NA
	Housekeeping	3	N	NA	NA	NA	NA

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Assessment of Controls and Residual Risk—Example (continued)

Activity/ Operation	Environmental Aspects	Significant Aspects		Controls in Place	Controls Rating	Residual Risk	Improvement Actions
		Score	Y/N				
Sitewide (continued)	Waste disposal (proper segregation of wastes and management of landfills)	7	Y	Management systems in place to ensure that all wastes are segregated at the source, disposed at formally approved facilities. On-site facilities properly designed and operated.	2.8	2.5	Include new waste stream evaluation and characterization in management of change procedure.
	Waste management—off-site recycling	3	N	NA	NA	NA	NA
	Petroleum-contaminated soils management	6	Y	Management systems are in place to handle, store, remediate, and dispose of petroleum-contaminated soils, as appropriate.	2.7	2.2	Improve training materials and identify groups that need the training.
	Open burning	5	N	NA	NA	NA	NA
	Legacy environmental issues	9	Y	Management systems in place to address environmental issues associated with any legacy operations at the site.	3.2	2.8	No improvements needed at this time.
	Water usage	8	Y	Flow measurement, water balance	2.3	3.5	Develop and implement a plan to install flowmeters to allow for an effective site water balance.
Office/ Administration	Office and food waste generation and disposal	2	N	NA	NA	NA	NA
	Resource use (paper, plastic, toner, etc.)	1	N	NA	NA	NA	NA
	Air pollutant emissions from energy use (electricity) and HVAC sources	3	N	NA	NA	NA	NA

Appendix 5
Operational Control Tables for Common Significant Environmental Aspects for Mining Operations Only—Example

Significant Environmental Aspects Stormwater Runoff from Mining Operations Only	
Potential Impacts	• Legal – Multi-sector General Stormwater Permit – Clean Water Act permitted discharge limits – Migratory Bird Treaty Act – Adjacent landowner adverse actions • Transport of contaminants off-site • Impacts resulting in impaired waters
Programs, Procedures, Work Instructions	• Mining and Reclamation Plans • Stormwater Pollution Prevention Plans (SWPPPs) • Site Water Balance Plan • Stormwater best management practices (BMPs) • Spill Prevention, Control, and Countermeasure (SPCC) for petroleum storage • Management of change • Environmental management systems and audits
Engineered Controls (hardware)	• Stormwater run-on controls, external and internal flow diversions, conveyance mechanisms, storage, pumping • Secondary and tertiary containments • Stormwater BMPs
Training	• Environmental management systems • Stormwater training • Stormwater management team functional training • Spill response training
Monitoring and Measurement Activities	• Stormwater sampling at outfalls – Benchmark monitoring • SWPPP inspections • BMP inspections • SPCC inspections
Emergency Planning and Response	• SPCC Plan • SWPPP Spill Response Procedures

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Operational Control Tables for Common Significant Environmental Aspects for Mining Operations Only—Example (continued)

Significant Environmental Aspects Fugitive Dust Emissions from Mining Operations Only	
Potential Impacts	• Exceed Clean Air Act Air Operating Permit limits • Exceed National Ambient Air Quality Standards • Exceed local nuisance ordinances • Trigger community relations concerns (aesthetics, quality-of-life, property value) • Trigger public health legal filings
Programs, Procedures, Work Instructions	• Mining and Reclamation Plans • Standard Operating Procedures • Air Operating Permit Fugitive Dust Control Plans • Occupational Health Exposure Mitigation Plans • Materials supply and management systems (water supply and availability, chemical suppressant supply and availability)
Engineered Controls (hardware)	• Haulage Surface Engineered Material Quality Assurance/Quality Control • Fugitive Dust Suppression Application Systems Preventive Maintenance Programs (water trucks, water wagons, pressurized sprays, water tankage) • Chemical suppressant delivery systems (chemical tankage, chemical transfer systems)
Training	• Environmental management systems • Air Operating Permit task • Fugitive Dust Control Plan task • Exceptional Events Response Procedures • Standard Operating Procedures • Operator dust minimization technique provisions (vehicle speed, drop heights)
Monitoring and Measurement Activities	• Air Operating Permit reporting and recordkeeping activities • Fugitive Dust Control Plan opacity measurements compliance • Fugitive Dust Control Plan general provisions compliance • Regulatory agency compliance inspections
Emergency Planning and Response	• Exceptional Events Response Procedures • Hazardous Materials Release (air) Plan