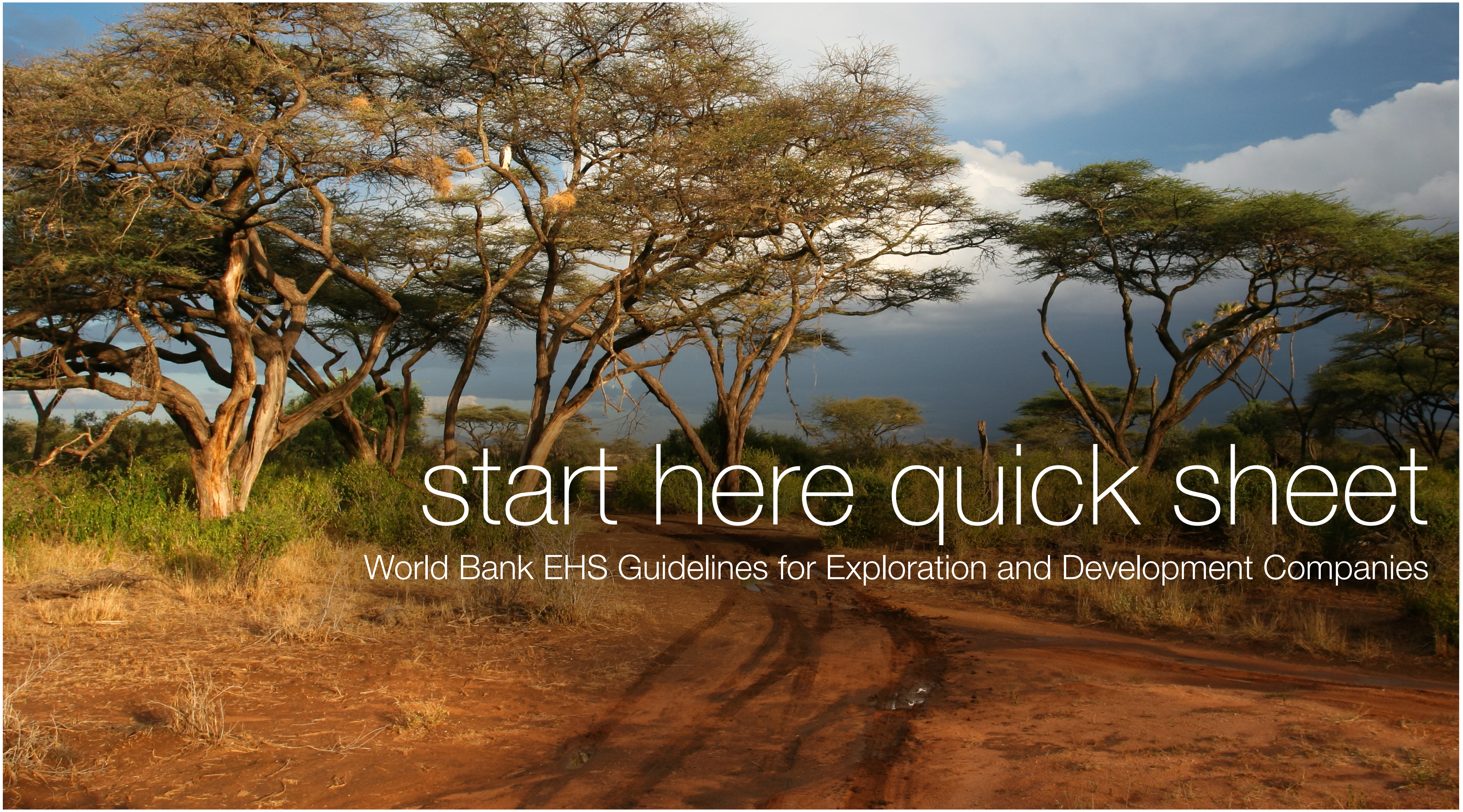

start here quick sheet

World Bank EHS Guidelines for Exploration and Development Companies

Network for Business Sustainability

Business. Thinking. Ahead.

Prepared by
Lindsay McIvor
Stephanie Bertels

start here quick sheet

World Bank Environment, Health, and Safety Guidelines (for Exploration and Development Companies)

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preface

This document has been tailored to present management solutions to the issues which exploration and development companies should manage from exploration through construction towards production. It mainly provides guidance on impact management and mine design. This document has **pulled select key advice out of the comprehensive 100-page** “Environmental, Health and Safety **General Guidelines**" document, as well as from the **30-page** “Environmental, Health and Safety **Guidelines for Mining**”. This is not an official World Bank document, nor has it been endorsed by the World Bank, and the entire contents of this Quick Sheet are credited to the World Bank. If you begin to do work in this area, we suggest referring back to the original document, which can be found here:

http://www1.ifc.org/wps/wcm/connect/Topics_Ext_Content/IFC_External_Corporate_Site/IFC+Sustainability/Sustainability+Framework/Environmental,+Health,+and+Safety+Guidelines/

Please note: The World Bank is currently engaged in a three-year process to review and update its EHS Guidelines (scheduled to be finalized in 2016). Please make sure to periodically check the IFC website for the most up-to-date information:

http://www.ifc.org/wps/wcm/connect/Topics_Ext_Content/IFC_External_Corporate_Site/IFC+Sustainability/Sustainability+Framework/Environmental,+Health,+and+Safety+Guidelines/EHS+Guidelines+Technical+Revision/

1. introducing the world bank ehs guidelines

The World Bank Group Environmental, Health and Safety Guidelines (EHS Guidelines) are technical reference documents with examples of good international industry practice. The International Finance Corporation (and subsequently Equator Principles Financial Institutions) uses the EHS Guidelines as a technical source of information during project appraisal.

The EHS Guidelines contain the performance levels and measures that are normally acceptable to the IFC, and that are generally considered to be achievable in new facilities at reasonable costs by existing technology.

Application of the EHS Guidelines to existing facilities may involve the establishment of site-specific targets, with an appropriate timetable for achieving them. The EHS Guidelines for Mining are applicable to underground and open-pit mining, alluvial mining, solution mining and marine dredging. **When host country regulations differ from the levels and measures presented in the EHS Guidelines, projects are expected to achieve whichever is more stringent.**

2. environmental guidelines

2.1 AIR EMISSIONS AND AMBIENT AIR QUALITY

Dust

Recommended dust management strategies include:

- Dust suppression techniques (e.g. wetting down, use of all-weather surfaces, use of agglomeration additives) for roads and work areas, optimization of traffic patterns and reduction of travel speeds
- Exposed soils and other erodible materials should be re-vegetated or covered promptly
- New areas should be cleared and opened-up only when absolutely necessary
- Surfaces should be re-vegetated or otherwise rendered non-dust forming when inactive

Ambient Air Quality

Projects with significant sources of air emissions, and potential for significant impacts to ambient air quality, should prevent or minimize impacts by ensuring that:

- Emissions do not result in pollutant concentrations that reach or exceed relevant ambient quality guidelines and standards by applying national legislated standards, or in their absence, the current WHO Air Quality Guidelines.
  - Ambient air quality standards are ambient air quality levels established and published through national legislative and regulatory processes, and ambient quality guidelines refer to ambient quality levels primarily developed through clinical, toxicological and epidemiological evidence (such as those published by the World Health Organization)

- Emissions do not contribute a significant portion to the attainment of relevant ambient air quality guidelines or standards. As a general rule, this Guideline suggests 25 percent of the applicable air quality standards to allow additional, future sustainable development in the same air shed

At facility level, impacts should be estimated through qualitative or quantitative assessments by the use of baseline air quality assessments and atmospheric dispersion models to assess potential ground level concentrations. Local atmospheric, climatic and air quality data should be applied when modeling dispersion, protection against atmospheric downwash, wakes or eddy effects of the source, nearby structures and terrain features.

WHO AMBIENT AIR QUALITY GUIDELINES		
	Averaging Period	Guideline value in µg/m^3
Sulfur dioxide (SO_2)	24-hour 10 minute	125 (Interim target-1) 50 (Interim target-2) 20 (guideline) 500 (guideline)
Nitrogen dioxide (NO_2)	1-year 1-hour	40 (guideline) 200 (guideline)
Particulate Matter PM_{10}	1-year 24-hour	70 (Interim target-1) 50 (Interim target-2) 30 (Interim target-3) 20 (guideline) 150 (Interim target-1) 100 (Interim target-2) 75 (Interim target-3) 50 (guideline)
Particulate Matter $PM_{2.5}$	1-year 24-hour	35 (Interim target-1) 25 (Interim target-2) 15 (Interim target-3) 10 (guideline) 75 (Interim target-1) 50 (Interim target-2) 37.5 (Interim target-3) 25 (guideline)
Ozone	8-hour daily maximum	160 (Interim target-1) 100 (guideline)

*Interim targets are provided in recognition of the need for a staged approach to achieving the recommended guidelines.

Monitoring

The air quality monitoring program should consider the following elements:

- *Monitoring parameters*: The monitoring parameters selected should reflect the pollutants of concern associated with project processes.
- *Baseline calculations*: Before a project is developed, baseline air quality monitoring at and in the vicinity of the site should be undertaken to assess background levels of key pollutants, in order to differentiate between existing ambient conditions and project-related impacts.
- *Monitoring type and frequency*: Data on emissions and ambient air quality generated through the monitoring program should be representative of the emissions discharged by the project over time. Emissions monitoring frequency and duration may also range from continuous for some combustion process operating parameters or inputs (e.g. the quality of fuel) to less frequent, monthly, quarterly or yearly stack tests.
- *Monitoring locations*: Ambient air quality monitoring may consist of off-site or fence line monitoring either by the project sponsor, the competent government agency or by collaboration between both. The location of ambient air quality monitoring stations should be established based on the results of scientific methods and mathematical models to estimate potential impact to the receiving airshed from an emissions source taking into consideration such aspects as the location of potentially affected communities and prevailing wind directions.

- *Sampling and analysis methods*: Monitoring programs should apply national or international methods for sample collection and analysis, such as those published by the International Organization for Standardization (ISO). Sampling should be conducted by, or under, the supervision of trained individuals. Analysis should be conducted by entities permitted or certified for this purpose. Sampling and analysis Quality Assurance / Quality Control (QA/QC) plans should be applied and documented to ensure that data quality is adequate for the intended data use (e.g., method detection limits are below levels of concern). Monitoring reports should include QA/QC documentation.
    - An on-line catalogue of ISO standards relating to the environment, health protection and safety is available at: http://www.iso.org/iso/en/CatalogueListPage.CatalogueList?ICS1=13&ICS2=&ICS3=&scopelist=

2.2 LAND USE AND BIODIVERSITY

Habitat alteration is one of the most significant potential threats to biodiversity associated with mining. Habitat alteration may occur during any stage of the mine cycle. Exploration activities often require the development of access routes, transportation corridors and temporary camps to house workers which may all result in varying degrees of land-clearing and population in-migration. The protection and conservation of biodiversity is fundamental to sustainable development.

Recommended strategies include consideration of the following:

- Whether any critical natural habitats will be adversely impacted or critically endangered or endangered species reduced
  - Critical natural habitat: As defined in IFC's Performance Standard (PS) 6 – Biodiversity Conservation and Sustainable Natural Resource Management. Readers should consult the definition and requirements applicable to Critical Habitat in the IFC Performance Standard.
- Whether the project is likely to impact any protected areas
- The potential for biodiversity offset projects (e.g. proactive management of alternative high biodiversity areas in cases where losses have occurred on the main site due to the mining development) or other mitigative measures
- Whether the project or its associated infrastructure will encourage in- migration, which could adversely impact biodiversity and local communities
- Consideration of partnerships with internationally accredited scientific organizations to, for example, undertake biodiversity assessments, conduct ongoing monitoring and manage biodiversity programs
- Consultation with key stakeholders (e.g. government, civil society and potentially affected communities) to understand any conflicting land use demands and the communities' dependency on natural resources and / or conservation requirements that may exist in the area

Terrestrial Habitats

Recommended management strategies include:

- Siting access routes and facilities in locations that avoid impacts to critical terrestrial habitat, and planning exploration and construction activities to avoid sensitive times of the year
- Minimizing disturbance to vegetation and soils
- Avoiding or minimizing the creation of barriers to wildlife movement, or threats to migratory species (such as birds) and providing alternative migration routes when the creation of barriers cannot be avoided
- Planning and avoiding sensitive areas and implementing buffer zones
- Implementing soil conservation measures (e.g. segregation, proper placement and stockpiling of clean soils and overburden material for existing site remediation); key factors such as placement, location, design, duration, coverage, reuse and single handling should be considered

- Where topsoil is pre-stripped, it should be stored for future site rehabilitation activities. Topsoil management should include maintenance of soil integrity in readiness for future use. Storage areas should be temporarily protected or vegetated to prevent erosion

Aquatic Habitats

Aquatic habitats may be altered through changes in surface water and groundwater regimes, and resulting increased pressures on fish and wildlife communities. Earth-moving operations may mobilize sediment which can enter watercourses and disrupt water quality and quantity.

Recommended management strategies include the following:

- Minimizing the creation and extent of new access corridors
- Decommissioning and re-vegetating exploration access routes and installing barricades to limit access
- Maintaining, to the extent possible, natural drainage paths and restoring them if they are disrupted
- Maintaining water body catchment areas equal or comparable to pre-development conditions
- Protecting stream channel stability by limiting in-stream and bank disturbance and employing appropriate setback from riparian zones
- Designing temporary and permanent bridges and culverts to manage peak flows depending on the associated potential risk
- Constructing, maintaining and reclaiming watercourse crossings that are stable, safe for the intended use and that minimize erosion, mass wasting and degradation of the channel or lakebed

Marine Habitats

Key impacts of concern to the marine environment may include habitat disturbance and destruction, suspension of sediment in the water column, change in water temperature and changed water quality. Project sponsors should engage the services of appropriate specialists to carry out marine impact assessments which also include socio- economic impacts (e.g. impacts on fishing grounds).

3. water

Management of water use and quality, in and around mine sites, can be a significant issue. Potential contamination of water sources may occur early in the mine cycle during the exploration stage and many factors including indirect impacts (e.g. population in-migration) can result in negative impacts to water quality. Reduction of surface and groundwater availability is also a concern at the local level and for communities in the vicinity of mining sites, particularly in arid regions or in regions of high agricultural potential. Mining activities should therefore include adequate monitoring and management of water use, in addition to treatment of effluent streams including storm water run-off from the mine property.

3.1 WATER USE

Mines can use large quantities of water, mostly in processing plants and related activities, but also in dust suppression among other uses. Water is lost through evaporation in the final product but the highest losses are usually into the tailings stream. All mines should focus on appropriate management of their water balance. Mines with issues of excess water supply, such as in moist tropical environments or areas with snow and ice melt, can experience peak flows which require careful management.

Recommended practices for water management include:

- Establishing a water balance (including probable climatic events) for the mine and related process plant circuit and using this to inform infrastructure design
- Developing a Sustainable Water Supply Management Plan to minimize impact to natural systems by managing water use, avoiding depletion of aquifers and minimizing impacts to water users
- Consulting with key stakeholders (e.g. government, civil society and potentially affected communities) to understand any conflicting water use demands and the communities' dependency on water resources and/or conservation requirements that may exist in the area

3.2 WATER QUALITY AND AVAILABILITY

Groundwater and surface water represent essential sources of drinking and irrigation water in developing countries, particularly in rural areas where piped water supply may be limited or unavailable and where available resources are collected by the consumer with little or no treatment. Project activities involving wastewater discharges, water extraction, diversion or impoundment should prevent adverse impacts to the quality and availability of groundwater and surface water resources.

Water Quality: Drinking water sources, whether public or private, should at all times be protected so that they meet or exceed applicable national acceptability standards or in their absence the current edition of WHO Guidelines for Drinking-Water Quality.

Water Availability: The potential effect of groundwater or surface water abstraction for project activities should be properly assessed through a combination of field testing and modeling techniques, accounting for seasonal variability and projected changes in demand in the project area. Project activities should not compromise the availability of water for personal hygiene needs and should take account of potential future increases in demand. The overall target should be the availability of 100 liters per person per day although lower levels may be used to meet basic health requirements. Water volume requirements for well-being-related demands such as water use in health care facilities may need to be higher.

World Health Organization (WHO) defines **100 liters/capita/day** as the amount required to meet all consumption and hygiene needs.

3.3 WASTEWATER AND AMBIENT WATER QUALITY

This guideline applies to projects that have either direct or indirect discharge of process wastewater, wastewater from utility operations or storm water to the environment. These guidelines are also applicable to industrial discharges to sanitary sewers that discharge to the environment without any treatment. Process wastewater may include contaminated wastewater from utility operations, storm water and sanitary sewage. It provides information on common techniques for wastewater management, water conservation and reuse that can be applied to a wide range of industry sectors.

INDICATIVE VALUES FOR TREATED SANITARY SEWAGE DISCHARGES[a]		
Pollutants	Units	Guideline Value
pH	pH	6 – 9
BOD	mg/l	30
COD	mg/l	125
Total nitrogen	mg/l	10
Total phosphorus	mg/l	2
Oil and grease	mg/l	10
Total suspended solids	mg/l	50
Total coliform bacteria	MPN[b]/100 ml	400[a]

a Not applicable to centralized, municipal, wastewater treatment systems which are included in EHS Guidelines for Water and Sanitation.

b MPN = Most Probable Number

3.4 STORM WATER

Key issues associated with management of storm water include separation of clean and dirty water, minimizing run-off, avoiding erosion of exposed ground surfaces, avoiding sedimentation of drainage systems and minimizing exposure of polluted areas to storm water. From exploration onwards, management strategies include:

- Reducing exposure of sediment-generating materials to wind or water (e.g. proper placement of soil and rock piles)
- Diverting run-off from undisturbed areas around disturbed areas including areas that have been graded, seeded or planted. Such drainage should be treated for sediment removal
- Reducing or preventing off-site sediment transport (e.g. use of settlement ponds, silt fences)
- Protecting storm water drains, ditches and stream channels against erosion through a combination of adequate dimensions, slope limitation techniques and use of rip-rap and lining. Temporary drainage installations should be designed, constructed and maintained for recurrence periods of at least a 25-year/24-hour event, while permanent drainage installations should be designed for a 100-year/24-hour recurrence period. Design requirements for temporary drainage structures should additionally be defined on a risk basis considering the intended life of diversion structures, as well as the recurrence interval of any structures that drain into them

3.5 SEPTIC SYSTEMS

Septic systems are commonly used for treatment and disposal of domestic sanitary sewage in areas with no sewerage collection networks. Septic systems should only be used for treatment of sanitary sewage, and are not suitable for industrial wastewater treatment. When septic systems are the selected form of wastewater disposal and treatment, they should be:

- Properly designed and installed in accordance with local regulations and guidance to prevent any hazard to public health or contamination of land, surface or groundwater
- Well maintained to allow effective operation
- Installed in areas with sufficient soil percolation for the design wastewater loading rate
- Installed in areas of stable soils that are nearly level, well drained and permeable, with enough separation between the drain field and the groundwater table or other receiving waters

3.6 MONITORING

A wastewater and water quality monitoring program with adequate resources and management oversight should be developed and implemented to meet the objective(s) of the monitoring program. The wastewater and water quality monitoring program should consider the following elements:

- *Monitoring parameters*: The parameters selected for monitoring should be indicative of the pollutants of concern from the process, and should include parameters that are regulated under compliance requirements.
- *Monitoring type and frequency*: Wastewater monitoring should take into consideration the discharge characteristics from the process over time. Monitoring of discharges from processes with batch manufacturing or seasonal process variations should take into consideration time-dependent variations in discharges and, therefore, is more complex than monitoring of continuous discharges. Effluents from highly variable processes may need to be sampled more frequently or through composite methods. Grab samples or, if automated equipment permits, composite samples may offer more insight on average concentrations of pollutants over a 24-hour period. Composite samples may not be appropriate where analyses of concern are short-lived (e.g., quickly degraded or volatile).
- *Monitoring locations*: The monitoring location should be selected with the objective of providing representative monitoring data. Effluent sampling stations may be located at the final discharge, as well as at strategic upstream points prior to merging of different discharges. Process discharges should not be diluted prior or after treatment with the objective of meeting the discharge or ambient water quality standards.
- *Data quality*: Monitoring programs should apply internationally approved methods for sample collection, preservation and analysis. Sampling should be conducted by or under the supervision of trained individuals. Analysis should be conducted by entities permitted or certified for this purpose. Sampling and Analysis Quality Assurance/Quality Control (QA/QC) plans should be prepared and implemented. QA/QC documentation should be included in monitoring reports.

3.7 WATER CONSERVATION

General recommendations include:

- Storm/Rainwater harvesting and use
- Project design to have measures for adequate water collection, spill control and leakage control system

4. community health and safety

Community health and safety issues that may be associated with mining activities include transport safety along access corridors, transport and handling of dangerous goods, impacts to water quality and quantity, inadvertent development of new vector breeding sites and potential for transmission of communicable diseases (e.g., respiratory and sexually transmitted infections resulting from the influx of project labor). In addition, there can be significant household and community level effects on the social determinants of health (e.g., drug, alcohol, gender violence and other psychosocial effects), associated with the rapid influx of labor during construction and operational phases. The rapid influx of labor and their associated extended family members may also place a significant burden on existing community health facilities and resources.

4.1 EMERGENCY PREPAREDNESS AND RESPONSE

An Emergency Response Plan should be prepared in accordance with the guidance of the UNEP APPEL for Mining: Awareness and Preparedness for Emergencies at the Local Level process (*APELL for Mining, Awareness and Preparedness for Emergencies at Local Level, Technical Report No. 41, UNEP 2001)*. The report provides a framework for preparation of an Emergency Response Plan involving the mine, emergency response agencies, local authorities and communities).

All projects should have an Emergency Preparedness and Response Plan that is commensurate with the risks of the facility and that includes the following basic elements:

- Administration (policy, purpose, distribution, definitions, etc)
- Organization of emergency areas (command centers, medical stations, etc)
- Roles and responsibilities
- Communication systems
- Emergency response procedures
- Emergency resources
- Training and updating
- Checklists (role and action list and equipment checklist)
- Business Continuity and Contingency

4.2 COMMUNICABLE DISEASES

Worker living quarters that are designed and maintained to prevent over-crowding can reduce the transmission of communicable respiratory diseases that may transfer to local communities.

4.3 HAZARDOUS MATERIALS MANAGEMENT

In order to minimize the risk associated with accidental spills from storage tanks and pipelines (e.g. tailings pipelines) the recommended mitigation measures include:

- Providing secondary containment to restrict movement into receiving water bodies (e.g. sumps, holding areas, impermeable liners), for example:
  - Constructing pipelines with double-walled or thick-walled sections at critical locations (e.g. large stream crossings)
  - Installing shutoff valves to minimize spill volumes and to isolate flow in critical areas

Preventive Measures

Recommended aspects of the inspection and maintenance program include:

- Developing inspection and maintenance procedures
- Establishing a quality assurance plan for equipment, maintenance materials and spare parts
- Conducting employee training on the inspection and maintenance procedures
- Conducting equipment, piping and instrumentation inspections and maintenance
- Identifying and correcting identified deficiencies
- Evaluating the inspection and maintenance results and, if necessary, updating the inspection and maintenance procedures
- Reporting the results to management

Cyanide

Cyanide use should be consistent with the principles and standards of practice of the International Cyanide Management Code, available at: http://www.cyanidecode.org/

Community Involvement and Awareness

When hazardous materials are in use above threshold quantities, the management plan should include a system for community awareness, notification and involvement that should be commensurate with the potential risks identified for the project during the hazard assessment studies. This should include mechanisms for sharing the results of hazard and risk assessment studies with potentially affected communities in a timely, understandable and culturally sensitive manner that provides a means for public feedback. Community involvement activities should include:

- Availability of general information to the potentially affected community on the nature and extent of project operations, and the prevention and control measures in place to ensure no effects to human health
- The potential for off-site effects to human health or the environment following an accident at planned or existing hazardous installations
- Specific and timely information on appropriate behavior and safety measures to be adopted in the event of an accident including practice drills in locations with higher risks
- Access to information necessary to understand the nature of the possible effect of an accident and an opportunity to contribute effectively, as appropriate, to decisions concerning hazardous installations and the development of community emergency preparedness plans

5. waste management

Structures such as waste dumps, tailing impoundments/ dams and containment facilities should be planned, designed and operated such that geotechnical risks and environmental impacts are appropriately assessed and managed throughout the entire mine cycle.

5.1 WASTE ROCK DUMPS

Recommendations for management of waste rock dumps include the following:

- Dumps should be planned with appropriate terrace and lift height specifications based on the nature of the material and local geotechnical considerations to minimize erosion and reduce safety risks.
- Management of Potentially Acid Generating (PAG) wastes should be undertaken as described in the guidance below.

5.2 WASTE GEOCHEMICAL CHARACTERIZATION

Mining operations should prepare and implement ore and waste geochemical characterization methods for proper routing of Potentially-Acid-Generating (PAG) materials and ARD management programs that include the following elements:

- Conducting a comprehensive series of accelerated leaching tests from feasibility study stage onwards, to evaluate the potential for ARD in all formations foreseen to be disturbed or otherwise exposed by the mine according to internationally recognized methodologies
    - See U.S. Department of the Interior, Office of Surface Mining, Acid Mine Drainage Prevention and Mitigation, available at: http://www.techtransfer.osmre.gov/NTTMainSite/Initiatives/ADTI/ACID%20MINE%20DRAINAGE%20INFO.pdf and Policy for Metal Leaching and Acid Rock Drainage at Mine Sites in British Columbia (BC MEM 1998) available at: http://www.empr.gov.bc.ca/Mining/Permitting-Reclamation/ML-ARD/Pages/Policy.aspx
- Conducting comprehensive ARD / metals leaching (ML) testing / mapping on an ongoing basis with decreasing block size as formations are transferred from long- to medium- and short-term mining plans

- Implementation of ARD and ML preventive actions to minimize ARD including:
  - Limiting exposure of PAG materials by phasing of development and construction, together with covering, and/or segregating runoff for treatment
  - Implementation of water management techniques such as diverting clean runoff away from PAG materials, and segregating "dirty" runoff from PAG materials for subsequent treatment; grading PAG material piles to avoid ponding and infiltration; and removing pit water promptly to minimize acid generation
- Controlled placement of PAG materials (including wastes) to provide permanent conditions that avoid contact with oxygen or water including:
  - Submerging and/or flooding of PAG materials by placing PAG materials in an anoxic (oxygen free) environment, typically below a water cover
- Isolating PAG materials above the water table with an impermeable cover to limit infiltration and exposure to air. Covers are typically less of a concern in arid climates where there is limited precipitation, and should be appropriate for local climate and vegetation (if any)
  - Blending of PAG materials with non-PAG or alkaline materials can also be employed to neutralize acid generation, as appropriate. Blending should be based on full characterization of each of the blended materials, the ratio of alkaline materials to acid generating materials, the case histories of failed operations and the need for static and long- term kinetic tests

5.3 TAILINGS PLANNING

Strategies should consider the site topography, downstream receptors and the physical nature of tailings (e.g. projected volume, grain size distribution, density, water content, among other issues).

- For additional information, refer to the Mining Association of Canada (MAC – www.mining.ca): A Guide to the Management of Tailings Facilities (1998), and Developing an Operations, Maintenance and Surveillance Manual for Tailings and Water Management Facilities (2003)

Riverine (e.g. rivers, lakes and lagoons) or shallow marine tailings disposal is not considered good international industry practice. By extension, riverine dredging which requires riverine tailings disposal is also not considered good international practice.

5.4 WASTE STORAGE

Hazardous waste should be stored so as to prevent or control accidental releases to air, soil and water:

- Store in closed containers away from direct sunlight, wind and rain
- Secondary containment systems should be constructed with materials appropriate for the wastes being contained and adequate to prevent loss to the environment
- Secondary containment is included wherever liquid wastes are stored in volumes greater than 220 liters. The available volume of secondary containment should be at least 110 percent of the largest storage container, or 25 percent of the total storage capacity (whichever is greater), in that specific location

6. noise and vibration

NOISE LEVEL GUIDELINES[1]		
	One Hour L_{Aeq} (dBA)	
Receptor	Daytime 07:00-22:00	Nighttime 22:00-07:00
Residential; institutional; educational[2]	55	45
Industrial; commercia	70	70

1 Guidelines values are for noise levels measured out of doors. Source: Guidelines for Community Noise, World Health Organization (WHO), 1999.
2 For acceptable indoor noise levels for residential, institutional, and educational settings refer to WHO (1999).

Sources of noise emissions associated with mining may include noise from vehicle engines, loading and unloading of rock into steel dumpers, chutes, power generation, shoveling, ripping, drilling, blasting, transport (including corridors for rail, road and conveyor belts), crushing, grinding and stockpiling. Good practice in the prevention and control of noise sources should be established based on the prevailing land use and the proximity of noise receptors such as communities or community use areas.

Recommended management strategies include:

- Installation of natural barriers at facility boundaries, such as vegetation curtains or soil berms

Some recommended noise reduction and control strategies to consider in areas close to community areas include:

- Planning activities in consultation with local communities so that activities with the greatest potential to generate noise are planned during periods of the day that will result in least disturbance
- Avoiding or minimizing project transportation through community areas
- Developing a mechanism to record and respond to complaints

NOISE LEVEL GUIDELINES

Noise impacts should not exceed the levels listed to the left, or result in a maximum increase in background levels of 3 dB at the nearest receptor location off-site.

MONITORING

Noise monitoring programs should be designed and conducted by trained specialists. Typical monitoring periods should be sufficient for statistical analysis and may last 48 hours with the use of noise monitors that should be capable of logging data continuously over this time period, or hourly, or more frequently, as appropriate (or else cover differing time periods within several days, including weekday and weekend workdays). The type of acoustic indices recorded depends on the type of noise being monitored, as established by a noise expert. Monitors should be located approximately 1.5 m above the ground and no closer than 3m to any reflecting surface (e.g., wall). In general, the noise level limit is represented by the background or ambient noise levels that would be present in the absence of the facility or noise source(s) under investigation.

When contamination of land is suspected or confirmed during any project phase, the cause of the uncontrolled release should be identified and corrected to avoid further releases and associated adverse impacts.

7. contaminated land

RISK SCREENING

This step is also known as “problem formulation” for environmental risk assessment. Where there is potential evidence of contamination at a site, the following steps are recommended:

- Identification of the location of suspected highest level of contamination through a combination of visual and historical operational information
- Sampling and testing of the contaminated media (soils or water) according to established technical methods applicable to suspected type of contaminant
    - Massachusetts Department of Environment. http://www.mass.gov/dep/cleanup
- Evaluation of the analytical results against the local and national contaminated sites regulations. In the absence of such regulations or environmental standards, other sources of risk-based standards or guidelines should be consulted to obtain comprehensive criteria for screening soil concentrations of pollutants
- Verification of the potential human and/or ecological receptors and exposure pathways relevant to the site in question

INTERIM RISK MANAGEMENT

Interim risk management actions should be implemented at any phase of the project life cycle if the presence of land contamination poses an “imminent hazard”, i.e., representing an immediate risk to human health and the environment if contamination were allowed to continue, even a short period of time. Examples of situations considered to involve imminent hazards include, but are not restricted to:

- Presence of an explosive atmosphere caused by contaminated land
- Accessible and excessive contamination for which short-term exposure and potency of contaminants could result in acute toxicity, irreversible long term effects, sensitization or accumulation of persistent biocumulative and toxic substances
- Concentrations of pollutants at concentrations above the Risk Based Concentrations (RBCs) or drinking water standards in potable water at the point of abstraction
    - For example, USEPA Region 3 Risk-Based Concentrations (RBCs) http://www.epa.gov/reg3hwmd/risk/human/index.htm

An assessment of contaminant risks needs to be considered in the context of current and future land use and development scenarios (e.g., residential, commercial, industrial and urban parkland or wilderness use).

8. structural safety of project infrastructure

The following issues should be considered and incorporated as appropriate into the planning, siting and design phases of a project:

- Inclusion of buffer strips or other methods of physical separation around project sites to protect the public from major hazards associated with hazardous materials incidents or process failure, as well as nuisance issues related to noise, odors or other emissions
- Incorporation of siting and safety engineering criteria to prevent failures due to natural risks posed by earthquakes, tsunamis, wind, flooding, landslides and fire. To this end, all project structures should be designed in accordance with engineering and design criteria mandated by site-specific risks, including but not limited to seismic activity, slope stability, wind loading and other dynamic loads
- Application of locally regulated or internationally recognized building codes to ensure structures are designed and constructed in accordance with sound architectural and engineering practice, including aspects of fire prevention and response http://www.ilo.org/wcmsp5/groups/public/---ed_protect/---protrav/---safework/documents/publication/wcms_110496.pdf
- Engineers and architects responsible for designing and constructing facilities, buildings, plants and other structures should certify the applicability and appropriateness of the structural criteria employed

International codes, such as those compiled by the International Code Council (ICC), are intended to regulate the design, construction and maintenance of a built environment and contain detailed guidance on all aspects of building safety, encompassing methodology, best practices and documenting compliance.

9. construction

SOIL EROSION

Soil erosion may be caused by exposure of soil surfaces to rain and wind during site clearing, earth moving and excavation activities. The mobilization and transport of soil particles may, in turn, result in sedimentation of surface drainage networks, which may result in impacts to the quality of natural water systems and ultimately the biological systems that use these waters. Recommended soil erosion and water system management approaches include:

Sediment mobilization and transport:

- Reducing or preventing erosion by:
  - Scheduling to avoid heavy rainfall periods (i.e., during the dry season) to the extent practical
  - Contouring and minimizing length and steepness of slopes
  - Mulching to stabilize exposed areas
  - Re-vegetating areas promptly
  - Designing channels and ditches for post-construction flows
  - Lining steep channels and slopes (e.g. use jute matting)
- Reducing or preventing off-site sediment transport through use of settlement ponds, silt fences and water treatment and modifying or suspending activities during extreme rainfall and high winds to the extent practical

Road design

- Limiting access road gradients to reduce runoff-induced erosion
- Providing adequate road drainage based on road width, surface material, compaction and maintenance

Structural (slope) stability

- Providing effective short term measures for slope stabilization, sediment control and subsidence control until long term measures for the operational phase can be implemented
- Providing adequate drainage systems to minimize and control infiltration

Disturbance to water bodies

- Depending on the potential for adverse impacts, installing free-spanning structures (e.g., single span bridges) for road watercourse crossings
- Restricting the duration and timing of in-stream activities to lower low periods, and avoiding periods critical to biological cycles of valued flora and fauna (e.g., migration, spawning, etc.)
- For in-stream works, using isolation techniques such as berming or diversion during construction to limit the exposure of disturbed sediments to moving water

10. additional guidelines and monitoring

EFFLUENT GUIDELINES*		
Pollutants	Units	Guidline Value
Total Suspended Solids	mg/L	50
pH	S.U.	6-9
COD	mg/L	150
BOD_5	mg/L	50
Oil and Grease	mg/L	10
Arsenic	mg/L	0.1
Cadmium	mg/L	0.05
Chromium (VI)	mg/L	0.1
Copper	mg/L	0.3
Cyanide	mg/L	1
Cyanide Free	mg/L	0.1
Cyanide WAD	mg/L	0.5
Iron (total)	mg/L	2.0
Lead	mg/L	0.2
Mercury	mg/L	0.002
Nickel	mg/L	0.5
Phenols	mg/L	0.5
Zinc	mg/L	0.5
Temperature	^0C	<3 degree differential

Note: Metals concentrations represent total metals.

*These levels should be achieved, without dilution, at least 95 percent of the time that the plant or unit is operating, to be calculated as a proportion of annual operating hours. Deviation from these levels in consideration of specific, local project conditions should be justified in the environmental assessment.

ENVIRONMENTAL MONITORING

Environmental monitoring activities should be based on direct or indirect indicators of emissions, effluents and resource use applicable to the particular project.

Monitoring frequency should be sufficient to provide representative data for the parameter being monitored. Monitoring should be conducted by trained individuals following monitoring and record-keeping procedures and using properly calibrated and maintained equipment. Monitoring data should be analyzed and reviewed at regular intervals and compared with the operating standards so that any necessary corrective actions can be taken.

ENERGY USE

Recommended energy conservation measures include:

- Use of non-invasive technologies such as remote sensing and ground-based technologies to minimize exploratory digging and drilling

OCCUPATIONAL HEALTH AND SAFETY

Beyond the scope of this project - refer to the EHS General and Mining-specific Guidelines for full guidance.

SUMMARY OF RECOMMENDED PERSONAL PROTECTIVE EQUIPMENT ACCORDING TO HAZARD		
Objective	Workplace Hazards	Suggested PPE
Eye and face protection	Flying particles, molten metal, liquid chemicals, gases or vapors, light radiation.	Safety Glasses with side-shields, protective shades, etc.
Head protection	Falling objects, inadequate height clearance, and overhead power cords.	Plastic Helmets with top and side impact protection.
Hearing protection	Noise, ultra-sound.	Hearing protectors (ear plugs or ear muffs).
Foot protection	Falling or rolling objects, pointed objects. Corrosive or hot liquids.	Safety shoes and boots for protection against moving & falling objects, liquids and chemicals.
Hand protection	Hazardous materials, cuts or lacerations, vibrations, extreme temperatures.	Gloves made of rubber or synthetic materials (Neoprene), leather, steel, insulating materials, etc.
Respiratory protection	Dust, fogs, fumes, mists, gases, smokes, vapors.	Facemasks with appropriate filters for dust removal and air purification (chemicals, mists, vapors and gases). Single or multi-gas personal monitors, if available.
	Oxygen deficiency.	Portable or supplied air (fixed lines). On-site rescue equipment.
Body/leg protection	Extreme temperatures, hazardous materials, biological agents, cutting and laceration.	Insulating clothing, body suits, aprons etc. of appropriate materials.

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about NBS

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Since the creation of Canada's first Executive MBA in 1968, the Beedie School of Business has championed lifelong learning, productive change and the need to be innovative as it delivers research and teaching that make an impact. In particular, it has been recognized for its contributions to knowledge creation in the areas of globalization and emerging markets; innovation and technology; sustainability and governance; and capital and risk management. The school's goal is to produce broadly educated, enterprising and socially responsible managers capable of making lasting contributions to their communities.

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