

# **Freeport-McMoRan Sierrita, Inc.**

## **Tailings Dam Dust Control Management Plan**

### **1.0 Introduction**

#### **1.1 Vision and Mission Statement**

##### VISION

A stable, dust-free, visually attractive tailings dam.

##### MISSION

Through teamwork, good communication, training, and technological improvements, we are leaders in tailings dam safety and environmental stewardship. Employees are empowered to construct Sierrita's dam in a manner that is structurally sound, weather resistant and blends into the natural landscape.

#### **1.2 Permit Requirements and Policy**

The Freeport-McMoRan Sierrita, Inc. (Sierrita) Air Quality Class I Permit requires that reasonable precautions be employed to prevent excessive amounts of particulate matter from becoming airborne. Airborne particulate from the tailings dam is also limited to no greater than 20% opacity measured in accordance with the Arizona Testing Manual, Reference Method 9. In addition, Sierrita shall not cause, suffer, allow or permit diffusion of visible emissions, including fugitive dust, beyond the property boundary line within which the emissions become airborne, without taking reasonably necessary and feasible precautions to control generation of airborne particulate matter. The actions constituting reasonably necessary and feasible precautions are included as conditions of the Title V Permit.

As company policy, Sierrita shall, to the extent practicable, maintain the surface of the tailings dam wet, along with taking other reasonable precautions, to prevent excessive amounts of particulate matter from becoming airborne and to meet or exceed compliance with the opacity and visibility limiting standards of the Air Quality Permit. Sierrita shall accomplish these goals via the methods, equipment and procedures outlined in this Tailings Dam Dust Control Management Plan. Sierrita shall operate as an environmentally-responsible producer of quality mineral products and Sierrita's Tailings Dam operations shall be designed and operated in a safe, economical, and environmentally responsible manner.

To meet or exceed Sierrita's Air Quality Permit requirements, Sierrita personnel shall strive to maintain a stabilized surface crust that is resistant to high-wind events. To ensure that a stabilized surface crust is maintained, Sierrita shall conduct frequent inspections of the tailings impoundment surface and identify signs of fatigue and areas susceptible to high wind events ("hot spots"). In accordance with the Tailings Dam Management System, the results of this inspection shall be used to determine the need for additional dust control measures.

### **1.3 Background**

The Sierrita milling facility, commonly known as the concentrator, is designed to economically produce marketable copper and molybdenum concentrates. The valuable minerals are liberated from the ore by first crushing and grinding the ore. The free minerals are then collected into enriched concentrates by flotation. For each ton of ore Sierrita processes, approximately 5 pounds of copper and ½ of a pound of molybdenum are recovered into about 20 lbs of material. The remaining 1980 pounds of ground rock material is referred to as tailings.

Tailings slurry gravity flows from the concentrator at about 25,000 gallons per minute and 50 percent solids by weight through a 42-inch pipeline to the Sierrita Tailings Dam. The tailings pipeline is approximately 12.5 miles in length. The tailings dam is down-gradient of the concentrator and comprises an area of about 3,200 acres. It is approximately 5 miles southeast of the concentrator and is divided into two areas referred to as the North and South dam.

The North and South dam are divided into three phases for a total of six phases. Refer to Attachment A for the general configuration of the tailings dam. Typically, five segments are utilized for tailings deposition while the remaining segment is allowed to evaporate to the moisture content at which it is safe for equipment to operate on the surface. Bulldozers are used to push tailings from the edges of the interior to form the perimeter dam berm for this segment. Tailings deposition continues on five active segments until all active surfaces are wetted with slurry.

During the construction period, surface binder products or water shall be applied to areas identified during inspection of the tailings impoundment that may become susceptible to dusting. Low-ground pressure bulldozers shall be utilized to minimize the evaporation period by ripping the surface of the inactive phase and accelerating moisture reduction of the tailings that will be used as borrow material for berm construction. The evaporation/construction cycle is typically accomplished in 12 to 14 weeks.

## **2.0 Control Plan – Normal Operations**

### **2.1 Operating Strategy and Inspections**

Sierrita's strategy is to ensure that fugitive dust emissions from the tailings impoundment surface are controlled by using reasonable precautions at all times. As described in this Plan, reasonable precautions used by Sierrita include the following:

- (1) Use wetting, chemical stabilization, or revegetation when constructing the tailings impoundment
- (2) Applying wetting agents
- (3) Barring or controlling vehicle access and limiting vehicle speed
- (4) Hydro-seeding and landscaping the side-slopes using Holistic Resource Management (animals) which stabilizes and compacts the tailings
- (5) Encrustation of the surface of the impoundment

- (6) New tailings dam roads, constructed as part of a pipeline raises, are capped with native dirt
- (7) Heavily traveled perimeter roads shall be treated with a dust suppressant, as necessary
- (8) Active berms and construction areas shall be sprayed with water, as necessary
- (9) The wet dam construction method shall be used to control the surface of the impoundment, maintaining the majority of the impoundment surface wet or encrusted, while the remaining area is under construction.
- (10) After heavy rainfall events (sufficient to cause surface runoff and flushing of natural dust suppressing surface salts) if the upper most layer becomes susceptible to wind erosion, a dust suppressant may be applied to the impoundment surface area requiring additional control

Frequent inspections of the tailings dam shall be conducted to observe the dam surface characteristics and weather conditions. In accordance with the Tailings Dam Management System, the inspection shall identify signs of fatigue on the surface crusts and areas on the surface of the impoundment that are susceptible to high wind events (“hot spots”). The results of this inspection shall be used to determine the need for additional dust control measures. Corrective and/or preventive actions taken in response to the results of this inspection shall be recorded. A copy of this form is provided in Attachment C.

## **2.2 Roads and Embankment Faces**

Various types of dust control measures shall be utilized to minimize fugitive emissions from the tailings dam. New tailings dam roads, constructed as part of each pipeline raise, shall be capped with native soil and routinely wetted with water trucks as soon as practicable. The soil cap is less susceptible to erosion and will hold more moisture when water is applied. Heavily traveled perimeter roads shall be treated with dust suppressant, as necessary, to minimize dust from vehicular traffic and high velocity winds. Dust suppressant (e.g.,  $MgCl_2$ ) is stored on-site for this purpose. Water trucks shall be used, as necessary, to spray the active berms and construction areas to minimize fugitive dust.

There are numerous re-vegetation programs in various stages of completion throughout the impacted area. The use of cattle to promote surface stabilization and revegetation is being used on the sloped embankments of the dam faces and on portions of the Esperanza tailings area. The hay fed to the cattle and the cowpad are tramped into the upper layer of tailings acting to bind and fertilize the surface. Cattle are also re-introduced to revegetated areas to graze and enhance future plant growth. Both the initial binding of the surface and the ultimate vegetation cover are effective dust control techniques.

## **2.3 Tailings Deposition – Dam Filling Operations**

When berm construction activities are not in progress, the dam shall be kept evenly wet by continual rotation of operating spigots and switching between North and South Dam pipelines. Dam building is accomplished by opening multiple six-inch spigot pipes that are attached to the 42-inch tailings pipeline to deposit tailings slurry into the interior of the tailings dam. Sierrita currently uses a “wet dam” construction method to minimize fugitive

dust emissions from the Tailings Dam. Under routine wet dam construction periods, five of the six phases of the dam shall be kept wet, while the remaining phase is under construction. Regular visual inspections shall be made to confirm uniform and complete wetting is occurring. The rotation schedule shall be adjusted based on these inspections.

The chemistry of the tailings slurry water and reclaim water shows that both calcium and sulfate are at or near the solubility limit of gypsum. As evapo-concentration of the interstitial water of the tailings occurs, gypsum and sodium sulfate salts form. These salts effectively cement or bind the surface of the tailings and prevent wind erosion. In addition, a mixture of cyanobacteria and indigenous algae which naturally develops a biological soil crust is cultivated on-site and added to the tailings slurry in order to augment this surface crust (please see Section 2.5 below).

After a heavy rainfall event, this rotation of operating spigots may be accelerated if necessary to reestablish the integrity of the surface crust that may have been flushed. These activities shall be documented on the Tailings Dam Environmental Activities Report (Reference Attachment A).

#### **2.4 Berm Construction – 8-Foot Berm**

As described above, Sierrita currently uses a “wet dam” construction method to minimize fugitive dust emissions from the Tailings Dam. The North and South dam are divided into three phases each for a total of six phases. Under routine wet dam construction periods, five of the six phases of the dam shall be kept wet, while the berm on the remaining phase is under construction.

The active construction area shall be worked as wet as possible while maintaining a moisture content that will not jeopardize berm compaction and the overall stability of the dam. Low ground pressure “swamp” bulldozers are required to push the damp interior sands to form the outer berm on the dam face. The berms are built in two separately compacted four-foot increments to insure stability of the dam. At normal, full production rates, the perimeter berms are raised approximately eight feet each year.

One phase of the dam is filled by depositing tailings slurry in preparation for raising it an additional eight feet. The reclaim water flows to the center of the dam where it is pumped off and reused in the mill processes. After a phase is filled, four to eight weeks of evaporating time is required to enable low-ground pressure “Swamp” bulldozers to work in the area. This drying period is also required in order to allow moisture content reduction needed for adequate compaction of the erected berm. The length of time that is required to achieve the proper moisture content is a variable controlled by weather conditions. The length of evaporating time is typically six weeks.

Attempts to start as early as possible shall be made, using a small low-ground pressure “Swamp” bulldozer to rip the surface and accelerate surface moisture reduction of the material that will be used as borrow material for berm and stabilize the area for the larger bulldozers. Larger low ground pressure “Swamp” bulldozers move into the area and rip deeper. Six to eight weeks is required to complete the phase once the material is workable.

If operating conditions are favorable, selected spigots can remain in place for a period of time during berm construction activities. These spigot lines can be extended by approximately 200 feet into the interior of the dam. This extension will increase the slurry coverage and reduce the drying area of the interior while construction is in progress.

As described above, a salt crust augmented by a biological soil crust developed by indigenous algae added to the tailings slurry effectively cement or bind the surface of the tailings and prevent wind erosion. Maintaining this crust is a critical component in preventing fugitive dust emissions especially in the first few weeks after deposition.

During the evaporation and construction period, the remaining five phases shall be operated as described above, with the following exception. When the phase under construction is four to eight weeks from completion, the next phase to be constructed typically is given a final fill. The wet tailings is then allowed to reduce in moisture content through decanting and evaporation so it will be ready when the existing phase under construction is completed. This method provides for wetting the newly constructed phase as soon as possible, while construction proceeds on the next phase.

If the need for additional dust control is identified during inspection of the tailings dam, All-Track Snow Utility Vehicles shall be utilized, as safe and practicable to apply the necessary dust suppressant on interior construction areas.

## **2.5 Berm Construction – Pipeline Lift**

Approximately every four to five years, the 42-inch pipeline around the perimeter of each side of the dam is raised to a higher working elevation to maintain a safe and practical operating pressure for the spigots. It is possible to raise the pipeline one side at a time. Since tailings deposition occurs at a rate of approximately eight feet per year, the pipeline is raised approximately 32 to 40 feet to the new working elevation. During this period only four of the six phases of the dam can be maintained using wet construction methods for a short period of time. The dam may be susceptible to fugitive dust emissions during the pipe lift construction phase if weather conditions are not favorable. This pipe lift construction period takes four to six months to dismantle and repair the existing pipeline so it can be lifted to the new elevation. Every effort shall be made not to schedule these pipeline moves during the monsoon season and its unfavorable weather conditions. Construction areas shall be inspected frequently and areas that may be susceptible to wind erosion shall be identified and addressed immediately. At the new elevation, a new road must be surveyed and built to support the pipeline and all pipeline maintenance and operational functions. This road shall be capped with native soil as soon as practicable.

Phase I of the dam is filled in preparation for construction of new berm, road and pipe bed. After final filling, four to eight weeks of evaporating time is required to enable low-ground pressure “Swamp” bulldozers to work in the area and provide proper moisture content for adequate compaction of the erected berm, road and pipe bed. The length of time required to achieve proper moisture content varies, depending on weather conditions after the final fill. Evaporating time is typically six weeks.

As in the 8-foot berm construction, attempts to start as early as possible shall be made, using a small low-ground pressure “Swamp” bulldozer to stabilize the area for the larger bulldozers. Once the tailings is workable, construction on the road and pipe bed is started. As sections of the road are completed, berm construction begins and spare perimeter pipe sections are hauled and reassembled on the road.

If operating conditions are favorable, selected spigots can remain in place for a period of time during berm construction activities. These spigot lines can be extended by approximately 200 feet into the interior of the dam. This extension will increase the slurry coverage and reduce the drying area of the interior while construction is in progress.

During the evaporation and construction period, the remaining five phases shall be operated as described above, with the following exception. Once the phase under construction is four to eight weeks from completion, the final wetting, filling and moisture reduction of the next two phases is started. This allows wetting of the newly constructed phase as soon as possible while construction proceeds on the following phases.

Once the final filling, wetting and moisture reduction of two phases are complete and enough road is built in advance, the pipeline on the lower level is disassembled and raised to the upper level. The time required to complete a phase is eight to ten weeks after the interior tailings borrow material becomes workable.

The new road shall be capped with native soil after completing the lift of all three phases. Water trucks shall be used as required to control fugitive dust on roads and berms in the tailings impacted areas. The All-Track Snow Utility Vehicles shall be deployed to control interior dust during the pipe lift construction period if surface conditions on the interior of the dam are acceptable for the equipment.

## **2.6 Cyanobacteria and Algae**

Biological soil crusts are commonly found in semiarid and arid environments throughout the world. Biological soil crusts hold the soil in place and protect underlying sediments from erosion. They pioneer soil development on bare inorganic sediments, absorbing water and enriching the surface with nutrients and organic matter. Crust-forming cyanobacteria have filamentous growth forms that bind soil particles. These filaments exude sticky polysaccharide sheaths around their cells that aid in soil aggregation by cementing particles together. Cyanobacteria and algae indigenous to the Sonoran Desert, is cultivated on site and introduced to the tails slurry at Point “A” Drop Box as an encrustation agent to develop a biological soil crust on the surface of the tailings impoundment. This crust works in combination with the Gypsum salts to provide a binder more resistant to rainfall. The water rejuvenates the algae so that new growth replaces the washed out gypsum.

## **2.7 Surface Application of Dust Suppressant**

Frequent inspection of the tailings dam shall be made to observe the dam surface characteristics and weather conditions. In accordance with the Tailings Dam Management System, the inspection shall identify signs of fatigue on the surface crusts and areas on the surface of the impoundment that are susceptible to high wind events (“hot spots”). The results of this inspection shall be used to determine the need for additional dust control measures.

If hot spots are observed and slurry deposition of the area is not practicable, low-ground pressure All-Track Snow Utility Vehicles shall be deployed, as safe and practicable, to apply dust suppressant to the affected areas. Dust suppressant is stored on-site for this purpose.

Sierrita will record locations where dust suppressant is applied. If a water soluble dust suppressant was used (such as  $MgCl_2$ ), Sierrita shall inspect areas of recent dust suppressant application (since the most recent slurry deposition of each phase) after heavy rainfall events to determine if re-application is necessary.

## **2.8 Environmental Management System**

As part of Sierrita’s Environmental Management System, standard operating procedures (SOPs) shall be developed to ensure implementation of the Tailings Dam Management System. These SOPs shall outline specific details regarding inspection procedures, dust suppressant application, and wet dam construction practices.

## **3.0 Contingency Plan**

### **3.1 Construction Schedule**

Sierrita shall schedule pipeline lift activities, to the extent practicable, so that construction activities are completed prior to the monsoon season. As a contingency plan, Sierrita shall dedicate additional manpower to the construction of a berm raise or pipeline lift project, as necessary to reduce the construction time and thereby minimize the potential for fugitive dust events associated with these activities.

### **3.2 Aerial Application of Dust Suppressant (e.g., $MgCl_2$ )**

After a heavy rainfall event, sufficient to cause surface runoff, flushing of the surface crusts may occur. If sufficient and repeated dissolution and flushing occurs, the uppermost layer will become susceptible to wind erosion. While the cyanobacteria and algae have been shown to augment that control, they both may become fatigued in severe storm events.

If these conditions are observed during times when pipeline and berm construction activities are in progress, and topical application using the All-Track Snow Utility Vehicles proves inadequate, a plan for aerial application of dust suppression may be implemented. The first

The first phase of this plan is to notify the aerial application company, and have them on standby. Frequent inspection of the tailings dam shall be made to observe the dam surface characteristics and weather conditions. An aerial application of dust suppression shall be implemented as a final contingency plan to control fugitive emissions. The aerial application plan shall include the concentration of dust suppressant (e.g., MgCl<sub>2</sub>) solution and the area of application. MgCl<sub>2</sub> has been successfully applied at both 0.12 gallons per square yard and at 0.05 gallons per square yard with MgCl<sub>2</sub> solution strength of approximately 32 percent.

## **4.0 Monitoring and Communication Procedures**

### **4.1 Inspections and Recordkeeping**

During times when berm construction activities are not in progress, the dam shall be kept evenly wet by continual rotation of operating spigots and switching between the North and South Dam pipelines. Regular visual inspections shall be made to confirm uniform and complete wetting is occurring. The rotation schedule is adjusted based on these inspections.

As described in Section 2.1, frequent inspection of the tailings dam shall be made to observe the dam surface characteristics and weather conditions. In accordance with the Tailings Dam Management System, the inspection shall identify signs of fatigue on the surface crusts and areas on the surface of the impoundment that are susceptible to high wind events (“hot spots”). The results of this inspection shall be used to determine the need for additional dust control measures. Corrective and/or preventive actions taken in response to the results of this inspection shall be recorded. A copy of this form is provided in Attachment C.

A certified Method 9 observer from the Environment, Land and Water Department will complete a weekly visual survey of the tailings impoundment. If the observer sees visible emissions that on an instantaneous basis appears to exceed the opacity standard, then the observer shall if practicable take a six-minute Method 9 observation of the plume. A copy of a VEO form is attached (Attachment B).

In accordance with the Sierrita Air Quality Permit, a Tailings Dam Environmental Activities Report shall be compiled weekly with records of the following:

- The area of tailings deposition and any special wetting areas
- The half of the dam, the phase and the section of the dam in which tailings was being deposited during the previous week.
- The number of loads of water that has been applied to roads and berms during the previous week.
- The location of cattle each week.
- The areas of application of any hydroseeding
- The amount and areas of chemical dust suppressant application during the previous week

A copy of the Tailings Dam Environmental Activities Report is attached (Attachment A).

**4.2 Evaluation of Objectives**

On a semi-annual basis, an internal review team shall evaluate the effectiveness of the control plan by conducting an inspection of the tailings dam, review records including the Tailings Dam Environmental Activities Reports, VEOs, and VEO training certifications. A checklist audit form shall be developed for internal use. The report shall include any recommendations for improving dust management at the Tailings Impoundment based on an audit of compliance with the measures specified in the Sierrita Air Quality Permit.

The internal review team shall make any necessary recommendation for improving the control plan. Any improvements or corrective actions that are necessary to comply with the objectives of this control plan shall be reviewed, developed, and implemented, as necessary.

**5.0 Potential Dust Control Improvement Projects Under Review**

The dust control program at the Sierrita tailings dam has been continually improving and new technologies have been utilized during the past several years to prevent excessive amounts of particulate matter from becoming airborne. Sierrita continues to evaluate binders, dust suppressants, and construction and reclamation techniques that provide a safe, economical and environmentally friendly means of managing the tailings dam facility. Dust control improvement experiments and their results are provided below.

Date	Experiment	Results
	Study wind patterns on the dam and effects of the height of the dam on wind velocities. Based on the results of this study, evaluate options for minimizing the effects of wind on the tailings dam.	
	Experiment with localized topical application of the following dust suppressants and determine resiliency and effectiveness as compared to MgCl: <ul style="list-style-type: none"> <li>a. Envirotac II (acrylic polymer)</li> <li>b. Biological Targets Reclafill (microbial project)</li> <li>c. Tall Oil Pitch</li> <li>d. Gypsum Solution</li> <li>e. Organic Fiber Matrix</li> </ul>	
	Work with a consulting firm to identify a seed mix that may be added to the tailings	

	tailings slurry in final deposition prior to construction of a phase in order to provide a natural binding of the soil during phase construction.	
	Test the addition of an organic bonded fiber matrix in the tailings slurry	
	Experiment with wind fencing of various heights at the perimeter of the tailings dam to determine effectiveness of preventing blown-in dust from depositing on the tailings dam surface.	

# Attachment A

## Tailings Dam Environmental Activities Report

Operator: \_\_\_\_\_

Date: \_\_\_\_\_

### Primary Controls

	N/S	Phase	Area	
Area of Deposition				
Special Wetting Areas				
Water Truck - # of Loads	07	35	84	85

	Gallons	Location	Approx. Area Covered
Alltrack/March Buggy Application			
MgCl Applied to Roads			

### Site Conditions

Areas Under Construction			
Inches of Rain			

### Special Projects

### Area of Application

HRM Project (Cattle)	
Hydroseeding Area	

### Comments

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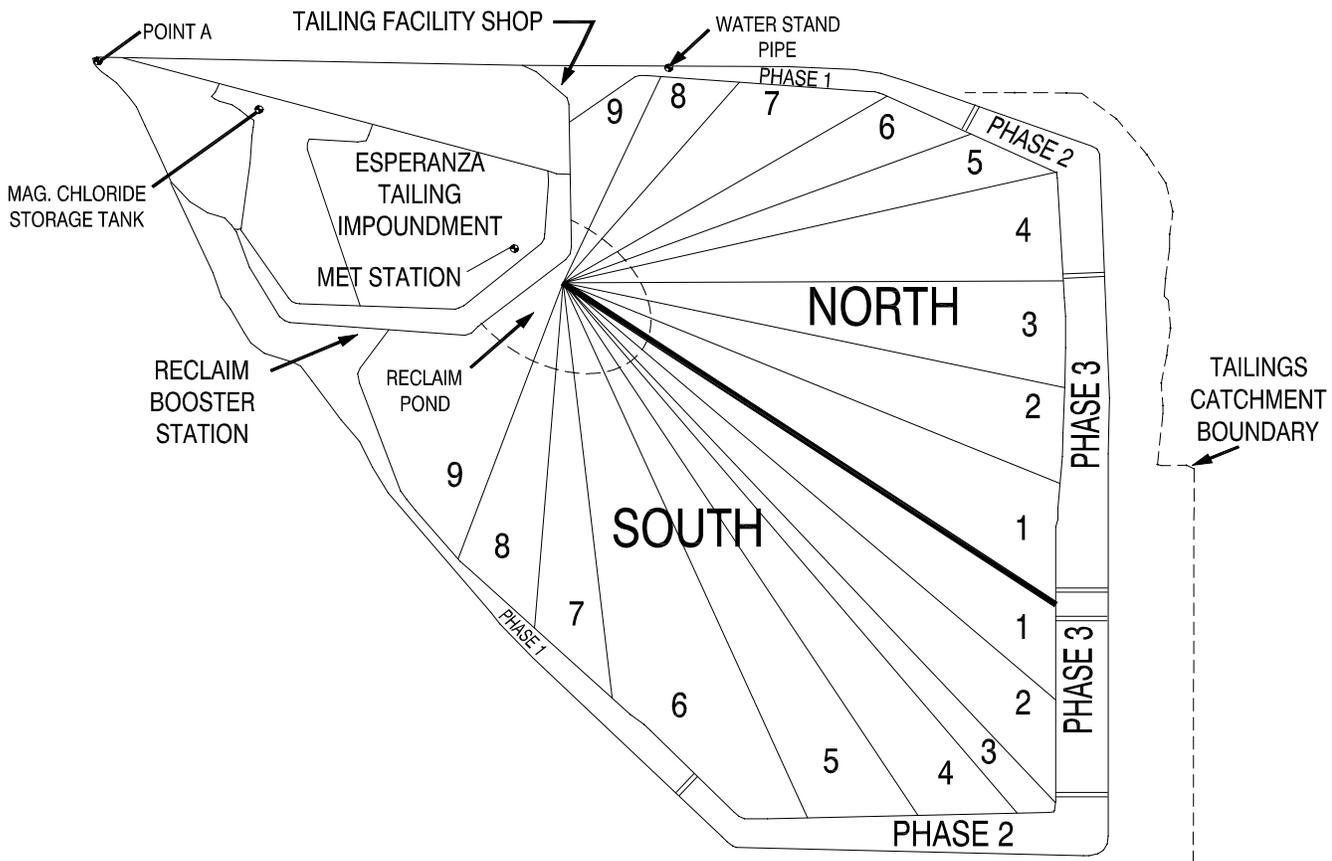
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# Attachment B - Tailing Dam Dust Control Management Plan

## Visible Emission Observation Form

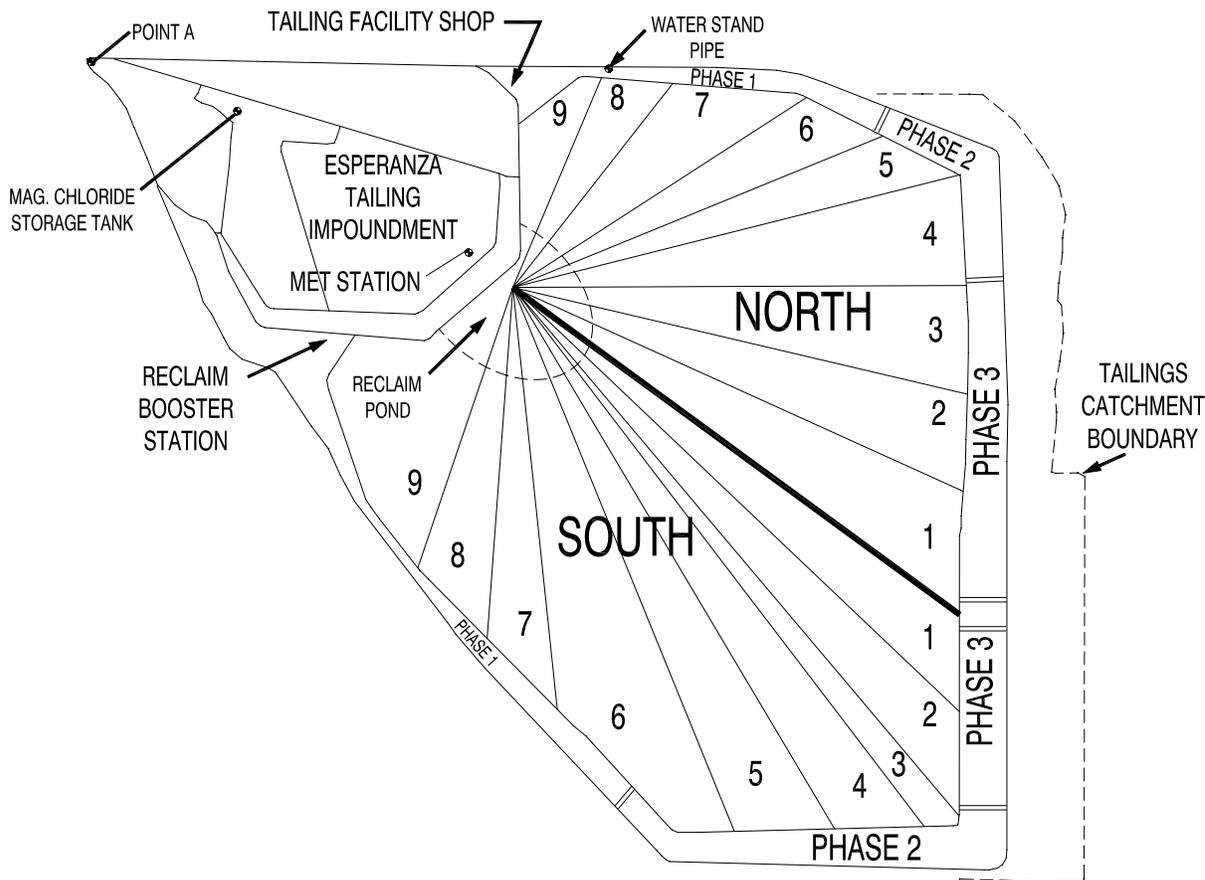
<b>FREEPORT-McMoRAN COPPER &amp; GOLD</b> 6200 W. Duval Mine Road P. O. Box 527 Green Valley AZ 85622-0527 Tel: (520) 648-8500  Sierrita Operations		Observation Date		Start Time		Stop Time																																								
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WIND SPEED	WIND DIRECTION	25																																												
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AMBIENT TEMPERATURE	WET BULB TEMP.	27																																												
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		ADDITIONAL INFORMATION																																												

Revision Date: February 2008

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# Attachment C - Tailing Dam Dust Control Management Plan Surface Inspection

**Date:** \_\_\_\_\_  
**Time** \_\_\_\_\_  
**Conditions** \_\_\_\_\_  
**Dam Inspected** \_\_\_\_\_ **Phase(s)** \_\_\_\_\_  
**GPS Coordinates** \_\_\_\_\_  
 \_\_\_\_\_  
**Inspected by:** \_\_\_\_\_



**Mark area inspected on diagram using number below that best describes conditions observed.**

1	Recent Deposition (14 days or less)	No Action Required
2	Moist Surface	No Action Required
3	Established Algae/Salt Crust	No Action Required
4	Crusted with light surface sands (blown in/washed in)	Watch Area / Reinspect in one week
5	Crusts breaking down	Watch Area / Reinspect in one week
6	Piles of Standing Sands (blown in)	Action Required - Deposition or Suppressant Application
7	Broken Down Crust	Action Required - Deposition or Suppressant Application
8	Delta	Action Required - Deposition or Suppressant Application
9	Area with Dust Suppressant Previously Applied	Watch Area / Reinspect as required

**Action Plan:** \_\_\_\_\_  
**Dust Suppressant Applied** \_\_\_\_\_ **Completed Y / N** **If N Date Completed** \_\_\_\_\_ **Initial** \_\_\_\_\_  
**Gallons Used** \_\_\_\_\_ **Operator** \_\_\_\_\_

**Weather Conditions:** Wind Speed \_\_\_\_\_ Gusts To \_\_\_\_\_ Temperature \_\_\_\_\_ Precipitation Last 24 Hrs. Y / N

Fax to 8730 & 8608